Geopolitics and the Measurement of National Power

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Karl Hermann Höhn

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Erstgutachter: Prof. Dr. Detlef Nolte

Zweitgutachter: Prof. Dr. Mirosław Sułek

And even if we reckon greatness by numbers, we ought not to include everybody, for there must always be in cities a multitude of slaves and sojourners and foreigners; but we should include those only who are members of the state, and who form an essential part of it. The number of the latter is a proof of the greatness of a city; but a city which produces numerous artisans and comparatively few soldiers cannot be great, for a great city is not to be confounded with a populous one.

ARISTOTLE, *Politics* 7.4

Abstract

This dissertation presents and compares all known formulas for the calculation of the power of nation states. The presentation is encyclopedic in character, and the comparison involves analyzing the indicators used, as well as the theoretical and conceptual considerations underlying their selection and weighting. The results of calculations based on the power formulas are provided, offering a topical insight into the global distribution of power. This work makes a distinction between theoretical power formulas and operational power formulas, concerning itself primarily with the latter, which are formulas for the purpose of calculation. The power formulas under discussion consist of several variables, whose number varies from two to 236. Since the advent of the internet the average number of variables used has more than doubled from 13 to 28. Power measurements based on single indicators are considered only briefly and to a lesser extent.

This dissertation first explains the scientific and historical roots of power formulas. This explanation starts in German geopolitics, continues through American geopolitics, and touches upon geoeconomic approaches. Then power concepts and definitions in different schools of international relations are discussed. A connection is made to the power formulas described later, along with an examination of the problems that arise in trying to operationalize (make measurable) the theoretical propositions underlying power formulas. It is followed by a critical assessment of the concepts of psychological power as well as soft power. The subsequent power indexes are derived from the long tradition of statistics as a "state science" [Staatswissenschaft] with direct relevance to the objective of later power formulas, namely, the evaluation of the strengths and weaknesses of states in comparison with other states.

The first power formula here comes from 1741, the others all appeared in the period 1936 to 2010. A total of 69 operational power formulas are recorded and explained. These include Japanese and Chinese power formulas as well as the Indian-designed National Security Index (NSI). In the second last chapter, the biographies of the designers of the power formulas (age, nationality, professional background) are compared, as well as the variables and weighting schemes. Most power formulas have been designed by Americans (37%), followed by Chinese (16%) and Germans (7%). A distinction is made between arbitrary and nonarbitrary weighting schemes. Whereas 73% of the operational power formulas use arbitrary weighting schemes, 17% derive the weights of variables exclusively via mathematical or statistical procedures, and 10% determine the weights of the variables with the assistance of perception surveys.

Zusammenfassung

Bei der Dissertation handelt es sich um ein enzyklopädisches Werk. Ziel der Arbeit ist es, alle bekannten Formeln zur Berechnung der globalen Machtverteilung zu erfassen und sie im Hinblick auf die verwendeten Indikatoren sowie die hinter der Auswahl und der Gewichtung der Indikatoren stehenden theoretisch-konzeptionellen Überlegungen zu vergleichen. Außerdem sind die Ergebnisse der auf den Machtformeln basierenden Berechnungen wiedergegeben. Es wird zwischen theoretischen Machtformeln und operationalen Machtformeln unterschieden. Mit operationalen Machtformeln können Berechnungen angestellt werden, und diese Arbeit befasst sich in erster Linie mit diesen Formeln. Die behandelten Machtformeln setzten sich aus mehreren Variablen zusammen. Die Zahl der Variablen variiert zwischen 2 und 236. In der Zeit vor dem Aufkommen des Internets lag die durchschnittliche Zahl der Variablen bei 13, danach bei 28. Machtmessungen, die nur auf einem einzigen Indikator basieren, werden nur kurz und im geringeren Umfang berücksichtigt.

Die Dissertation ist wie folgt aufgebaut: Zunächst werden die historischen und wissenschaftsgeschichtlichen Wurzeln von Machtformeln herausgearbeitet, beginnend mit der deutschen Geopolitik, über amerikanische Vertreter der Geopolitik und Ansätze der Geoökonomie. Danach werden Machtkonzeptionen und -definitionen in unterschiedlichen Schulen der internationalen Beziehungen behandelt. Ein Bezug zu den später behandelten Machtformeln wird hergestellt und auf Probleme die theoretischen Überlegungen mittels Machtformeln zu operationalisieren bzw. messbar zu machen wird verwiesen. Dem folgt eine Auseinandersetzung mit den Konzepten der seelischen Kraft und Ausdauer sowie der „weichen Macht“ [soft power]. Die späteren Machtindizes werden aus einer langen Tradition der Statistik als Staatswissenschaft hergeleitet mit direktem Bezug zur Zielsetzung späterer Machtformeln: der Herausarbeitung von Stärken und Schwächen von Staaten im Vergleich mit anderen Staaten.

Die erste behandelte Machtformel stammt aus dem Jahr 1741, die nachfolgenden Machtformeln entfallen alle auf die Zeit 1936 bis 2010. Insgesamt werden 69 Machtformeln erfasst und erläutert. Japanische und chinesische Machtformeln und der in Indien entworfene Nationale Sicherheitsindex (NSI) sind darin mit einbezogen. Im vorletzten Kapitel werden die Biographien der Erfinder der Machtformeln (Alter, Nationalität, beruflicher Hintergrund) verglichen, sowie die Variablen und Gewichtungsverfahren. Die meisten Machtformeln wurden von Amerikanern entworfen (37%), gefolgt von Chinesen (16%) und Deutschen (7%). Es wird zwischen willkürlichen und nicht-willkürlichen Gewichtungsverfahren unterschieden. 73% der operationalen Machtformeln verwenden willkürliche Gewichtungsverfahren. 17% der Machtformeln leiten die Gewichtung der Variablen ausschließlich aus mathematischen und statistischen Verfahren ab. 10% der Machtformeln kommen zu einer Gewichtung der Variablen mit Zuhilfenahme von Umfrageergebnissen zur Wahrnehmung.

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Abbreviations

AMS	Academy of Military Sciences (China)
CAS	Chinese Academy of Sciences
CASS	Chinese Academy of Social Sciences
CIA	Central Intelligence Agency (United States)
CICIR	China Institute of Contemporary International Relations
CINC	Composite Index of National Capabilities
CNKI	China National Knowledge Infrastructure
CNP	comprehensive national power
CNS	comprehensive national strength
COW	Correlates of War
DON	Dimensionality of Nations
EEZ	exclusive economic zone
EPA	Economic Planning Agency (Japan)
EVI	Environmental Vulnerability Index
FIFA	Fédération Internationale de Football
GATT	General Agreement on Tariffs and Trade
GCI	Global Competitiveness Index
GDF	Global Development & Finance
GDP	gross domestic product
GNI	gross national income
GNP	gross national product
GWP	gross world product
HDI	Human Development Index
HDR	*Human Development Report*
IAEA	International Atomic Energy Agency
IFs	International Futures
IHEDN	Institut des hautes études de défense nationale (France)
ILO	International Labour Organization
IMF	International Monetary Fund
INSAR	*India's National Security Annual Review*
IR	international relations
ITU	International Telecommunication Union
MGIMO	Moscow State Institute of International Relations
NGO	nongovernmental organization
NIRA	National Institute for Research Advancement (Japan)
NSCS	National Security Council Secretariat (India)
NSI	National Security Index
OECD	Organisation for Economic Co-operation and Development
OER	official exchange rate
PCA	principal component analysis
PPP	purchasing power parity
QOL	quality of life
R&D	research and development
RPC	Relative Political Capacity
SIPRI	Stockholm International Peace Research Institute
SOPAC	South Pacific Applied Geoscience Commission
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WDI	World Development Indicators
WEF	World Economic Forum
WHO	World Health Organization
WMD	weapon of mass destruction
WMEAT	*World Military Expenditures and Arms Transfers*
WTO	World Trade Organization
WWI	First World War
WWII	Second World War

Acknowledgment

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1. Introduction

The quintessential message is simple: "If international relations is to become a science it will have to establish a definitive quantitative measure for its most basic variable—national power" (ALCOCK & NEWCOMBE 1970: 335). By this standard international relations is still not a science, because it has failed to produce a generally accepted measure of national power. Power formulas seek to measure mathematically the power resources of a given set of countries in order to make those countries comparable to one another. A power formula typically consists of quantified power indicators. The aim is complexity reduction: to transform a multifaceted 'something' into unidimensional values, which in turn approximate national power. It implies that some information may inevitably get lost in the process, but embodies the hope that the most important information will be retained. As for the issue of what power is, a working definition might be that

> power is the linkage between different states of being; between potentialities and actualities, between dispositions and manifestations, and between determinables and determinants (specifics). (RUMMEL 1976: 165)

Other definitions are put forward in the chapters on theory. Still this definition implies that power is 'something' dynamic, as is its measurement.

1.1 Objective – Structure – Method

What is the puzzle? The root problematic in measuring national power is the absence of an underlying universal theory to justify one set of variables and methods vis-à-vis others. Technically the selection and weighting of variables has often been arbitrary and subjective, making power formulas look convincing to their respective designers but not necessarily to anyone else. The puzzle remains the creation of a valid universal formula for measuring power along with objective justifications:

IR Theory ⇔ Definition of Power ⇔ Power Indicators ⇔ Power Calculations

The general tendency is for mathematically inclined people to avoid theory and for theoretically inclined people to avoid mathematics. Even if the power formulas and their results can be seen as a history of failure and disappointment in which the discovery of the ultimate power formula has remained elusive, this quest itself has represented an ongoing achievement in the way it has approached power from a pragmatic level. In other words, if one cannot solve the problem, one can still learn from the difficulties involved in trying to solve it.[1]

[1] When Joseph Schumpeter wrote his article in the first issue of *Econometrica* in 1933, it was far from clear that econometrics could ever deliver anything useful, and still he made a forceful argument in favor of it: "We should not indulge in high hopes of producing rapidly results of immediate use to economic policy or business practice. Our aims are first and last scientific. We do not stress the numerical aspect just because we think that it leads right up to the core of the burning questions of the day, but rather because we expect, from constant endeavor to cope with the difficulties of numerical work, a wholesome discipline, the suggestion of new points of view, and helps in building up the economic theory of the future. But we believe, of course, that indirectly the quantitative approach will be of great practical consequence. The only way to a position in which our science might give positive advice on a large scale to politicians and business men, leads through quantitative work. For as long as we are unable to put our arguments into figures, the voice of our science, though occasionally it may help to dispel gross errors, will never be heard by practical men. They are, by instinct, econometricians all of them, in their distrust of anything not amenable to exact proof" (SCHUMPETER 1933: 12).

Two key questions in the area of power formulas are: (1) **which key indicators to use** and (2) **how to determine the weights of those power components**. Given that no definite conclusion has been reached on this issue, the focus of this work is to observe trends in the development of power formulas and to establish: (a) what implicit or explicit yardsticks or definitions of power the designers of power formulas use, (b) what type of indicators they use, (c) which methods they use to assign weights to different components of power, and (d) how these yardsticks, indicators, and methods are connected and integrated into a comprehensive framework for measuring power, that is, what do all of these quests have in common?

The primary objective of this study has been **to collect as many power formulas as possible in order to publish a comprehensive and international overview of power formulas**. The secondary objectives are as follows:

1. **To investigate the theoretical foundations of national power and its operationalization.** This has involved an exploration of: German geopolitics (primarily the work of Friedrich Ratzel and Alexander Supan), American geopolitics (Nicholas Spykman), and the relationship of Marxism and geopolitics (Karl August Wittfogel and Daniel Deudney); geoeconomics; American IR theories (realism, liberalism, and constructivism); psychological power in comparison to the soft power concept.
2. **To review the history of statistics and explore its relationship to political science, geopolitics, and international relations**. This has involved an exploration of: the etymological origin of the word "statistics"; pre-1850 statistics with its focus on state power; the use of statistics in the *Journal of Geopolitics* [*Zeitschrift für Geopolitik*]; the development of quantitative approaches in the United States; arguments against the quantitative approach as part of the second debate in American IR.
3. **To render comprehensive descriptions of the operational power formulas in terms of their background, technical construction, and feedback.** This has involved an exploration of: the history of power formulas, how to define them as operational, as well as the four scales of measurement; single-variable approaches; multivariate power formulas, with regard to the professional background of the designer as well as underlying geopolitical theories, with regard to variables, their respective weights, and the structures of the formulas, with regard to the published results, their interpretation, and feedback from other scholars.
4. **To look beyond the horizon especially to China and India and their understanding of a broader, more holistic, concept of national power.** This has involved an exploration of: the emergence of Comprehensive National Power (CNP) as an operational concept; the role of the cultural background in viewing power, strategy, and war; preliminary criticisms and fears associated with the CNP concept; the Indian National Security Index (NSI) in all its details, emphasizing it as an ongoing creative experiment, in ways representing the culmination of previous efforts in East and West with the addition of a distinctly Indian perspective.

5. **To finish this study of power formulas with a number of observations and generalizations on their designers as well as the input variables.** This has involved the exploration of: the designers in terms of average age, distribution of nationalities, and trends in professional backgrounds; the increase in the number of available variables, correlating with the increase in the number of variables used in power formulas, and the issue of data gaps.
6. **To present a tentative classification for three types of nonarbitrary weighting schemes based on operational definitions of power.** This has involved the exploration of: the problematic of theoretical-deductive arbitrariness; weighting schemes using statistical techniques aimed at the complexity reduction of the data, based on nothing but the data itself; weighting schemes relying on surveys (or consultation of experts) to determine the general perception of national power or the relative importance of variables; weighting schemes seeking an empirical measuring rod for national power, such as performance in war.

The aim has been to build a sound and rich foundation for further research, providing other scholars with comprehensive and detailed access to the information on past and present power indexes. By noting the successes and failures of different approaches, future designers of power formulas may avoid repeating the mistakes of others and instead be able to focus their creative energy on developing new theories and approaches. The three nonarbitrary methods for the quantification of national power may be useful in increasing the scientific validity of formulas.

1.2 Limitation of the Topic

National power is a huge topic. It is impossible in a single work to discuss everything related to its measurement. The absence until now of a comprehensive listing of power formulas has necessitated the extensive groundwork contained in this study. Altogether it implies the need for considerable further research into this niche area with more attention paid to related topics. In practice this means that this study contains

- no in-depth discussion on quantitative studies of war (war studies); no discussion of direct assessments of military power (military science and history); no in-depth discussion of international hierarchies and regional powers (area studies); no discussion on what determines the size of countries;[2]
- no modeling of international relations to retrodict past state behavior or predict future state behavior (computer simulations); no in-depth discussion of how to measure the distribution of national power in the global system (issues of concentration and polarities);
- no discussion of voting power indexes that may quantify national power within international or regional organizations like the UN, IMF, EU (e.g. Banzhaf, Shapley/Shubik); no in-depth

[2] For a brief introduction to this interesting topic, see ALESINA 2003.

discussion of proposed weighted voting schemes for international institutions (e.g. UN Security Council reform);

- no discussion of indexes related to national power, such as the Bertelsmann Transformation Index, the Failed States Index, the Euromoney Country Risk ratings; no discussion of vulnerability indexes as the reciprocal of national power indexes;[3] no discussion of "behavioral power" and its measurement.[4]

1.3 Contemporary State of Research

In 1987 Richard Merritt and Dina Zinnes started to describe and compare five power indexes, publishing the article "Validity of Power Indices" (MERRITT & ZINNES 1988). They then added some analysis in an improved version of the article, which was published a year later as a book chapter titled "Alternative Indexes of National Power" (MERRITT & ZINNES 1989). The five power indexes are those of Norman Alcock and Alan Newcombe (section 13.14), David Singer (section 13.15), Wilhelm Fucks (section 13.10), Ray Cline (section 13.20), and Clifford German (section 13.5). They take note of the number of variables, linearity versus nonlinearity, the number of countries, the time spans covered by the indexes. They use the Spearman correlation coefficients (r_s) and Pearson correlation coefficients (r) to see how the results of these power indexes relate to each other. The average scores for all available pairs of power indexes are $r_s = 0.821$ and $r = 0.926$. When splitting these pairs into halves (that is, the more powerful and the less powerful countries), the average scores for the more powerful countries are $r_s = 0.796$ and $r = 0.920$, whereas the average scores for the less powerful countries are $r_s = 0.459$ and $r = 0.538$. Their comment on the issue:

> Why is this the case? The most reasonable explanation is that the analysts are more knowledgeable about, interested in, and hence better able to assess the degree of power among the world's more powerful states. Comparative data on the ranking of weaker states are most likely to be inaccurate. (MERRITT & ZINNES 1989: 26)

The high correlations between different power indexes as found by Merritt and Zinnes are, in fact, overrated and misleading. The major reason for high correlations is population, so China and the United States will always be more powerful than San Marino and Nauru. This appearance of high correlations would quickly, if not totally, disappear if one were to calculate and compare national power *per capita*.[5]

In the same book *Power in World Politics*, where Merritt and Zinnes published the improved version of their article, Charles Taber contributed a chapter titled "Power Capability Indexes in the Third World" (TABER 1989). He looks into the issue of whether power indexes are more consistent for

[3] For a concise introduction to vulnerability indexes, see BRIGUGLIO 1999.
[4] "Without looking for beneficial outcome or relying on possession of material capabilities, I conceptualized power as the ability to influence either directly or indirectly the behaviors of other nations. Simply, what I was looking for was a way to capture the ability to start trouble. Nations whose actions preceded a great burst of activity on the part of other nations were by inference said to be behaviorally powerful" (WARD 1989: 122; further HOUSE & WARD 1988; WARD & HOUSE 1988).
[5] Only 1 of 69 indexes listed in this study looks at national power *per capita* (section 13.24).

developed nations than for the underdeveloped ones. He had access to the same set of five power indexes, though he does not utilize the one by Alcock and Newcombe. For his purposes he divides countries into two groups of developed nations and underdeveloped nations, and using pairwise comparisons between the four remaining power indexes, the developed nations have r_s ranging from 0.759 to 0.958, whereas the underdeveloped nations have r_s ranging from 0.586 to 0.891. Regardless of this overlap in r_s ranges, in all direct comparisons between two power indexes the r_s for the developed nations is higher than that of the underdeveloped nations. He provides four possible explanations for this: First, developed nations are more balanced in their attributes; Second, indicators appropriate to measure the power of developed nations may be less appropriate for measuring the power of underdeveloped nations. Taking a radical interpretation, this would mean that one cannot take the same variables with the same weight for all nations;[6] Third, underdeveloped nations are in a greater state of flux than developed nations; Fourth, rankings fail when values are clustered together, making the reasonable assumption that this applies more to the lower ranks than to the higher ranks. In other words, the higher ranks are more distinguishable.

Michael Sullivan had access to the same set of five power indexes, and in his book published a year later he does some arbitrary comparisons (SULLIVAN 1990: 110–119). For that purpose he also comes up with a power index of his own (section 13.29). His analysis does not add any significant insights. Nor did most of the descriptive compilations that followed. Wang Enyong and colleagues describe four power indexes in their 1996 book (WANG et alia 1996: 147–155). In 2000 Michael Pillsbury published his groundbreaking work on Chinese strategic assessments. In line with shedding light on the Sino-Japanese concept of comprehensive national power (CNP), it includes a detailed treatment of Chinese power formulas (PILLSBURY 2000: 203–258). His work refers to seven power indexes, four of them Chinese (sections 14.3, 14.4, 14.6, 14.7), the three non-Chinese ones (sections 13.10, 13.20, 14.1) having served as original inspiration for the Chinese power indexes (compare introduction to chapter 14). In 2001 Mirosław Sułek dedicated a whole book to the measurement of power. He describes six power indexes, in addition to which he elaborates on his own power index (SUŁEK 2001: 68–97). Unfortunately, his work has been only available in Polish.[7] He has been working on his power formulas since 1990 (section 13.30).

In 2003 the Chinese Academy of Sciences (CAS) published a report that lists brief descriptions of ten power indexes (CAS 2003: 13–17). Nathalie Serrão lists 20 power indexes in her master's thesis that was submitted in 2009 (SERRÃO 2009: 23–39, 111–116), 18 of which were already referred to in a 2008 conference paper of mine (HÖHN 2008a). In addition to that she did her own quantification of national power (section 13.51). Seyed Hadi Zarghani mentions four power indexes in his 2008 article, extended to a discussion of six in his 2010 book (HAFEZNIA et alia 2008: 231; ZARGHANI 2010: 56–68). In addition to that he contributed his own quantification of national power

[6] The Global Competitiveness Index (GCI) can be mentioned as an effective example for such an approach. The GCI uses different weights for different groups of variables ("pillars") in accordance with a country's level of development as indicated by per capita income. The basic idea is that these twelve pillars change in relative importance for competitiveness in line with the three specific stages (factor-driven, efficiency-driven, or innovation-driven) that countries happen to be in.

[7] Appendix B provides the first English-language rendition of Sułek's work.

(section 13.41). In Sułek's 2010 book the number of described power indexes rises to 13 (including his own) (SUŁEK 2010b: 110–143). This study here presents a total of 69 multivariate, operational power formulas and indexes (including my own), not counting modifications and theoretical formulas.

1.4 Relevance of Power Formulas

In general, the purpose of power formulas is to enable a shift from theoretical speculations to empirical confirmations. If national power were defined in operational terms, it could be measured by empirical means (prevailing in war, crisis, international decision making). One could analyze the composition of power, that is, the weighting of factors and their specific relationship to one another. Even if one assumed the absence of any objective base for national power, one could still find it useful to penetrate subjectivity, including shifts in time and culture. One could look at how the definitions and compositions of national power concepts have changed and speculate on the reasons. In a strategic sense it could help states to understand their enemies better by comparing how other states may perceive national power differently and to what degree these differences matter.[8]

Power is for politics the equivalent to energy in physics or money in economics, as imperfect as analogies always are. As for power being equivalent to energy, Bertrand Russell writes that "the fundamental concept of social science is Power, in the sense in which Energy is the fundamental concept of physics" (RUSSELL 1938: 10), further that "power, like energy, must be regarded as continually passing from any one of its forms into any other, and it should be the business of social science to seek the laws of such transformations" (RUSSELL 1938: 11–12). As for power being equivalent to money, David Baldwin writes: "*To say that power is like money except for the lack of a standardized measure of power is to say that the problem of measuring political power is very much like the problem of measuring purchasing power in an economy without money*" (BALDWIN 1971: 595).

Some measure of national power is necessary for the modeling of intrastate and interstate behavior (**quantification → simulation**). "Simulation modeling is a combination of mathematical and experimental methods – it takes the intermediate place between the logical and empirical methods and is a binding link between theory and practice" (MICHALIK 2010: 171).[9] This could help explain some historical patterns like the rise and fall of empires and civilizations. It could also help to predict the future, not in a deterministic sense, but in terms of probabilities: most likely scenarios as well as risks. There is, of course, always the hope that if national power were better understood, it might increase the rationality of decision makers as well as their decisions. The best example is the avoidance of unnecessary wars and conflicts if the probable victor and loser could be predicted, based on rational calculations of trade-offs and the like.

[8] Andrew Marshall, director of the United States Department of Defense's Office of Net Assessment since 1973, wrote in the context of the Cold War: "The Soviet calculations are likely to make different assumptions about scenarios and objectives, focus attention upon different variables, include both long-range and theater forces (conventional as well as nuclear), and may at the technical assessment level, perform different calculations, use different measures of effectiveness, and perhaps use different assessment processes and methods. The result is that Soviet assessments may substantially differ from American assessments" (MARSHALL 1982: 48).

[9] Polish text: "Modelowanie symulacyjne stanowi skojarzenie metody matematycznej i eksperymentalnej – zajmuje pośrednie miejsce między metodami logicznymi i empirycznymi i stanowi wiążące ogniwo między teorią i praktyką."

Michael Pillsbury writes that "one side seldom starts a war knowing in advance it will lose. Thus, we may presume there are almost always miscalculations in strategic assessments of varying types according to the nature of the national leadership that made the assessment" (PILLSBURY 2000: 356). Conversely it could help powermongers to optimize their internal resources and external strategies for maximizing power. The usefulness of power formulas could be to determine more effective benchmarks for measuring country performance and this way provide effective feedback for national strategies. The UN, for example, uses a list of benchmarks in their Millennium Development Goals, which are meant to measure the success in fighting various maladies in poorer countries.

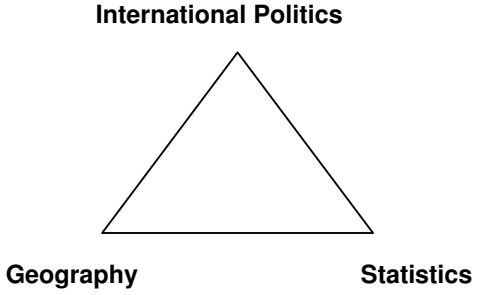
International organizations could benefit from less radical and arbitrary methods in determining the voting powers of countries. This applies especially to the UN Security Council, and to a lesser degree the UN General Assembly. If the gap between institutional voting power and actual power were minimized, it could strengthen effective decision making and enforcement capabilities. Given the current general perception that certain institutional setups are unjust and outdated, the legitimacy of such institutions and their decisions could be increased if such perception could be reduced.

If changes in measured national power were automatically linked to representation and voting power, it could aid avoiding unnecessary debates for former powers facing decline, keeping institutions up-to-date in the process. This efficient process would be different from a lengthy and humiliating debate, in which the power of tomorrow has to convince the power of yesterday that it is time for retirement. It would be like the periodic reapportionment for national legislatures in some countries, that is, the territorial subunit may not like a decrease in its seats and/or votes, but given that the rules of reapportionment are known in advance, and knowing that the process is transparent and automatic, it reduces the hurt to a minimum.

2. Traditional Geopolitics and National Power

Though traditional geopolitics was never an exclusively German, let alone National Socialist, discipline, it has nevertheless been much criticized since WWII over the alleged connection between German geopolitics and expansionist ambitions. In recent decades geopolitics' academic respectability has experienced a gradual comeback and this has also encouraged a differentiated treatment of certain historical issues (KORKISCH 1987: 26–27). In 1993 Samuel Huntington published his controversial article "The Clash of Civilizations?" (HUNTINGTON 1993), which ignited a whole debate on post-Cold War geopolitics. In 1999 the *Economist* dedicated a whole special section to "The New Geopolitics" (*Economist* 1999). When asked about the German geopolitician Karl Haushofer, prominent IR expert Parag Khanna stated recently in an interview that "Germany was indeed an essential pillar of geopolitical thought. […] Of course we can use the old geopolitical terms" (KHANNA 2010: 45).[10] This shows to what extent things have normalized.

The examination of traditional geopolitics is unavoidable when looking at the measurement of national power, for no other school of thought has been more focused on the elements of national power than traditional geopolitics. It in part relates to the more empirical-inductive focus of geopolitics, which is interested first of all in facts about international politics. For the purpose of geopolitics, it is preferable to have these facts in the most comparable format, which is statistics. It also relates to the geographic input into geopolitics, for geographical country descriptions feature many relevant country statistics,[11] many of which are elements of national power. A triangle can be constructed to visualize the three inputs that go into geopolitics and geopolitical measurements of national power:



Rudolf Kjellén saw it in bipolar terms: on one side is regular political science [Staatswissenschaft] as the thesis, on the other side are statistics and geography as the anti-thesis, both sides calling forth a new synthesis. In a broader context he considered economics, society, and state as cultural formations, whereas territory and population are the natural foundations (KJELLÉN 1917: 32, 44–45).

[10] German text: "Deutschland war in der Tat eine wesentliche Säule des geopolitischen Denkens. […] Natürlich können wir die alten geopolitischen Begriffe verwenden."
[11] In this context it can be said that nonexperts in geography most often judge matters from the viewpoint of utility (SUPAN 1922: 9). This may mean that the information they find in almanacs – that is country descriptions with statistical and constitutional data in combination with descriptive bits of information on localities – is geography itself.

3. German Geopolitics: Friedrich Ratzel & Alexander Supan[12]

In 1897 the German geographer Friedrich Ratzel (1844–1904) laid the foundation of geopolitics when he published his seminal *Political Geography* [*Politische Geographie*] (RATZEL 1923).[13] Ratzel points out in the introduction to this work that "for some political scientists and sociologists the state stands in the air, as it does for many historians, and the soil is just a larger type of real estate" (RATZEL 1923: 1).[14] Right from the beginning he defined political geography more in line with an empirical emphasis. In 1899 the Swedish geographer Rudolf Kjellén (1864–1922) coined the term "geopolitics" ["Geopolitik"]. In 1917 he published his work *The State as a Life Form* [*Der Staat als Lebensform*] (KJELLÉN 1917), which popularized geopolitics as a term and concept. In this work Kjellén criticizes the reduction of the state to the status of a juristic person, whereby the study of the state is reduced to the study of law. In contrast to that he supports a more empirical approach (KJELLÉN 1917: 1–6, 12–13, 22–23). Political geography and geopolitics can be considered an empiricist reaction to an excessively theoretical political science [Staatswissenschaft]. The *Journal for Geopolitics* [*Zeitschrift für Geopolitik*] was published by Karl Haushofer (1869–1946) and associates from 1924 to 1944, a period which can be regarded as the heyday of German geopolitics. Though many people contributed to the development of German geopolitics, the names of Ratzel, Kjellén, and Haushofer usually stand out as the founders of German geopolitics.

Alexander Georg Supan (1847–1920) was a well-known geographer in his lifetime and the subsequent period, though since 1945 his name has been more or less forgotten. He was born and educated in Austria; his name is of Slovenian origin. From 1884 to 1909 he was professor of geography at the University of Czernowitz, from 1909 to 1916 he was professor of geography at the University of Breslau. From 1884 to 1909 he also edited *Petermann's Geographical Announcements* [*Petermanns Geographische Mitteilungen*], one of the leading geographical journals of the time. His main work *Principles of Physical Geography* [*Grundzüge der physischen Erdkunde*] was published for the first time in 1884. Its 16th edition appeared in 1938. Nowadays he is best remembered for his naming of undersea features after his proposal for terminology was adopted in 1904 by an international congress of geographers in Washington DC, resulting in the first edition of the General Bathymetric Chart of the Oceans (GEBCO).

In 1918 Supan published the *Guidelines to General Political Geography* [*Leitlinien der allgemeinen politischen Geographie*], a second revised edition of which was published in 1922 after his death (SUPAN 1922). In terms of proper chronology, Supan should be regarded along with Ratzel and Kjellén as one of the main pioneers of German geopolitics [Geopolitik]. Supan knew Ratzel's *Political Geography*. His *Guidelines to General Political Geography* can be understood as a constructive criticism of, and supplement to, Ratzel's work. Supan's intention was to bring more system into the matter (SUPAN 1922: III, 7). In the following discussion of national power in the work of

[12] Pieces of this section have been published in two different articles (HÖHN 2011, further 2008b, or 2009).
[13] Ratzel published the second edition of this book in 1903, one year before he died, and Eugen Oberhummer did some minor revisions to publish the third edition in 1923. It is this third edition that subsequent references apply to.
[14] German text: "Für manche Staatswissenschaftler und Soziologen steht der Staat geradeso in der Luft wie für viele Historiker, und der Boden des Staates ist ihnen nur eine größere Art Grundbesitz."

Supan, Ratzel's thoughts are presented as the groundwork on which Supan built his ideas. As for relating theory to quantitative method and thereby operationalizing it, 24 variables (that is, six variables for each of the three different indicators of national power, and six variables for national power in general) are tested in the following sections for tentative viability by looking at the Pearson correlation coefficients of each of these variables in relation to a survey on power conducted by Jean-Yves Caro in 1998 (CARO 2000b: 103–104; also section 13.33).[15]

3.1 Definition of German Geopolitics

A number of people have defined geopolitics. The following definition was expounded in a joint essay, published in 1928, by the three publishers of the *Journal for Geopolitics* [*Zeitschrift für Geopolitik*], Karl Haushofer, Erich Obst (1886–1981), Otto Maull (1877–1957), plus long-time freelance contributor Hermann Lautensach (1886–1971):

1. Geopolitics is the study of the conditioning of political processes by the physical territory on which they take place.
2. It is based on the broad foundations of geography, especially political geography as the theory of states as living political organisms occupying particular territories, and their structure.
3. The essence of regions as comprehended from the geographical point of view provides the framework for geopolitics within which the course of political processes must proceed if they are to succeed in the long term. Though political leaders will occasionally reach beyond this frame, the link to the particular patch of earth on which they act will always eventually exact its determining influence.
4. With this sense in mind, geopolitics aims to provide tools for political action and act as a guidepost in political life.
5. In this way it becomes a theory of art capable of guiding practical politics to the place at which it becomes necessary to make the leap from firm ground. Only in this way will the leap into skillful statecraft proceed from knowledge, rather than from dangerous and erroneous ignorance.

[15] The survey was conducted in the first semester of 1998 at the Institute of Higher Studies for National Defense [Institut des hautes études de défense nationale – IHEDN]. The IHEDN is a French public institution for the purpose of training military and civilian public servants in defense matters. 214 students agreed to participate in the survey, 36 of whom were in the military, 39 were economists, and another 40 were civilian auditors. The average age of the surveyees was 38.5. In the survey the surveyees were asked to assign scores ranging from 1–15 for the estimated power of 40 selected countries. These scores were averaged into an interval scale (section 13.33). The issue remains how representative this expert survey is: In their 1970 article, Norman Alcock and Alan Newcombe had presented the survey results of 38 Canadian citizens ranking 122 nations (ALCOCK & NEWCOMBE 1970). In 1974 Charles Doran, Kim Hill, Kenneth Mladenka, and Wakata Kyoji replicated the study by Alcock and Newcombe (DORAN et alia 1974). Contemplating the issue of whether power perceptions may differ across cultures and political systems, they surveyed Finnish, Japanese, and American university students. The Spearman correlation coefficients between the three national groups plus the Canadians surveyed by Alcock and Newcombe are all 0.90 or above. This demonstrates that perceptions are fairly consistent and reliable (section 13.14).

6. Geopolitics wants to, and must, become the geographical conscience of the state.

(HAUSHOFER et alia 1928: 27; also WITTFOGEL 1929: 21, 1932: 583)[16]

Then again, according to Karl Haushofer, geography alone can explain at most 25% of phenomena associated with human development:

> It must not be forgotten that the geopolitical approach necessarily requires as its complement man's heroic side, his worship of heroes, and that its focus on geographic causes can help answer only about a quarter of the questions on human development by explaining man as a product of his spatial environment — completely ignoring the other three quarters which have to be explained in conscious, compelling contrast to this environment by looking deep within man and his race and at his moral will. (Haushofer, quote inserted into WITTFOGEL 1932: 588; compare WITTFOGEL 1929: 500)[17]

Joseph Nye declared that "geography and psychology are both important factors in geopolitics" (NYE 1990b: 185), which can be wholly confirmed.

The border line between political geography and geopolitics has been fluid. It could be said that political geography has been considered to be more descriptive in being more strictly attached to geography, whereas geopolitics has tended to be more prescriptive in relating more to a wide range of disciplines beyond geography. Otto Maull depicts geopolitics as applied political geography (HAUSHOFER et alia 1928: 22). Robert Sieger (1864–1926) thought that geopolitics emerges when the predictions start (MAULL 1951: 779). As an early work of geopolitics, Supan's work is more geographical than political (compare HAUSHOFER et alia 1928: 15).

3.2 Power in Political Geography

Power is the most ubiquitous term in politics and international relations. The same applies to geopolitics and political geography. Alexander Dugin emphasized it this way: "Geopolitics — a worldview of power, a science about power and for power" (DUGIN 1997: 13).[18] The problem is that this

[16] German text: "[1.] Die Geopolitik ist die Lehre von der Erdgebundenheit der politischen Vorgänge. [2.] Sie fußt auf der breiten Grundlage der Geographie, insbesondere der politischen Geographie als der Lehre von den politischen Raumorganismen und ihrer Struktur. [3.] Die von der Geographie erfasste Wesenheit der Erdräume gibt für die Geopolitik den Rahmen ab, innerhalb dessen sich der Ablauf der politischen Vorgänge vollziehen muß, wenn ihnen Dauererfolg beschieden sein soll. Gewiß werden die Träger des politischen Lebens gelegentlich über diesen Rahmen hinausgreifen, früher oder später aber wird sich die Erdgebundenheit immer wieder geltend machen. [4.] Im Sinne dieser Erkenntnis will die Geopolitik Rüstzeug zum politischen Handeln liefern und Wegweiser im politischen Leben sein. [5.] Damit wird sie zur Kunstlehre, die die praktische Politik bis zu der notwendigen Stelle des Absprungs vom festen Boden zu leiten fähig ist. Nur so wird dieser Sprung vom Wissen zum Können und nicht vom Nichtwissen aus erfolgen, woher er sicher weiter und gefährlicher ist. [6.] Die Geopolitik will und muß zum geographischen Gewissen des Staates werden."

[17] German text: "'Man darf eben überhaupt nicht vergessen, daß die geopolitische Betrachtungsweise notwendig der Ergänzung nach der heroischen Seite des Menschen, der Heldenverehrung bedarf, und daß sie nur etwa ein Viertel der Fragen menschlicher Entwicklung aus erdbestimmten Ursachen ableiten kann, wenn sie den Menschen aus seiner Umwelt erklärt — ganz ohne Berücksichtigung der anderen drei Viertel, die aus seinem und seiner Rasse Inneren, seinem sittlichen Willen und dem bewußten, zwingenden Gegensatz zu dieser Umwelt erklärt werden müssen' […]." The original text appeared in the introduction to (page 6): Fairgrieve, James. 1925. *Geographie und Weltmacht*, Berlin-Grunewald: Kurt Vowinckel Verlag.

[18] Russian text: "Геополитика — это мировоззрение власти, наука о власти и для власти." This statement also relates inadvertently to the difference between geopolitics and political geography. Political geography is "about power" in analyzing the relation of power to space, whereas geopolitics is "for power" in advocating policy prescriptions.

short definition broadens geopolitics to include almost everything, a problem that André Cholley in his *Guide of the Geography Student* [*Guide de l'Étudiant en Géographie*] describes as pertaining to political geography:

> What makes the handling of this political geography difficult is that it focuses on value judgments. The idea of power is behind all designs. Its main purpose is to evaluate the power of political organisms created by man. Yet the power of a political organism depends on some very complex elements, the value of which can vary from one era to another and even from one area of the globe to another. It includes not only the facts of geographical nature: area facts (location, demarcation of borders, military organization of the territory), population facts (density, distribution and social structure), but also psychological or moral notions (organization of culture, training of the elites or cadres), even religious facts, which are obviously nothing geographic. (CHOLLEY 1942: 76–77)[19]

Supan likewise puts the emphasis on power. He suggests distinguishing between strong and weak countries, rather than big and small ones, while stating that "strength and weakness are only expressions for different intensities of power to freely exercise our conscious will" (SUPAN 1922: 13).[20] In the context of territorial policy he formulates the analogy that "power is for the state what freedom is for the individual" (SUPAN 1922: 130).[21] For him it is of central importance to analyze how the state grows, and what conclusions this throws on the issue of power.

3.3 The Concept of the State

Supan has a favorable view of the state. For him "the state is the foundation of all civilization and culture" (SUPAN 1922: 1).[22] The state is a complex manifestation, which for the purpose of political geography he defines as an association of humans within fixed borders. He defines four geographical categories of the state: shape, size, location, and structure.[23] States differ in size and shape and, logically, location. The type of internal cohesion represents the structure. A state cannot exist in empty **space**. The **population** constitutes the body of the state, whereas its laws, regulations, and institutions bring **organization** into this human-occupied space.[24] Whereas Ratzel considers the state

[19] French text: "Ce qui rend difficile le maniement de cette Géographie politique, c'est qu'elle porte avant tout des jugements de valeur. L'idée de puissance est derrière toutes ses conceptions. Elle a essentiellement pour but d'évaluer la puissance des organismes politiques créés par l'homme. Or la puissance d'un organisme politique dépend d'éléments très complexes et dont la valeur peut varier d'une époque à l'autre et même d'une zone de la surface du globe à l'autre. Il y entre, non seulement des faits de nature géographique: faits d'étendue (situation géographique, tracé des frontières, organisation militaire du territoire), faits de peuplement (densité, répartition et structure sociale) mais encore des notions psychologiques ou morales (organisation de la culture, formation des élites ou des cadres) même des faits religieux, qui n'ont naturellement rien de géographique."

[20] German text: "Stärke und Schwäche sind nur Ausdrücke für verschiedene Intensitätsgrade der Macht, unseren bewußten Willen frei zu betätigen."

[21] German text: "Macht ist für den Staat dasselbe, was Freiheit für den einzelnen ist […]."

[22] German text: "[…] der Staat die Grundlage aller Zivilisation und Kultur ist."

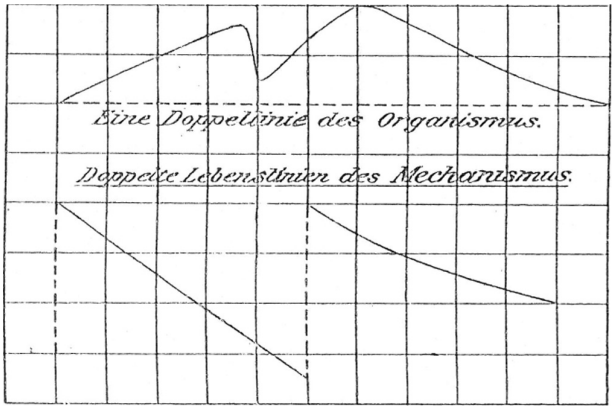
[23] Structure and location are considered "basic categories", whereas shape and size are considered "derived categories" (SUPAN 1922: 13). Ratzel thought in three politico-geographical categories, that of location, space, and borders. He was skeptical as to the possibility of expressing politico-geographical values in terms of economic exchange values (that is, a price denominated in some currency). In other words, he did not believe that some elements of power can be quantified (RATZEL 1923: 80–82).

[24] In fact these three elements are all necessary characteristics of a fully sovereign and independent state: "In order to be a legal person, a state must own certain characteristics. It must, first of all, occupy a fixed *territory* over which it exercises

as an imperfect organism based on the division of labor (RATZEL 1923: 8–9, 14, 75–76), Supan considers the state to have merely the semblance of an organism. According to Supan, the organs of an organism grow from within, whereas the organs of the state are organized from the outside. He concedes that morality, customs, and law in older, more anarchic times may have developed the "organic" way. Apart from such primitive societies, he appears to have seen the construction of the state as a willful act of reason. In this regard he can be considered a liberal. He also rejects Kjellén's definition of the state as a "sensual-rational being" ["sinnlich-vernünftiges Wesen"] (KJELLÉN 1917: 30; SUPAN 1922: 3).

Supan displays an early cybernetic understanding of the state by looking at its lifeline. The following diagram from his book illustrates two possible lifelines:

Figure 1: Organic vs. Mechanic Life Lines [Supan]



Source: SUPAN 1922: 4.

He visualizes a lifeline for the organism that rises and subsequently falls. It can rise more and fall more than once (see the upper line in figure 1: "a double line of the organism"), but it must not fall below a certain absolute level (the dotted line), which the cyberneticist Marian Mazur called "idle power" (that is, the minimal power necessary to sustain the organism). Such an occurrence spells the death of the organism (MAZUR 1961: 217). Supan sees the lifeline of the machine in contrast to the lifeline of the organism (see lower two lines in figure 1: "doubled lifelines of the mechanism"). The starting points and the points of optimal performance of each of the two lifelines are identical, that is, rather than rising and falling in cycles, the machine performs best in the beginning, and from then on the performance declines. If the machine is broken, it can be repaired, or it can be regularly set back to optimal performance by maintenance, only to decline once more. The resurrection of Poland from

exclusive jurisdiction. Within this territory, there must be *stability* of organization and administration, and the entity must be able to fulfill its international duties and obligations. […] *Population* represents an obvious second characteristic of a state, for without it no government would be possible. […] *Operation of a government* is a third characteristic of a state, for without it there could be no assurance of internal stability and the ability to fulfill international obligations" (GLAHN 1996: 51); "According to the *Restatement (Third) of Foreign Relation Law of the United States*, § 201 (1987), 'International law generally defines a 'state' as 'an entity that has a defined territory and a permanent population, under the control of its own government, and that engages in, or has the capacity to engage in, formal relations with other such entities'" (GLAHN 1996: 51). Article 1 of the Montevideo Convention of 1933 can also be cited: "The state as a person of international law should possess the following qualifications: (a) permanent population; (b) a defined territory; (c) government; and (d) capacity to enter into relations with the other states" (*Wikisource* 2011).

the dead after WWI displayed such a mechanic lifeline, which was possible because population and territory had remained unified. According to Supan, the lifelines of states can go from the organic mode to the mechanical mode and vice versa. The state is a hybrid, mixing organic as well as mechanical modes, with organization increasing the mechanical relative to the organic, with the state always consisting of the natural (that is, material) body of population-territory and *organization*.[25] He regards the state as the synthesis of population and territory. Likewise in Mazur's work the machine consists of energy, matter, and *structure* (MAZUR 1961: 214).

3.4 Space as a Power Indicator

Though Supan agrees with Ratzel that "nations do not hover over the ground but are connected to the hard soil" (SUPAN 1922: 130),[26] he criticizes Ratzel for putting too much focus on space (SUPAN 1922: 7, 46). To do so is formally correct, but is still a little unfair. Ratzel freely acknowledges that population figures are better at explaining great power status. He stresses that space and population are politico-geographic constants of equal standing, to which all the other political quantities must relate (RATZEL 1923: 302–303). Overall he leans towards space (see RATZEL 1923: 23). While thinking in economic terms of supply and demand, he notes that the amount of space on this planet is fixed, while population is increasing, for that reason the value of land has to increase (RATZEL 1923: 17–18).[27] A large space with a small population might in the long run develop into a great power, considering the value of empty land as equaling its potential capacity to feed people (RATZEL 1923: 305, 311).

Ratzel asserts that space itself is a political force and not only the carrier of political force, thinking of space not only in terms of economic utilization but also strategic dimensions such as freedom of movement (RATZEL 1923: 261–262).[28] In economic as well as strategic terms he places as much emphasis on the organization of space through the existence of an adequate transportation infrastructure (railroads, roads, canals) as Supan places on the state. The transportation infrastructure connects and integrates the parts of the state from within, enabling and supporting cultural and scientific development. Ratzel observes that areas with much traffic tend to be wealthy, whereas areas with little traffic tend to be poor. In addition to that, the transportation infrastructure affects the military mobility, especially of larger states (RATZEL 1923: 16, 43, 90, 340, 363, 380). Supan likewise acknowledges that no state is possible without transportation infrastructure (SUPAN 1922: 168).

[25] Mazur showed that organization is not "unnatural", that is, biological organisms and machines display an identical steering logic (MAZUR 1963). This removes the last barrier to a holistic understanding of biological and mechanical processes, though this in itself does not render the depicted difference in lifeline patterns obsolete, nor the different notions of internally conditioned, spontaneous self-organization vis-à-vis externally imposed, planned organization.

[26] German text: "Die Völker schweben nicht frei in der Luft, sondern sind an den harten Boden gebunden."

[27] It is possible to observe that the prominence of territory in the measurement of national power has receded a bit. An explanation is that data for many other variables has become available over time. When it comes to the importance attached to space in practice, it is possible to observe that in the past it had been quite common to trade land. The most famous examples are obviously the purchase of Louisiana, and later Alaska, by the United States. The most recent example of such trade may be the United States purchasing the Danish West Indies in 1917 for 25 million dollars. Given that Japan is relatively rich and Russia relatively poor, one can imagine how easily the Kurile Islands dispute might have been resolved merely a hundred years ago. Today such deals appear unthinkable, though leasing still seems acceptable. An example is Singapore leasing sites for military use and training in Indonesia and Thailand.

[28] In another discussion related to history, his line of argument appears to suggest that the character of economic production is to be bound to the soil and as such to a particular location, whereas the character of military force is to be nomadic (RATZEL 1923: 59). It offers food for thought.

In discussing space (SUPAN 1922: 46–52), Supan first of all notes that space is the most obvious power indicator because it can be visually perceived through maps. He thinks that this focus on the political coloring of maps can lead to dangerous delusions, because countries may strive for space for the sake of looking good on maps without assessing the utility and cost of such expansion. As such he advocates the distinction between *active* space and *passive* space. Active space is tentatively defined as land with a population density of one person per square kilometer or higher, the sterile rest constituting passive space. One principal intention is to look at land useful for cultivation, disregarding deserts, mountains, and polar regions (SUPAN 1922: 47–48, 65–68). Ratzel also distinguishes between habitable and nonhabitable soil, stating that nonhabitable soil does not necessarily add to power and can even be a burden (RATZEL 1923: 4, 274, 309, further 206–208). Nevertheless, he tends to be more positive on the potential of "worthless" soil with regard to mineral exploration and developments in agricultural technology (RATZEL 1923: 23, 32).

With this in mind it is worth mentioning here an article by Max Krahmann, published in 1927, titled "Capital, Technology and Geopolitics" ["Kapital, Technologie und Geopolitik"] (KRAHMANN 1927, translation plus original text available in Appendix A). He proposes territory as the horizontal dimension and technology as the vertical dimension, which can be taken to mean:

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geopolitical_space = territory × technology
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A wealthy country with a high level of technology can get more out of its soil in terms of food and minerals than a poor country. In consequence a country has the option to expand horizontally in terms of conquering space or vertically in terms of investing in R&D, the latter being the basic idea of contemporary geoeconomics aiming at techno-industrial supremacy (section 7.3). Overall three conceptions of space can be constructed, the first being physical, possibly improved by transportation infrastructure, and useful in a military-strategic sense, the second being biological in terms of living space necessary to feed the population of a country, and the third being biological-mineralogical in relation to the level of available technology.

The following table shows six different spatial variables (one synthetic) and the Pearson correlation coefficients (r) for them in relation to power perception scores from 1998:[29]

Table 1: Spatial Variables and their Correlation to Power Perception in 1998

Spatial Variables	r	Data Source
Highways, Paved (km)	0.790	CIA 1990–2008
Highways, Total (km)	0.708	CIA 1990–2008
Surface Area (km^2) × Per Capita GDP (PPP) [Krahmann Equivalent]	0.544	CIA 1990–2008
Total Internal Area (km^2) + Exclusive Economic Zone (km^2)	0.416	*Wikipedia* 2010
Agricultural Land (km^2)	0.388	CIA 1990–2008
Surface Area (km^2)	0.258	CIA 1990–2008

Source: Author's own calculations.

[29] I computed the Pearson correlation coefficient of the logarithm of given variables in relation to power-perception scores for 40 countries derived from a 1998 survey of 214 French defense industry experts (CARO 2000b: 103–104; also section 13.33). The data used from the *CIA Factbook* is for the year 1998 (interpolated in some cases). The *Wikipedia* data used appears to be current (November 2010).

If, in theory, maritime territory (here measured by the extent of the exclusive economic zone – EEZ) should be the least valuable/useful and agricultural land the most valuable/useful, then the table shows the surprising result that correlations are inconsistent. Total surface area plus maritime territory yields the best result, agricultural land follows, but surface area, which is the most straightforward measure located between the other two measures, actually performs worst. It is possible to argue that access to the sea is beneficial for trade, but only one of the 40 countries of the Caro set is landlocked (Zambia). Another factor that may explain these strange results is that the great colonial powers (France, the UK, also the US in the Pacific) of the past still hold a number of islands around the globe that very much increase their EEZs, therefore the correlation to power. In any case, those three correlations are fairly weak.

Ratzel and Supan had already concluded that much by looking at the territorial size of countries in relation to recognized great power status (RATZEL 1923: 302; SUPAN 1922: 49). When it comes to the transportation infrastructure as a factor modifier applied to territory, Ratzel was right on target: the correlations for highways are much stronger. If we put into operation Krahmann's suggestion on space as the horizontal dimension, and technology as the vertical dimension, it performs better than the pure territorial variables, though not as good as highways.

3.5 Population as a Power Indicator

In relating population to space, Ratzel thinks that population density relates to the cultural (that is, technological) level, though he does not consider that to be a strictly statistical relationship.[30] An advantage of dense populations is that they support the accumulation of knowledge and capital (RATZEL 1923: 47–48, 91). He notes again in an economic sense of supply and demand that increased population densities decrease the value of human life in relation to space, which means that the expansion of space increases again the value of the human being (RATZEL 1923: 283). In a Malthusian sense he asserts the existence of a natural limit to population, when a larger population tends to weaken rather than strengthen the force of the state. Hence the force of state does not grow proportionally to population. He illustrates this point with examples from famines and epidemics in China, as well as the famine years of 1847 in Ireland (RATZEL 1923: 308–307). He thinks that it is better for national cohesion if the population of a state is distributed uniformly across the territory (RATZEL 1923: 14, 310).

Supan places more emphasis on population than Ratzel. He also highlights the issue of cohesion as a factor modifier. He emphasizes that "even though the state is superior to the nation, national unity is still of decisive importance for its strength and durability"

[30] In 1741 Johann Peter Süßmilch suggested a measure for national power: population multiplied by population density, with population density serving as a proxy for development (section 13.1). Ratzel comments on that measure that it reflected the overestimation of population as a meter (measurement scale) for state power that was typical for the spirit of the age of enlightened absolutism (RATZEL 1923: 303–305). Supan likewise states that population density is of lesser importance in assessing the power of a state, more important would be to know the density maximum (SUPAN 1922: 155). The basic idea behind the density maximum is akin to the concept of living space or carrying capacity, which is the maximum population size that the soil of a given country can support (compare section 13.1).

(SUPAN 1922: 131).[31] According to Supan, the state is kept together by force, which he considers the external factor, and a sense of togetherness (community spirit), which he considers the internal factor (SUPAN 1922: 82–83, 95–96). Likewise Adolf Menzel had spoken of authority and solidarity as the foundations of the state (KJELLÉN 1917: 14–15). Supan asserts homogeneity to be important for national cohesion. In this regard he discusses three primary factors: (1) He judges a common ancestry (pure ethnicity) to guarantee the highest degree of homogeneity;[32] (2) He judges language to be important, though he notes that language also needs a common cultural background. For example, negroes in the United States had not been integrated despite whites and blacks speaking a common language; (3) He judges religion to have been significant as a factor in the Middle Ages but of decreased importance since that time (SUPAN 1922: 98–110). These long-term factors of national cohesion have to be distinguished from public consciousness as an important short-term factor, which he considers to be somewhat independent of organization, fluctuating as a consequence of temporary, unconscious impulses (SUPAN 1922: 98).

Another factor Supan regards as important is intelligence, though he suggests that the actual value of a population's intelligence is diminished in the absence of its culturally guided organization. He pinpoints to the importance of organization in his reflections on the Chinese, who, despite their intelligence and industriousness, did not (at the time of his writing) have much power (SUPAN 1922: 61). When discussing the issue of transportation infrastructure, he wonders what economic impact a railway infrastructure in China would have in conjunction with these "many hundred millions of bustling and intelligent humans" (SUPAN 1922: 171).[33] Likewise Ratzel mentions the "strong intelligence" ["kräftige Intelligenz"] of the Chinese. He also quotes Lajos Lóczy speaking of the "high intelligence" ["hohe Intelligenz"] of the Chinese (RATZEL 1923: 132).[34]

The following table shows six different demographic variables and the Pearson correlation coefficients (r) for them in relation to power perception scores from 1998:[35]

[31] German text: "[...] wenn auch der Staat höher steht als die Nation, für seine Stärke und Dauerhaftigkeit doch der Grad der nationalen Geschlossenheit den Ausschlag gibt."
[32] Supan is merely making an observation. He is not in any sense advocating racial policies. Though he opposes miscegenation as an evil, he supports trade and cultural exchange between nations (SUPAN 1922: 135, 181). In this regard it is worth mentioning that the American geopolitician Nicholas Spykman listed "ethnic homogeneity" as one of eleven factors of national power (SPYKMAN 1942: 19; also chapter 5). For a more updated treatment on the issue of genetic similarity and its relevance regarding nationalism and geopolitics, see RUSHTON 1986, 2005.
[33] German text: "[…] mehreren hundert Millionen emsiger und intelligenter Menschen […]."
[34] Indeed IQ tests have shown that the Chinese are more intelligent than any European population, so Richard Lynn calculated a national IQ of 105 (British IQ=100) on the basis of ten IQ tests taken from 1990 to 2001 (LYNN & VANHANEN 2006: 297). Supan's and Ratzel's assessment of the Chinese is noteworthy, because they do not talk of other populations with such esteem. Apparently many geopolitical scholars of the time shared this high regard for Chinese potential. China was the most discussed country in the *Journal of Geopolitics* [*Zeitschrift für Geopolitik*] from 1924 to 1936, that is, before Germany and Japan signed the Anti-Comintern Pact.
[35] I computed the Pearson correlation coefficient of the logarithm of given variables in relation to power-perception scores for 40 countries derived from a 1998 survey of 214 French defense industry experts (CARO 2000b: 103–104; also section 13.33). The population figures are for the year 1998. The scores on homogeneity/fractionalization used were calculated for various years (2001 or before). The scores used for IQ and cognitive ability (mix of IQ and educational performance scores) also consist of diverse data for various years. The calculations for combined variables were done in such way as to maximize the correlation to perception scores.

Table 2: Demographic Variables and their Correlation to Power Perception in 1998

Demographic Variables	r	Data Source
Population × IQ	0.811	CIA 1990–2008; LYNN & VANHANEN 2006; LYNN & MEISENBERG 2010
Population × Cognitive Ability	0.810	CIA 1990–2008; RINDERMANN 2007; RINDERMANN et alia 2009
Population × Ethnic Homogeneity[36]	0.662	CIA 1990–2008; ALESINA et alia 2003
Population × Religious *Diversity*	0.634	CIA 1990–2008; ALESINA et alia 2003
Population × Linguistic Homogeneity	0.612	CIA 1990–2008; ALESINA et alia 2003
Population	0.566	CIA 1990–2008

Source: Author's own calculations.

It is of logical necessity that a combined score should always perform equally or better in terms of correlation than one of its components. The issue then is by how much. Multiplying population by fitted IQ and cognitive ability scores yields clearly superior results to population alone. As a result the argument can be constructed that intelligence/education as a factor modifier applied to population adds a much needed quality dimension, with these enhanced population figures indeed representing **human capital**. Not so remarkable are the improvements in terms of correlation when looking at population multiplied by the three fitted homogeneity variables. Still the correlations indicate that ethnic homogeneity correlates better to power than linguistic homogeneity. Surprisingly, when it comes to religion, religious diversity (the reciprocal of homogeneity) correlates better to power than homogeneity.[37] Caution should be applied in deriving generalizations from those results. Much more extensive testing would be necessary for this. Nevertheless, the results indicate that Supan was not wrong in judging ethnic homogeneity most important, religious homogeneity least important, and linguistic homogeneity somewhere in the middle.

3.6 Organization as a Power Indicator

Ratzel's *Political Geography* mentions many times the issue of organization. Because the state organizes space politically (transportation infrastructure being one aspect), the development of the state coincides with the organization of space and results in the tightening of the population's relationship to the soil. This increases the natural sources of power. A more effective organization of space is the difference between civilized people and barbarians (RATZEL 1923: 4–5, 28). In this context it should be pointed out that Ratzel's somewhat chauvinistic sounding emphasis on cultural superiority is actually one of technology and organization (hence dynamic). The less developed states in 1897 lacked structure corresponding not only to the absence of a standing army, bureaucracy, and

[36] Ethnic homogeneity/fractionalization is not available for Yemen, which is one country of the 40 countries of the Caro set. A note of caution: Just as it is difficult to quantify homogeneity/fractionalization, it is difficult to assess the reliability of such figures.

[37] Alesina et alia observed similar phenomena: "While ethnic and linguistic fractionalization are associated with negative outcomes in terms of the quality of government, religious fractionalization is not; in fact, if anything, this measure displays a positive correlation with measures of good governance. This is because measured religious fractionalization tends to be higher in more tolerant and free societies, like the United States, which in fact displays one of the highest level [sic] of religious fractionalization. This result has no bearing, however, on the question of whether specific religious denominations are correlated with better politico-economic outcomes" (ALESINA et alia 2003: 158). Also: "Our ethnic variable is highly negatively correlated with GDP per capita growth, schooling and telephones per capita. These correlations are slightly lower for the linguistic measure. The measure of religious fractionalization does not seem to bear any pattern of correlation with the above mentioned variables" (ALESINA et alia 2003: 165).

taxes, but also a lack of transportation infrastructure (roads, railways, canals) (RATZEL 1923: 6).[38] It is by building the "spiritual" cohesion for a common purpose that the state connects the physically disconnected human bodies and their property (RATZEL 1923: 8, 36, 90). The cultivation of the soil as well as increases in population density create the need for security and protection, which in turn gives the state the power to force this "spiritual" cohesion (RATZEL 1923: 12, 37–38). Ratzel discusses the political value of population through development, so the value of the individual increases through economic performance, which in turn implies that a state with many industrious humans also has a strong army (RATZEL 1923: 305–306). Rudolf Kjellén also emphasizes the importance of organization, so "nature delivers only the framework and raw materials; it depends on the population and the state to fill it up and shape it, in a word, to organize it" (KJELLÉN 1917: 79).[39]

If space and population were relatively simple to discuss, organization is more complicated in terms of content, meaning, and assessment. If one follows Supan's view on the state, then "there can be no doubt that everywhere, where humans live next to each other and socialize with one another, total anarchy is impossible and traces of organization have to be found" (SUPAN 1922: 142).[40] Hence organization can be considered common and constant. In general, one can deduct from the numerous ways and instances that organization is used in the works of Ratzel and Supan that organization refers to what is nowadays called governance, that is, organization refers more often than not to political organization, the term "political" implying the state.[41] Yet organization can also relate to economic activity, so governance and economics go hand in hand in promoting development. This source of confusion becomes obvious when one considers that Supan trisected power into three basic measures, that is, space, population, and organization, then similarly trisected the analysis in political geography to be concerned with the physical structure, demographic structure, and economic structure (SUPAN 1922: 84, 87). The first two categorizations in these two sets are identical, whereas the third categorization in these sets is different.

The following table shows the six Worldwide Governance Indicators (WGI) from the World Bank and the Pearson correlation coefficients (r) for them in relation to the power perception scores from 1998:[42]

[38] Ratzel also uses organization as a major variable in his interpretation of colonial history. Accordingly, the Spanish colonization in the Americas was lacking in organization but sufficient in the number of colonists. Vice versa, the French colonization in North America excelled in organization but was insufficient in the number of colonists, whereas the British performed adequately in both organization and the number of colonists (RATZEL 1923: 267–268).
[39] German text: "Die Natur liefert im Grunde nur den Rahmen und den Rohstoff; es liegt dem Volk und dem Staat ob, jenen auszufüllen und diesen zu gestalten, mit einem Wort, sie zu organisieren."
[40] German text: "[…] kann es keinem Zweifel unterliegen, daß überall, wo Menschen nebeneinander wohnen und miteinander verkehren, völlige Anarchie unmöglich ist und sich Spuren einer Organisation finden müssen."
[41] For example Supan discusses three types of "political organization" in the chapter on the demographic (!) structure, which are autocracy, oligarchy, and democracy (SUPAN 1922: 96–97).
[42] I computed the Pearson correlation coefficient for the logarithm of a given variable in relation to power-perception scores for 40 countries derived from a 1998 survey of 214 French defense industry experts (CARO 2000b: 103–104; also section 13.33). The calculations for combined variables were done in such a way as to maximize the correlation to perception scores. All the data used is for the year 1998.

Table 3: Governance Indicators and their Correlation to Power Perception in 1998

Governance Indicators	r	Data Source
Population × Rule of Law	0.835	CIA 1990–2008; World Bank 2010
Population × Control of Corruption	0.827	CIA 1990–2008; World Bank 2010
Population × Government Effectiveness	0.802	CIA 1990–2008; World Bank 2010
Population × Political Stability[43] & Absence of Violence/Terrorism	0.754	CIA 1990–2008; World Bank 2010
Population × Voice and Accountability	0.752	CIA 1990–2008; World Bank 2010
Population × Regulatory Quality	0.722	CIA 1990–2008; World Bank 2010

Source: Author's own calculations.

The correlations show that organization/governance delivers higher correlations than spatial or demographic variables alone. Though again one must be careful not to generalize from these results, this ranked hierarchy of governance indicators invites speculation. It is interesting to observe that political stability only occupies an intermediate position. One may speculate that governments able to cope with unending instability and violence (e.g. Israel) are relatively stronger than governments that cannot. This in turn should suggest that government effectiveness is the most important, but it also occupies an intermediate position. Instead, rule of law and control of corruption are most important. These two variables are also more closely related to each other than to the rest. If these results can be sustained by more extensive testing, it could suggest that trust in the social order is an important glue for making a strong society and, by extension, a strong country. Bertrand Russell wrote that "economic power, unlike military power, is not primary but derivative. Within one State, it depends on law" (RUSSELL 1938: 123). In other words, property is a meaningless concept if there is no system of rules and force to protect it. Property needs laws and a government to enforce them. The integrity of government and the execution of laws might be the very foundation of socio-economic development and, by extension, national power.

3.7 National Power as Organized Energy

Ratzel frequently uses the term "energy" in reference to the activeness of states, for example in reference to climate zones he stated that "political energy, spiritual force, and economic activity bestow upon the states of the colder nations a decisive preponderance over the warmer" (RATZEL 1923: 197).[44] This also entails some elements of power he considers as important for domination, though he makes no systematic effort to define national power, the elements of national power changing with every paragraph. In another context he describes war in line with spatial expansion as a collision of energies (RATZEL 1923: 451). Supan uses the term "energy" but to describe the power of the state rather than its activeness (SUPAN 1922: 12, 37, 60–61, 78, 80). He tries to build a system and provides this definition:

[43] Peter Beckman uses political stability as a component of his power formulas for assessing the power of countries. For him political stability represents the ability of the government to mobilize its population. He argues that political instability means that governments need to devote more resources and attention to domestic control (BECKMAN 1984: 54; also section 13.27).
[44] German text: "Den Staaten der kalten Länder verleiht die politische Energie, die geistige Kraft, die wirtschaftliche Aktivität ein entscheidendes Übergewicht über die warmen."

> Power, or more generally force, and the will to use it, we can summarize in the concept of energy. The state-based society represents a sum of individual energies that differ in value. But this is not a simple summation. How else to explain that the Chinese, despite their intelligence and their generally recognized industriousness, throw only a small amount of energy into the equation? Apparently because the energy units are not uniformly oriented and as a result of this thwart and hamper each other, in a word, because the organization is missing. Thus we come to the conclusion that the power position of a state depends on its organized energy, which is represented by population. The space plays only a role insofar as it offers opportunities for the energy to be active. (SUPAN 1922: 60–61)[45]

He states that organized energy is represented by population, though in the context of operationalizing the pressure quotient (next section), he states that "a different result would be obtained, if the calculation were based on the energy sums of both sides, but for that we lack all capability for quantification" (SUPAN 1922: 78).[46]

Likewise it is important to look at how Supan explains power. There are many individuals with differing degrees of power, and in a state of anarchy these individuals use their power against one another, or they slow each other down by moving in mutually exclusive directions. For example, one person floods a piece of territory for irrigation, while another person is mining, the lack of coordination benefiting neither individual.[47] It is like the difference between speed and velocity, so the atoms in a body may have a lot of speed, but if they do not share the same direction, the body does not move. It is only through a common direction that the body has velocity. Or, to return to Marian Mazur, it is the structure of the machine that allows the machine to function properly. If the machine exists in terms of matter, and if there is energy to make it work, it will still not work if the design is flawed (MAZUR 1961: 214). It is the state in Supan's conception that structures and organizes society in order to encourage individuals to cooperate most efficiently in such a way that their actions inadvertently maximize the sum total. Supan is not a Marxist advocating micromanagement along with total control, rather he focuses on the macro-management of society in the form of setting some priorities and setting up institutions to enforce laws and policies.

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[45] German text: "Macht, oder allgemeiner gesprochen Kraft, und Wille, sie zu gebrauchen, können wir in dem Begriff Energie zusammenfassen. Die staatliche Gesellschaft stellt eine Summe von verschiedenwertigen Einzelenergien dar. Es findet aber hier nicht eine einfache Summierung statt. Wie wäre es sonst zu erklären, daß die Chinesen trotz ihres allgemein anerkannten Fleißes und trotz ihrer Zahl nur eine kleine Energiesumme in die Waagschale werfen können? Offenbar deshalb, weil die Energieeinheiten nicht einheitlich orientiert sind und infolgedessen sich durchkreuzen und vielfach gegenseitig hemmen, mit einem Worte, weil die Organisation fehlt. So kommen wir zu dem Schlusse, daß die Machtstellung eines Staates von seiner organisierten Gesamtenergie, die durch Bevölkerung repräsentiert wird, abhängt. Der Raum spielt dabei nur insofern eine Rolle, als er der Energie Möglichkeiten zu ihrer Betätigung anbietet" (SUPAN 1922: 60–61).

[46] German text: "Ein anderes Resultat würde sich dagegen ergeben, wenn wir die Berechnung auf die beiderseitigen Energiesummen basieren könnten, aber für diese fehlt uns jede Möglichkeit eines zahlenmäßigen Ausdruckes."

[47] Ratzel thinks that in nations, which are split into many states (as in the case of Germany before 1871), the forces of these states will act against another instead of providing impulses for the growth of the whole. The term "reorganization" ["Reorganisation"] stands then for the summation of these split forces (RATZEL 1923: 151). Ratzel links in general the ability to build larger states to the level of technology and organization. For that reason primitive populations build only small states. In return one can infer from the size of a large country something about its cultural level (RATZEL 1923: 147–149, 152–154).

In his discussion of power (SUPAN 1922: 58–61), Supan mentions the will as the root of power,[48] the most immediate tool of this will being the weapon. In antiquity and the Middle Ages this weapon was primarily human in the form of military personnel and correspondingly a function of population. With the invention of gun powder and the ever increasing mechanization of warfare, military force came increasingly to depend on financial means, which means military expenditures as a function of national wealth.[49] Besides that, Supan supports limited autarchy as much as necessary in order to preserve the heterogeneity of the economic structure, which he finds as important as the homogeneity of the demographic structure. Both Ratzel and Supan are followers of Friedrich List (RATZEL 1923: 263; SUPAN 1922: 183; also section 7.1). If the beauty of Supan's trisection of power into space, population, and organization is its relative clarity and persuasive simplicity, then this discussion of the will, military personnel, and military expenditures in line with national wealth complicates things, that is, the proper place and function of these variables appear somewhat ill-defined in his efforts at systematization.

The following table shows six variables to measure national power and the Pearson correlation coefficients (r) for them in relation to the power perception scores from 1998:[50]

Table 4: Power Indicators and their Correlation to Power Perception in 1998

Variables	r	Data Source
Military Expenditures (current $)	0.927	AVC 2009
Total Electricity Net Consumption (kWh)	0.906	EIA 2010
GDP (current $)	0.900	AVC 2009
Total Primary Energy Consumption (Btu)	0.897	EIA 2010
GDP (PPP)	0.870	CIA 1990–2008
Armed Forces Personnel	0.656	AVC 2009

Source: Author's own calculations.

All measures with the exception of military personnel perform reasonably well. It is interesting to observe that electricity outperforms both GDP measures, though the energy variables and nominal GDP are very close.

[48] Rudolf Kjellén sees the state as will and power, the will standing for aims, and power standing for the capability to achieve them. He emphasizes space as a necessary condition for the state's existence (KJELLÉN 1917: 8, 47). He places politics into five categories in relation to five elements of the state: geopolitics concerned with space, demopolitics concerned with population, econopolitics concerned with economics, sociopolitics concerned with society, and kratopolitics concerned with governance (KJELLÉN 1917: 43).

[49] Another indication that Supan considered economic data important for the assessment of power is that he complained about the unfortunate absence of comprehensive economic data as well as the unreliability of existing estimates (SUPAN 1922: 59, 148–149). In this regard it should be remembered that the *Fischer Almanach* (one of the most popular almanacs in Germany) has published the GNP of (some) countries only since 1973. Similarly, the American *Information Please Almanac* has published the GNP of (some) countries only since 1979.

[50] The measures must have some relationship to Supan's thinking. If Supan thought of power as *energy* (regardless of the degree that this may have been intended as a metaphor), it constitutes an invitation to have at least a look at actual energy consumption as well as electricity consumption. I computed the Pearson correlation coefficient for the logarithm of a given variable in relation to power-perception scores for 40 countries derived from a 1998 survey of 214 French defense industry experts (CARO 2000b: 103–104; also section 13.33). All the data used is for the year 1998.

3.8 The Pressure Quotient

Supan considers the political borders between two countries as just a temporary expression of momentary power relations. In line with that he assumes there will always be war,[51] and that peace can last only as long as the political pressure and the counterpressure (power) of countries balance/cancel another. Power is relative and depends on location in the concrete form of direct neighbors (SUPAN 1922: 25, 29, 77, 79, 188–189). If the relative power of one side dramatically increases, the border may move correspondingly after some delay (that is, after a war). As most borders are the results of war, they normally benefit the victor (SUPAN 1922: 31, 41). The 'unfairness' of borders is inherent, in the same way that the reversion of borders has been normal. Ratzel stresses that location is as important as space, therefore the assessment of location corrects for over- and underestimations of space (RATZEL 1923: 187–188, 301).[52] At another point he talks of *radii of force* emanating from a state that disperse like waves, which suggests that power decreases with distance (RATZEL 1923: 91). He stresses that the strength of a country depends also on the weakness of its neighbors (RATZEL 1923: 231). Supan asserts that both foreign and domestic policy depend on location (SUPAN 1922: 80). He concedes that the sea does not necessarily offer protection.[53] Still he considers the pressure coming from a common border area much more permanent. The pressure quotient he developed takes account only of land borders (SUPAN 1922: 76–78).[54] There are two possible versions of the pressure quotient:

$$\text{pressure\_quotient\_v1} = \text{pop}_{ext} \,/\, \text{pop}_{int}$$

pop_{ext} = the population of countries that one shares a land border with;

pop_{int} = the population one has

$$\text{pressure\_quotient\_v2} = \text{afp}_{ext} \,/\, \text{afp}_{int}$$

afp_{ext} = the military personnel of countries that one shares a land border with;

afp_{int} = the military personnel one has

As already stated in the previous section, Supan would have preferred to use the energy sums of countries rather than population or military personnel, but he did not see any way to quantify these.

[51] Supan also describes a sense of opposition to other nations as the downside of this sense of togetherness (community spirit) that builds a state (SUPAN 1922: 98). In this context it may be useful to recall Carl Schmitt's theory on the political. For him, the essence of the political is the friend/foe distinction. The political field is one where forces and powers constantly unite as friends and divide as enemies, the foreigner always being a potential enemy, with nations that are weak in will and force perishing in the political sphere (SCHMITT 1932: 9, 26–27, 46, 53–54). It is precisely this foe/friend distinction that makes the concept of national power meaningful, because, in a world full of friends, differences could still exist in wealth and spirit (intelligence, morale, and so on), yet the notion of national power would be meaningless, just as it would be if a world government existed. As for Supan's *political* leanings, he supported a German-Russian alliance in opposition to the United Kingdom, the Latin countries (France, Italy), and Japan (SUPAN 1922: 195).

[52] Ratzel contrasts Russia and Great Britain in this regard. Whereas Russia had the most uniform space as one huge chunk of land, Great Britain had the advantage of many dispersed, but strategically important, locations that enabled it in Ratzel's opinion to be the only true world power at the time (RATZEL 1923: 252, 270).

[53] With regard to the sea, Supan designed a maritimity quotient (maritime borders / land borders) (SUPAN 1922: 70–72; further HÖHN 2008b, or 2009).

[54] Supan may have taken part of his inspiration for his pressure quotient from Rudolf Kjellén, who states that if a state loses power, the borders of such state will have to resist the increased pressure from the other members of the system (KJELLÉN 1917: 78).

The pressure quotient has become a bit dated with the advancement of air power and missile technology. The following table shows the calculation of the pressure quotient for one geopolitical hotspot where it still matters, that is, Israel:

Table 5: Pressure Quotient of the State of Israel in 2005

Country	Military Expenditures US $	Armed Forces Personnel	Nominal GDP US $	Population
Egypt	2,630,000,000	440,000	93,200,000,000	77,600,000
Jordan	986,000,000	100,000	12,600,000,000	5,800,000
Lebanon	970,000,000	57,000	21,600,000,000	3,800,000
Syria[55]	*1,188,640,000*	325,000	*25,840,000,000*	18,400,000
Exterior	5,774,640,000	922,000	153,240,000,000	105,600,000
Israel	10,800,000,000	180,000	131,000,000,000	6,700,000
Exterior / Israel	0.535	5.122	1.170	15.761

Source: AVC 2009; CIA 1990–2008; author's own calculations.

The table demonstrates that population is a poor indicator of national power, because if we consider the pressure quotient resulting from it, Israel should have been smashed a long time ago. Military personnel improves the value of this measure. Still nominal GDP and, more importantly, military expenditures are better in explaining the threat that Israel poses to its neighbors rather than considering only the threat that they pose to Israel. In any case, regarding the international situation, an integrated distance model (gravity model) may be more appropriate. John Stewart suggested a more basic measure (power / distance) (STEWART 1945: 160–167, 1954; also section 13.3).

[55] GDP data for Syria seems to have been exaggerated in the *WMEAT* data. For that reason the GDP value from the *CIA Factbook* for 2005 is taken. The military expenditures of Syria were recalculated correspondingly.

4. Marxist Criticism of German Geopolitics: Karl August Wittfogel

Karl August Wittfogel (1896–1988) was a German sociologist and expert on China. In 1930 he did his PhD on *China's Economy and Society* [*Wirtschaft und Gesellschaft Chinas*] at the University of Frankfurt, where he was also involved with the Institute for Social Research, a Marxist think tank that was the institutional home of the Frankfurt School and Critical Theory. In 1918 he became politically involved as a Marxist, which he remained until after WWII, when in turn he became extremely anticommunist. During the 1920s he displayed a great interest in the works of Karl Haushofer, whose work he appreciated despite ideological differences. Haushofer was a national conservative in his political sentiments. Nevertheless, he reciprocated Wittfogel's appreciation. Haushofer especially appreciated that Wittfogel looked at both sides of an issue, so he looked at an issue based on his Marxist point of view, but he also considered the point of view of the bourgeoisie (WITTFOGEL 1929: 39). When Wittfogel tried to flee Germany in 1933, he was caught and put in a concentration camp. Thanks to the help of Haushofer and two other people, Wittfogel could emigrate to England in 1934, from where he went to the United States, the citizenship of which he adopted in 1941.

In 1929 Wittfogel published a lengthy article on "Geopolitics, Geographic Materialism and Marxism" ["Geopolitik, Geographischer Materialismus und Marxismus"] (WITTFOGEL 1929), parts of which were reprinted in the *Journal of Geopolitics* [*Zeitschrift für Geopolitik*] in 1932 (WITTFOGEL 1932). As a Marxist, Wittfogel commends the geographical materialism found in geopolitics, but then he severely criticizes that the economic factor is either ignored or used in an incoherent manner. For instance, Ratzel states that the acquisition of soil is the aim of political development, but he fails to explain this process through a proper chain of causation. As a result the expansionary drive looks like some vitalistic-mystical principle, depriving it of any economic explanations (WITTFOGEL 1929: 29). Kjellén analyzes four aspects of each great power in his 1914 book *The Great Powers of the Present* [*Die Grossmächte der Gegenwart*], that is, territory, population, society, and state, but he ignores altogether the economic sphere (WITTFOGEL 1929: 33). Wittfogel gives Haushofer some credit for paying considerable attention to economic aspects, though not so much to social aspects. Still he criticizes that this consideration of economic aspects is arbitrary, lacking in a methodology based on some type of systematic understanding (WITTFOGEL 1929: 38). He sees the critical flaw of geopolitics in omitting the intermediate, the geopolitical paradigm of causation being this:

geographical factors ⇨ political sphere

In contrast to that the Marxist paradigm has at least two intermediate variables:

geographical factors ⇨ production process ⇨ social order ⇨ political sphere

This omission of the intermediate results in a geographic materialism that is often condemned to bridge this gap by arbitrary eclecticism (WITTFOGEL 1929: 22–27). As a result geopolitics represents an inadequate synthesis, at most being able to collect some useful materials, which Marxism-Leninism must then break again into pieces in order to reassemble them in a methodologically valid way (WITTFOGEL 1929: 42–43).

Wittfogel also presents the Marxist conception of nature and relation to humans. According to Marx, it is the capacity for purposeful action that makes humans special. It allows them the use and creation of tools to extend their power. In return these tools cause new needs, but as long as the increase of power surpasses this increase in needs, this is a development towards human freedom. This establishes the dialectics of human and labor on the one side, and nature and materials on the other side. Nature provides working people with a location, space for production, food storage, and tools, whereas progress is achieved through the accumulation of experience and knowledge as well as higher levels of organization. Still humans remain always a part of nature. Whenever humans change nature, they also change their own nature, which represents a cybernetic feedback loop. Nor does human labor abolish the natural character of materials. It merely changes them with respect to utility (WITTFOGEL 1929: 505–508, 511, 714, 734).

Wittfogel warns frequently against an overvaluation of technology (WITTFOGEL 1929: 516, 704).[56] This is relevant even nowadays as technophile visions often present themselves as the latest trend. People a hundred years ago were not less intrigued by technology. The technophile paradigm of causation is this (WITTFOGEL 1929: 514, 720):

technology ⇨ development

In contrast to that, the Marxist paradigm that Wittfogel wants to uphold (WITTFOGEL 1929: 516) is:

amount_of_work × technological_level × richness_of_resources = productivity

Further, Marx subdivided the modern capitalist production process into four areas: (1) agriculture providing organic resources, (2) extractive industries providing nonorganic resources, (3) the "actual" industry, and (4) the transport industry that connects the different areas (WITTFOGEL 1929: 699). Wittfogel does not mention that Ratzel had likewise placed much emphasis on the transportation infrastructure (section 3.4).

[56] Karl Kautsky was one of the people criticized by Wittfogel is this regard. Daniel Deudney states that "Karl Kautsky, a leading theorist of the Second International, attempted a synthesis of Darwinism and Marxism" (DEUDNEY 2000: 100), further regarding Kautsky and associates that "their central move was to incorporate changing technology into their conceptualization of the physical environment, thus enabling them to locate the drive of change in human arrangements in the nature exogenous to human control that was changing via technological development" (DEUDNEY 2000: 83).

5. American Geopolitics: Nicholas John Spykman

Nicholas John Spykman (1893–1943) is one of the major figures of American geopolitics, moreover he is considered one of the founders of the realist school in international relations. Originally born in the Netherlands, he adopted US citizenship in 1928. He did most of his postsecondary education at the University of California at Berkeley, and from 1928 to 1940 he was professor of international relations at Yale University. In 1942 he published *America's Strategy in World Politics: The United States and the Balance of Power* (SPYKMAN 1942). The bibliography shows that he understood German and French. In 1944 *The Geography of Peace* was published posthumously (SPYKMAN 1944). Together with George Kennan he was a major early proponent of the strategy of containment. Next to American naval theorist Alfred Thayer Mahan (1840–1914) and the British geographer Halford Mackinder (1861–1947), he was influenced by Karl Haushofer and German geopolitics, though in the context of WWII he proclaimed a critical attitude towards it (SPYKMAN 1944: 5–7).

Spykman asserts that due to the absence of a central authority for international society, the priority of countries must be to preserve and improve their power positions, for which countries must be willing to fight offensively. He considers struggle to be a basic aspect of life, defining power as survival as well as the ability to impose one's will on others.[57] The survival aspect is further defined as control over territory and political independence. He emphasizes that power is not only useful for coercion, defined as crushing the enemies' will to resist, but that the mere fact (not threat) that one is able to coerce often suffices in facilitating negotiations. All the same he asserts that power is in the last instance the ability to wage war, correspondingly the struggle for power is in the last instance a preparation for war (SPYKMAN 1942: 7, 12, 17–19, 25–26, 29). He is unambiguously Machiavellian in stating that "the search for power is not made for the achievement of moral values; moral values are used to facilitate the attainment of power" (SPYKMAN 1942: 18).[58]

The objective of geopolitics is to analyze security problems in terms of geographic factors and to make policy recommendations based on this analysis. Geopolitics is a technique to reckon with geographic position and physical power. In other words, geopolitical analysis is focused on power politics in a geographical context. Changes in technology can rapidly alter the situation and thus the power position of countries. Though geographical facts usually do not change, the meaning of these geographical facts for foreign policy do change. In the 18th century a strategist simply needed to know the strength of military forces as well as the terrain of the probable battlefield. In the 20th century technological changes brought about the concept of *total war*.[59] A strategist has to look at economic and psychological warfare as well,[60] because it is no longer only armies on the battlefield but whole

[57] The first chapter on "Power Politics and War" starts with a quote from Thucydides: "We both alike know that into the discussion of human affairs the question of justice only enters where the pressure of necessity is equal, and that the powerful exact what they can, and the weak grant them what they must" (Thucydides, quoted in SPYKMAN 1942: 11).
[58] He further explains that morality can be a weakness: "The nation which suffers from a feeling of guilt about its use of force in the past is at a great disadvantage compared to the nation which not only accepts the reality of force but affirms its creative value with no sense of shame or sin" (SPYKMAN 1942: 38). This statement is applicable to modern-day Germany and Japan.
[59] Spykman makes this clarification as for the origin of the concept: "Contrary to popular opinion, total war was not an invention of the Germans but the result of a long process of historical development. Its most successful exponents in the First World War were the Allies who used with telling effect all the weapons that modern civilization makes available" (SPYKMAN 1942: 38).
[60] In his 1942 work Spykman listed four dimensions of warfare: military, political, economic, and ideological; psychological warfare was put under ideological warfare, political warfare referring to the game of winning and keeping allies, as well as

nations. The concept of total war has effaced any distinctions between war time and peace time. Total war is in effect permanent war, which means that even in the absence of military warfare, economic and psychological warfare still proceed (SPYKMAN 1942: 8, 38–40, 1944: 5–7).[61]

Spykman thinks of power as relative power, so the power position of a particular state depends on its own power in relation to the power of potential enemies (SPYKMAN 1942: 19, 1944: 5). Likewise the geographic location of a particular state in relation to the geographic locations of its potential enemies matters as well. The power of states depends on eleven factors. I have divided these eleven factors into five categories, with special regard to the three types of warfare (military, economic, and psychological):

Table 6: Factors of Power and their Categories [Spykman]

Geographic	Demographic	Military	Economic	Psychological
Size of Territory	Size of Population	Military Force	Economic & Technological Development	Effective Social Integration
Nature of Frontiers	Ethnic Homogeneity		Financial Strength	Political Stability
Absence / Presence of Raw Materials				National Spirit

Source: SPYKMAN 1942: 19; author's own categorizations.

In his 1944 work he also considers agriculture and energy as two important factors of power. He puts emphasis on agriculture, with temperature and rainfall as secondary factors conditioning agricultural production. Energy is clearly a factor he also puts emphasis on. He specifies coal and iron as important industrial resources. Besides coal he mentions oil and water power as energy-producing factors (SPYKMAN 1944: 28).

As can be seen from the table, Spykman places a heavy emphasis on the psychological dimension, making him a theoretical predecessor of Ray Cline's power formula in 1975 (section 13.20), which is also put together on the basis of the five categories used in the table. If the aim of coercion is to destroy the enemy state's will to resist, then the aim of psychological warfare is to destroy the individual's will to fight, eroding national cohesion, discipline, and collective morale. The countermeasure of states is to cultivate martial spirit and nationalism, to convince public opinion of a national purpose. While he thinks that it is relatively easy to measure mechanical forces,[62] he concedes it is impossible to measure the spirit of the people or political power. That is why overall the judgment of power is purely subjective (SPYKMAN 1942: 27, 29, 36–37, 1944: 29).

destroying the alliances of opponents (SPYKMAN 1942: 26–38). In his 1944 work he appears to have merged ideological warfare and political warfare into psychological warfare. This partitioning of power into these three dimensions is typical for the time after WWI to today (chapter 9).

[61] The Cold War appears to be a perfect example for this.

[62] He lists a number of statistics in a number of appendixes. For countries he lists four basic variables: area, population, government expenditure, and armament expenditure. He also includes some statistics on exports, imports, origins of critical and strategic raw materials, and military equipments (SPYKMAN 1942: 484–493).

As for the measurability of mechanical forces, this statement can be found:

> The dependence of a particular state on the world economy is a rough indication of its vulnerability to economic attacks. […] The defense against such attacks must inevitably be directed at the creation of a maximum self-sufficiency within national boundaries or within the region of immediate military control […]. (SPYKMAN 1942: 35–36)

In operational terms this suggests the trade-to-GDP ratio as a measure of vulnerability:

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trade-to-GDP_ratio = ( imports + exports ) / GDP
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His endorsement of relative autarchy (protectionism) is well within the tradition of geopolitics and geoeconomics (section 7.1).

In the end, according to Spykman, "the only objective test of relative strength is to fight the war and see who wins, but that is hardly a helpful guide to the state that wants to decide whether to fight or not" (SPYKMAN 1942: 22). Likewise Karl Haushofer had stated before him that "the most severe test of people's performance is and will remain war" (HAUSHOFER 1913: 8).[63] In addition to that, Spykman points out yet another hurdle regarding the measurement of national power:

> The second difficulty lies in the fact that the elements contributing to strength are not static but dynamic; they do not stay put. A new economic development, a new raw material, a new weapon, a new martial spirit may produce the most profound inequality between states that only a few years before had been approximately equal. (SPYKMAN 1942: 22)

It is a real problem for measuring national power that elements of national power do change in importance over time. This problem is most severe when these changes are sudden (compare DEUDNEY 2000: 89–91). His 1942 work was published only three years before nuclear weapons would enter the stage and thrust the United States into a position of temporary invincibility.

[63] German text: "[…] die schärfste Probe der Volksleistung ist und bleibt eben der Krieg."

6. American Geopolitics: Daniel Deudney

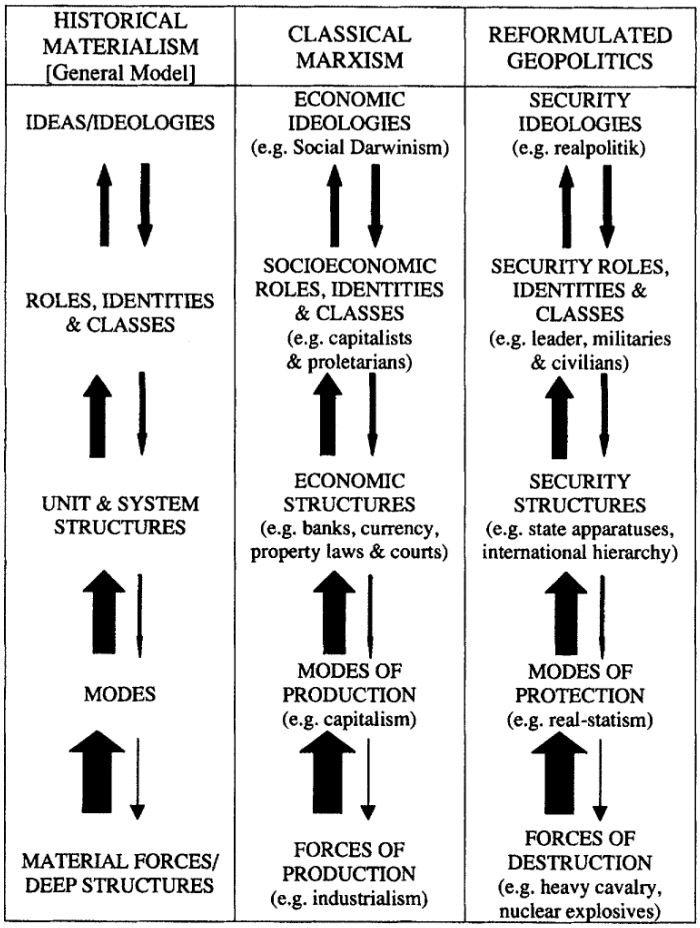
Daniel H. Deudney has been associate professor of political science at John Hopkins University since 1998. His main interests are international relations and political theory, with an emphasis on geopolitics and environmental issues. In 1989 he had obtained his PhD from Princeton University. The title of his dissertation was *Global geopolitics: a reconstruction, interpretation, and evaluation of materialist world order theories of the late nineteenth and early twentieth centuries*. He considers himself neither a realist nor a liberal, as he combines theories and approaches from realism and liberalism, which he considers to be fragments of "republican thought". According to Deudney, "republican thought" focuses on negotiating the space between anarchy and hierarchy. In 2000 he published the article "Geopolitics as Theory: Historical Security Materialism" (DEUDNEY 2000), which represents his attempt to reformulate geopolitics by injecting Marx's conceptual apparatus into it. He basically implements what Karl August Wittfogel in his criticism of German geopolitics had suggested needed to be done (chapter 4). Deudney's bibliography includes Wittfogel's 1929 article, that is, the reference refers to a translated version of it.

If Wittfogel warned of exaggerating the importance of technology as to disregard other important factors, then Deudney does not heed this warning. He is in the line of Spykman and many others in appreciating how technology dramatically alters situations and the meaning of geographic facts. Humans are vulnerable beings interacting with a material environment consisting of geography and technology.[64] This material environment shapes security politics. Consequently any realistic theory in international relations relating to security studies must incorporate material factors. He criticizes international relations theories for lacking a conceptual apparatus for the security-political implications of major changes in the material context, such as oceanic navigation, industrialism, nuclear weapons, and so on. As no conceptual framework exists, the treatments of such developments remain a series of ad hoc insights (DEUDNEY 2000: 78–79).

Deudney considers Marxism and geopolitics to be two branches or varieties of historicist materialism emerging in the 19th century. Geopolitics stands for a historical security materialism[65] focused on destructive capabilities and security implications, but conceptually it is unsophisticated. Marxism stands for a historical production materialism, and conceptually it is highly sophisticated. Still Marxism is one step removed from security politics because of its almost exclusive focus on productive forces and relations. Still nowadays Marxist scholars of international relations persist in their focus on capitalism. Deudney proposes to take Marx's highly sophisticated conceptual apparatus and inject it into geopolitics with its focus on the forces of destruction based on the material context of geography and technology. For him geopolitics is as much about technology as it is about geography (DEUDNEY 2000: 78, 80, 87–89).[66] He illustrates his proposal in the following diagram:

[64] Max Krahmann had already defined geopolitical space to be consisting of territory as the horizontal variable and technology as the vertical variable (KRAHMANN 1927, available in Appendix A; also section 3.4).
[65] To consider geopolitics as materialist is one way of looking at it. In contrast, Otto Forst de Battaglia criticized geopolitics for its romanticism (BATTAGLIA 1932).
[66] He quotes Albert Wohlstetter in this regard: "In discussing geography, geopoliticians at best have been talking about the technologies of communications, or transport, or weapons" (Wohlstetter, quoted in DEUDNEY 2000: 89).

Figure 2: Marxism and Geopolitics [Deudney]



Source: DEUDNEY 2000: 89.

If for Marx the forces of production are the driving force in production materialism, then for Deudney the forces of destruction are the driving force in security materialism. These forces of destruction are based on the material context. Communication and transportation affect the velocity of violence, considering geography, whereas destructive technologies affect the volume of violence. Technological opportunities and constraints determine the limits of viability of changing modes of production, which he defines as clusters of interrelated productive practices. In simpler words, these modes can be regarded as sets of organizational principles that are likely to arise at certain levels of technological development. According to Marx, then the forces and modes of production are the infrastructure, contrasted to a superstructure of political, social, and cultural relations.[67] Likewise, security practices and political structures are conditioned by the opportunities and constraints of the material environment (DEUDNEY 2000: 85, 88–89).

[67] Different from Deudney, Marx's paradigm of structuration could also be schematized this way:

technology ⇆ economy ⇆ society ⇆ politics

7. Different Forms of Geoeconomics

The term "geoeconomics" is used rarely in comparison to the term "geopolitics".[68] Nevertheless the less common usage of "geoeconomics" does not imply a less common usage of the ideas associated with it. Basically three sets of economic preferences can be referred to as geoeconomics. The first one is traditional economic nationalism associated with mercantilism and protectionism, which may include some less radical visions of autarchy especially promoted by traditional geopoliticians. The second one is traditional geoeconomics with its primary focus on natural resources. The so-called geopolitics of oil also falls in this category. The third one consists of more recent geoeconomics with its focus on achieving and maintaining techno-industrial supremacy. Edward Luttwak popularized the term "geoeconomics" along this line of thought beginning in 1990.[69] These three versions of geoeconomics can be found in various combinations: they are not mutually exclusive.

7.1 Protecting Industries and Economic Diversity

Alexander Hamilton (1755–1804) and Friedrich List (1789–1846) can be considered two major theorists of economic nationalism in the sense of favoring protectionism. According to Robert Gilpin, economic nationalism "is essentially a doctrine of state-building and asserts that the market should be subordinate to the pursuit of state interests" (GILPIN 1987: 26). Whereas free trade liberalism (globalization) places the market above the state, "all nationalists ascribe to the primacy of the state, of national security, and of military power in the organization and functioning of the international system" (GILPIN 1987: 31). Economic nationalists consider wealth and power to be complementary. Consequently states should seek both at the same time.[70] In reality this simultaneous pursuit of two goals may conflict at least in the short run. Given that industry and manufacturing are the most direct economic basis of military power, economic nationalists focus primarily on industrial development, with a certain tendency towards equating power with industrial capacity. As a consequence they tend to favor protective tariffs to protect and encourage further industrial development. Different from liberalism, this means that economic nationalism may redistribute income from consumers to producers. As a result economic nationalism can be abused and manipulated by industrial lobby groups (GILPIN 1987: 32–33, 47–48, 181, 185).

The traditional geopolitical notion of *relative autarchy* refers to the implementation of protective tariffs for the underdeveloped sectors of the economy, what is nowadays called "infant industries" but not limited to that. Relative autarchy implies a limitation of trade to such extent that the national economic production of a given country remains diversified and does not specialize on a few products

[68] A search with Google Scholar (http://scholar.google.com/ [13 May 2011]) yielded 60,900 entries for "geopolitics" and 2,930 entries for "geoeconomics".
[69] In 1927 Max Krahmann had already promoted geopolitics to be aimed at techno-industrial supremacy (KRAHMANN 1927). Both original and translation of the article are available in Appendix A.
[70] "The object of the economy of this body is not only wealth as in individual and cosmopolitical economy, but power and wealth, because national wealth is increased by national power, as national power is increased and secured by national wealth" (List, quoted in EARLE 1986: 247).

alone. Geopoliticians referred to an excessive degree of specialization as monoculture.[71] The underlying strategic idea is that diversity in national economic production will enable the economy of a particular country to continue functioning even if there is some disruption of trade. This way dependency on foreign countries is minimized. Foreign countries are also reduced in their ability to blackmail a particular country by withholding exports or disrupting trade routes (see RATZEL 1923: 7, 263; SUPAN 1922: 183; KJELLÉN 1917: 162, 169, 180; MACKINDER 1919: 175–178; SPYKMAN 1942: 35–36; also EARLE 1986: 234–235, 241).

Hamilton and List had a bias towards industry over agriculture, because at their times the economies of the United States and Germany featured a preponderance of the agricultural sector relative to an underdeveloped industrial sector. In the 1920s industries were sufficiently developed in many Western countries, whereas especially the food supply had proven inadequate in Germany during WWI. As a result, geopoliticians of the time valued agricultural production as much as industrial production. This preference for necessities brings along yet another approach that focuses on strategic key sectors ignoring less important sectors. Ideally a state wants to be strong in such areas most useful in a possible case of war or crisis (compare 13.46). Mike Huckabee, who was running as a candidate in the United States' presidential primaries in 2008, repeatedly focused on three strategic key sectors in various speeches and debates. Here is one example from such a debate in 2007:

> Q: Does our country's financial situation creates [sic] a security risk?
>
> A: It's most certainly a national security threat because a country can only be free if it can do three things.
>
> 1. It has to be able to feed itself. It has to be able to put food on the table for its own citizens.
> 2. It's got to be able to fuel itself. If it looks to somebody else for its energy needs, it's only as free as those are willing for it to be.
> 3. And it also has to be able to fight for itself. It's got to be able to manufacture its own weapons of defense--tanks, airplanes, bullets and bombs.
>
> When we start outsourcing everything and we are in that kind of a trade deficit, then just remember, who feeds us, who fuels us and who helps us to fight, that's to whom we are enslaved. So if we can't do those three things, our national security is very much at risk.
>
> (Huckabee, quoted in *Des Moines Register* 2007)

Especially with regard to arms production countries like France and the United Kingdom are keen on maintaining their positions (CARO 2002).[72] Arms imports are a sensitive issue, even compared to food

[71] "Specialization makes the welfare of the society vulnerable to the market and to political forces beyond national control. In the past this situation was applicable only to the producers of raw materials, but now it applies increasingly to industrial producers as well" (GILPIN 1987: 189).

[72] Large countries with large armies (great powers) are in the best position to engage in advanced weapons manufacturing due to economies of scale as well as the high costs related to R&D.

and energy, because it is much more difficult for a particular country to switch to another supplier in the case of an embargo. Food from one place can be replaced with food from another place, the same for oil. In the gas sector things are less flexible because of dependence on pipelines. The need for spare parts for a particular sort of aircraft makes countries highly dependent on particular suppliers, because it is not possible to simply get the same spare parts from another supplier.[73]

7.2 The Quest for Natural Resources

This type of geoeconomics is primarily focused on the acquisition and control of natural resources, which can be direct or indirect, by colonialism or neocolonialism. The 19th century colonialism had a strong geoeconomic component, for the great powers had the ambition to build for themselves greater economic areas to secure in this way their wealth as well as their political and strategic power. Also the North-South Conflict since WWII between developed and developing countries can be interpreted as a geoeconomic conflict. Geoeconomic reasons have played often a decisive role in various geopolitical strategies (KORKISCH 1987: 19–20). A great deal of emphasis was placed on natural resources especially during the interwar period between WWI and WWII. Brooks Emeny conducted an influential study on the self-sufficiency of the great powers in terms of raw materials:[74]

> The size and effectiveness, too, of national power is no longer determined by the extent of a nation's territory and population, the wealth of its treasuries, or even the strength of its armed forces, but *rather by its capacity for industrialization*. For inasmuch as large-scale industrialization depends upon the possession or ready availability of vast quantities of the basic raw materials, nature, through her unequal distribution of these, has rigidly set a limit to the number of states capable of achieving great power status. (EMENY 1934: 1; or SIMONDS & EMENY 1939: 32)

K. J. Holsti used the data found in the 1939 work of Simonds and Emeny to emphasize his point on the discrepancy between capabilities and actual influence.[75] Whatever the case may be, the unequal distribution of natural resources is the main raison d'être for resources oriented geoeconomics. It is clear that the availability of natural resources is of importance in the case of war (SIMONDS & EMENY 1939: 73; also section 13.2).

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[73] Venezuela's change of political allegiance from being pro-US to anti-US has caused it problems in obtaining spare parts for maintaining its air force. It will take time before all Venezuelan weapons systems are replaced by acquisitions from Russia. For a general treatment about how weak states are vulnerable and dependent on external suppliers when it comes to major modern weapons systems, see HANDEL 1990: 83–89. To differentiate between great powers and weak states, Handel developed this theoretical power formula (HANDEL 1990: 68–69):

```
total_power_of_a_state = internal_power_(mobilized_&_potential) + external_power
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Four elements go into the internal/domestic strength of the state: (1) geographic conditions, (2) material conditions, (3) human resources, and (4) organizational capabilities. External sources are more diffuse, consisting of: (a) informal ties, (b) formal alliances, and (c) international institutions.

[74] Brooks Emeny gathered the basic material for his 1934 work when doing his PhD at Yale University, where Nicholas Spykman (chapter 5) was also professor. Emeny lists Spykman in his acknowledgements (EMENY 1934: viii).

[75] Holsti compares the great powers during the interwar period for their level of self-sufficiency regarding the most important natural resources ("great essentials"). He concludes that this would result in the following ranking based on capabilities: (1) United States, (2) Germany, (3) Great Britain, (4) France, (5) Russia, (6) Italy, (7) Japan. In turn he suggests a different ranking of actual influence based on the diplomatic history for the time from 1925 to 1930: (1) France (2) Great Britain, (3) Italy, (4) Germany, (5) Russia, (6) Japan, (7) United States (HOLSTI 1972: 160–161). The Spearman rank correlation coefficient of these two rankings is –0.07, meaning no relation whatsoever.

7.3 Techno-Industrial Supremacy

In 1990 Edward Nicolae Luttwak (born in 1940) published the article "From Geopolitics to Geo-Economics: Logic of Conflict, Grammar of Commerce" (LUTTWAK 1990). In the article he argued that the importance of military power is decreasing with the end of the Cold War. As a result states focus on economic priorities, shifting rivalries to the economic realm. From then on the strategies of states are less geopolitical in relying on military weapons and more geoeconomic in relying on so-called commercial weapons: restriction of imports, subsidization of exports, funding of technology projects, support of education, provision of infrastructures, and so on.[76] In 1993 he elaborated on the ideas in his article when he published *The Endangered American Dream: How to Stop the United States from Becoming a Third World Country and How to Win the Geo-Economic Struggle for Industrial Supremacy* (LUTTWAK 1993). The book title reflects the paranoia that the rise of Japan had caused in the United States especially during the 1980s.[77] In a sense Japan's industrial policy was the actualized prototype for Luttwak's geoeconomics (compare section 14.1).

The ultimate purpose of Luttwak's geoeconomics is the maximization of high-grade employment, which is the result of so-called industrial supremacy, which in turn rests on a decisive technological superiority.[78] For this purpose the United States needs more domestic capital for private and public investments. Luttwak calls attention especially to R&D and education (LUTTWAK 1990, 1993: 41, 292, 307). Ashley Tellis' approach to measuring national power is well-known (see TELLIS et alia 2000a, 2000b).[79] Though he failed to operationalize his approach to produce any numbers, his approach features a comparable paradigm to that of Luttwak when he states that

> national power is ultimately a product of the interaction of two components: a country's ability to dominate the cycles of economic innovation at a given point in time and, thereafter, to utilize the fruits of this domination to produce effective military capabilities that, in turn, reinforce existing economic advantages while producing a stable political order […]. (TELLIS et alia2000a: 22, or 2000b: 4)

The key difference to Luttwak is once again a look at military capabilities. As Gilpin had noted, states have been looking for advanced technology throughout modern history (GILPIN 1987: 34). Luttwak popularized the term "geoeconomics" quite a bit. As far as any uniqueness is to be found in his argument, it is this focus on technology exclusively for the sake of economics. If, however, according to Gilpin, one difference between liberals and nationalists is that liberals focus on absolute gains and nationalists on relative gains (GILPIN 1987: 31, 33), then Luttwak can still be considered a nationalist in

[76] In this context it is also worth mentioning strategic trade theory, which was developed in the 1980s. It demonstrates how governments through certain policies, for example export subsidies, may manipulate international trade to their advantage (KRUGMAN 1987; also GILPIN 1987: 215–221). Paul Krugman stated that "a protected domestic market can—under some circumstances!—promote rather than discourage exports, and possibly raise income" (KRUGMAN 1987: 136).

[77] Luttwak did his best to further incite this fear of American decline with graphic examples like this: "American girls serving as bar hostesses and part-time call girls are now so common in Tokyo that their services no longer command a premium (AIDS has put American call boys right out of business). When a country is in economic decline, not only its currency but also its flesh is cheapened" (LUTTWAK 1993: 120–121).

[78] He further clarifies this goal when comparing geopolitics to geoeconomics: "In traditional world politics, the goals are to secure and extend the physical control of territory, and to gain diplomatic influence over foreign governments. The corresponding geo-economic goal is not the highest standard of living for a country's population but rather the conquest or protection of desirable roles in the world economy" (LUTTWAK 1993: 309–310).

[79] The Tellis approach is briefly presented in the footnote #129 in section 11.2 (compare sections 13.37, 15.4).

upholding a competitive paradigm focused on the relative performance of states.[80] Realists are naturally not inclined towards a purely economic view of international relations. However, even Joseph Nye (section 8.4) has criticized geoeconomic approaches:

> It has become fashionable to say that the world after the Cold War has moved beyond the age of power politics to the age of geoeconomics. Such clichés reflect narrow analysis. Politics and economics are connected. International economic systems rest upon international political order. (NYE 1995: 90)

Though the liberal school of international relations favors looking at economic interdependence rather than military capabilities, it is still far from advocating the abandonment of power politics in a military sense altogether.

[80] Luttwak defends his preference for relative gains as the common choice: "Readers might conduct their own experiment, by asking themselves and others whether they would prefer GNP growth rates of, say, 4% for the United States and 10% for Japan, or 2% for both. Professor Bernard Reich of Harvard's Kennedy School of Government, who has been asking such questions of different groups, reports that only economists prefer higher US growth rates regardless of the Japanese rate of growth" (LUTTWAK 1993: 332). He does not have Japanese readers in mind.

8. Power in International Relations Theories

Geopolitics has had a marked impact on international relations, especially on the realist school, in part because of the work of Nicholas Spykman and Hans Morgenthau. Many standard introductory works on international relations appear to include power inventories, which in their various forms list what their authors perceive to be the most important elements of national power.[81] Geopolitics has had a tendency towards a more empirical-inductive approach, with theory sometimes appearing as a weak spot. The opposite is true for international relations, which tends towards a more theoretical-deductive approach, with lack of empiricism sometimes appearing as a weak spot. If this perceived lopsidedness of both disciplines can be thought of as complementary, an integration of international relations and geopolitics might be promising. Theories of international relations are sufficiently known. For that reason this chapter focuses exclusively on the issue of national power within those theories. This focus is limited to a number of seminal works by the major theorists. It explores how they theorize national power as well as the concrete elements they suggest looking at. Here is a simplified summary of some differences between realism and liberalism with regard to the issue of national power: realists prefer to think about relative power, defining it in terms of resources (capabilities), and emphasizing military force primarily; liberals prefer to think about absolute power, defining it in terms of outcomes (influence), and emphasizing economic gain primarily (compare GILPIN 1987: 26–34). Psychologically the issue appears to be one of pessimism versus optimism, with pessimists posing as realists and optimists posing as liberals (compare MEARSHEIMER 2001: 15, 17). Constructivism in turn focuses on the construction of images and what influence they exercise on reality.

8.1 Human Nature Realism

Though realism presumes to have a long tradition, Hans Joachim Morgenthau (1904–1980) is perhaps the most representative theorist of this school of thought. The main difference between Morgenthau's human nature realism and the structural realisms of Kenneth Waltz and John Mearsheimer is the emphasis on human psychology. In 1930 Morgenthau wrote an unpublished manuscript titled *On the Derivation of the Political from the Nature of Man* [*Über die Herkunft des Politischen aus dem Wesen des Menschen*], which reveals how much Sigmund Freud influenced Morgenthau's developing conception of the political (SCHUETT 2007: 55). Given that much of Freud's conception of the unconscious came in part from Arthur Schopenhauer, this link to pessimism as a general philosophical outlook can be established. In fact Morgenthau extols Freud for having "'rediscovered the autonomy of the dark and evil forces which, as manifestations of the unconscious, determine the fate of man'" (Morgenthau, quoted in SCHUETT 2007: 58). This may in turn partially explain Morgenthau's rejection of simplistic and overtly confident rationalism in explaining human behavior and by extension that of states. He posits human nature to be driven by egoism (**self-preservation → security**) and a lust for

[81] Whenever an author is listing the elements of power, then this can be considered a power inventory. For some worthwhile comparative collections of power inventories, including their listed elements of national power, see KNORR 1956: 40–41; COPLIN & KEGLEY 1975: 18–19; EPA 1987: 25–31.

power (**self-assertion → aggression**),[82] the latter corresponding to Freud's sex drive (SCHUETT 2007: 58–59, 68).

Morgenthau asserts in his major work *Politics Among Nations: The Struggle for Peace and Power* that "whatever the ultimate aims of international politics, power is always the immediate aim. […] When we speak of power, we mean man's control over the minds and actions of other men" (MORGENTHAU 1948: 13). He emphasizes that "those elemental bio-psychological drives […] to live, to propagate, and to dominate are common to all men" (MORGENTHAU 1948: 17). He explains the phenomenon of nationalism joining individuals together in a common quest for national power. Rules and institutions surround individuals to either divert or suppress their individual power drives, as a result individuals identify with their country to find their satisfaction in national aspirations for power (MORGENTHAU 1948: 74–75). In Freudian terms this means "identification […] with the subject who can act out the suppressed instincts. […] Via the process of identification, man has a share in the power of the nation; he becomes powerful himself" (SCHUETT 2007: 63). The phenomenon of international conflict can also be explained this way. The two different drives of human nature cause an internal conflict in the individual. The drive to dominate (lust for power) places the individual into conflict with repressive society, ultimately finding release only in international conflict (SCHUETT 2007: 68).[83]

Morgenthau stresses that power is a complex psychological relationship, and unlike wealth in economics, it is not a measurable quantity, so "what can be quantified are certain elements that go into the making of power, individual or collective, and it is a common error to equate such a quantifiable element of power with power as such" (MORGENTHAU 1967: 245). In the first edition of *Politics Among Nations* in 1948 he discussed the following elements of national power: (1) geography, (2) natural resources, (3) industrial capacity, (4) military preparedness, (5) population, (6) national character, (7) national morale, (8) the quality of diplomacy; adding one more element in the second edition in 1954: (9) the quality of government (MORGENTHAU 1948, 1954). The first five elements of national power are susceptible to some sort of quantification, though the last four are not without recourse to surveys. He warns of "attributing to a single factor an overriding importance, to the detriment of all the others" (MORGENTHAU 1948: 116).

8.2 Defensive Realism

Kenneth Neal Waltz (born 1924) is the best known theorist of neorealism or structural realism. His type of neorealism can also be called *defensive* realism to distinguish it from John Mearsheimer's *offensive* realism. Whereas classical realism tried to explain the behavior of states on the basis of human nature, neorealism seeks to explain state behavior on the basis of the international system.

[82] Thomas Hobbes had also reduced many passions to the drive for power: "The passions that most of all cause the differences of wit are principally the more or less desire of power, of riches, of knowledge, and of honour. All which may be reduced to the first, that is, desire of power" (HOBBES, *Leviathan* VIII).

[83] As for the escalation of conflict, Morgenthau writes that "out of the conflict for opposing desires for power there arises a propensity to violence whose consummation is the physical destruction of the opponent" (MORGENTHAU 1967: 243). Hobbes states that physical destruction is the basis of peace and power: "The passions that incline men to peace are: fear of death […]" (HOBBES, *Leviathan* XIII), "[…] because preservation of life being the end for which one man becomes subject to another, every man is supposed to promise obedience to him in whose power it is to save or destroy him" (HOBBES, *Leviathan* XX).

Waltz rejects the theory that stable states produce a stable environment as well as the notion that international politics is merely the sum total of the external behaviors of states. Rather it is the anarchic nature of the international system that accounts for the continuity in behaviors and outcomes of state-units despite the numerous changes of principal actors. The structural constraints of the international system affect the interacting state-units in their behaviors as well as the outcomes of their actions. In return the state-units, weighted by their capabilities, affect the international system (**state-units ⇆ international system**). Waltz assumes that state-units seek security in a world where their survival is uncertain, as a precondition for any other goals they may pursue as well (WALTZ 1979: 64, 73, 91–92).[84]

States perform similar functions in an anarchic system. It is in their capabilities that they differ. Capabilities are attributes of the state-units, whereas the distribution of capabilities is an attribute of the international system. This distribution of capabilities determines the structure of the international system, whether it is unipolar, bipolar, or multipolar, which in turn affects how the state-units behave towards each other and what outcomes their interactions produce (WALTZ 1979: 96–97). The structure of the international system determines the power of units, given that "power is estimated by comparing the capabilities of a number of units" (WALTZ 1979: 98). This means that power and capabilities are not synonymous. Capabilities refer to the ability of state-units independent of each other, whereas power refers to the capability of a state-unit relative to the capabilities of other state-units.[85] Waltz lists the following items that determine the ranks of nations: (1) size of population, (2) size of territory, (3) resource endowment, (4) economic capability, (5) military strength, (6) political stability, and (7) competence (WALTZ 1979: 131). The first five items can be found more or less directly in Morgenthau's listing of power elements as well. Political stability in turn can be regarded as a summary of national character and national morale, and competence as a summary of the quality of foreign policy and the quality of government.

Waltz stresses that states must rely on their combined capabilities: a state needs to score in all seven areas to come out top. Excelling in a few areas is insufficient and cannot compensate for severe deficiencies in other areas, seeing that "the economic, military, and other capabilities of nations cannot be sectored and separately weighed" (WALTZ 1979: 131). For power formulas this requires using a nonlinear, multiplicative approach ($A \times B \times C \times \ldots$) instead of a linear, additive approach ($A + B + C + \ldots$). Nevertheless he realizes that "states have different combinations of capabilities which are difficult to measure and compare, the more since the weight to be assigned to different items changes with time" (WALTZ 1979: 131). This all illustrates how Waltz makes a number of relevant statements for the construction of power formulas, calling attention to (a) how the

[84] The defensive orientation in looking at conflict, equating in some way power with security, is itself nothing new. It can also be found in the thinking of statesmen of the 18th century (KLUETING 1986: 38, 306). Harold Lasswell and Abraham Kaplan also emphasized the immanent threat involved in the usage of force: "In the exercise of brute force (struggle for existence), the issue is one of survival, not a redistribution of power, wealth, respect, or other values" (LASSWELL & KAPLAN 1952: 90).

[85] As an example one may imagine two different scenarios. In the first scenario state A has 10 units of capability, and state B has 20 units of capability. In the second scenario state A has 10 units of capability, state B has 5 units of capability, state C has 5 units of capability, state D has 5 units of capability, and state E has 5 units of capability. In both scenarios state A has the same amount of capabilities (10), further the sum total of capabilities is also the same (30). However, it is obvious that the power of state A is greater in the second scenario than in the first scenario.

concentration of capabilities in the international system is affecting the power of nations, emphasizing (b) nonlinearity in combining variables, (c) different weights for different variables, and (d) changing weights for different times. No other theorist comes close in offering as much practical advice within purely theoretical discussions.

8.3 Offensive Realism

John J. Mearsheimer (born 1947) has developed the theory of offensive realism, which states that power maximization is the most rational strategy for a state to increase its security in an international system characterized by anarchy.[86] The more relative power a state has in the international system, the higher its chance for long-term survival.[87] In contrast to that, Waltz assumes that any power maximization strategy of one country will be countered by a balancing coalition of other countries. That is why states have an incentive to maintain the status quo (WALTZ 1979: 118; MEARSHEIMER 2001: 20–21). Mearsheimer diverges in his assessment of the efficacy of these balancing mechanisms. He points out that one study showed that the initiators won 39 out of 63 interstate wars between 1815 and 1980, which amounts to a 62% success rate (see ARQILLA 1992: 2). For him the secret of success is timing, that is for states to look out for opportune situations to gain power at the expense of other states (MEARSHEIMER 2001: 20–21, 39–40). He also inserts geography back into neorealism, emphasizing the locations and regions of states as well as the stopping power of water.[88] In view of that one must deem Mearsheimer's approach geopolitical.

He considers power the core concept of his theory and, by extension, international relations in general. One of his six major questions in *The Tragedy of Great Power Politics* is how to define and measure power. He asserts that "with good indicators of power, it is possible to determine the power levels of individual states, which then allows us to describe the architecture of the system" (MEARSHEIMER 2001: 12). His focus is nevertheless on the great powers, these being defined as the dominant state or any state that could turn a conflict with the dominant state into a war of attrition (MEARSHEIMER 2001: 5),[89] assuming that "great powers inherently possess some offensive military

[86] Mearsheimer states that "survival mandates aggressive behavior" (MEARSHEIMER 2001: 21). He mentions that Nicholas Spykman (chapter 5) among others made the case for offensive realism (MEARSHEIMER 2001: 410). Spykman supported an offensive outlook, writing that "unless public opinion is educated to the strategic advantages of offensive action or inspired by a messianic ideology, […] this preference of the good man for dying on his own soil instead of abroad is a serious handicap of the democratic state. Most of the successful wars of history have been carried on in other people's territory" (SPYKMAN 1942: 27), as well as that "strategy teaches that there can be no victory without offensive action" (SPYKMAN 1942: 29).

[87] Thomas Hobbes implied no less in the *Leviathan*: "So that in the first place, I put for a general inclination of all mankind a perpetual and restless desire of power after power, […] because [man] cannot assure the power and means to live well, which he hath present, without the acquisition of more" (HOBBES, *Leviathan* XI).

[88] Mearsheimer repeatedly underlines the importance of geographical concepts such as location and region. He states, for example, that "regional hegemons prefer that there be at least two great powers located together in other regions, because their proximity will force them to concentrate their attention on each other rather than on the distant hegemon" (MEARSHEIMER 2001: 42). He dedicated a whole section of his major work to the stopping power of water, a subsection of which deals with the different strategic situations of continental states and insular states, which is a classical geopolitical topic (MEARSHEIMER 2001: 126–128; compare SUPAN 1922: 69–74).

[89] As for defining a great power (or by extension a pole in the system), it is tempting to use the 3:1 rule of thumb for breakthrough battles. Mearsheimer wrote that "a theater-wide balance of 3:1 or more would almost surely mean rapid defeat for the defender" (MEARSHEIMER 1988: 176). A country with at least a third of the military power of the world's leading military power should theoretically be able to face down this leading military power in a drawn out war of attrition.

capability […] to hurt and destroy each other" (MEARSHEIMER 2001: 30).[90] He defines actual power by the size and strength of military forces, and latent power as the resources a state has to build up its military forces (MEARSHEIMER 2001: 43, 56).[91] Mearsheimer follows Waltz in not equating power with outcomes. Unlike Waltz, he explicitly considers only tangible assets or material capabilities and not nonmaterial factors, whereas Waltz includes five tangibles and two intangibles in his listing of capabilities (MEARSHEIMER 2001: 60; WALTZ 1979: 131, 191–192). When looking at the balance of power for the year 2000, Mearsheimer chooses (1) GNP and (2) population as indicators for latent power, further (3) armed forces personnel and (4) the number of nuclear warheads as indicators for actual power (MEARSHEIMER 2001: 60–67, 133–135, 383–385).

8.4 Neoliberalism

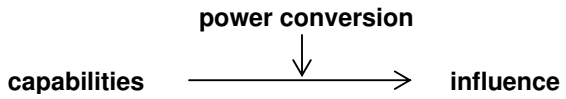
Joseph Samuel Nye (born in 1937) and Robert Owen Keohane (born in 1941) developed neoliberalism in their 1977 book *Power and Interdependence*, which can be considered a response to Waltz's neorealism. According to their criticism, realists mistakenly treat power as something fungible (like money), meaning that power resources can be easily transferred from one issue area to another. Correspondingly major states will be inclined to shift their power resources in such ways that they gain an about equal share in all issue areas, meaning that the distribution of power in particular issue areas should resemble to a large extent the general distribution of power. Keohane and Nye argue that this is not the case. For instance, the 1973 oil embargo demonstrated that the distribution of power in the petroleum sector was obviously different from the distribution of power in the military or economic sectors (KEOHANE & NYE 2001: 37, 43). Another argument against realism is

> that the use of force has become increasingly costly for major states as a result of four conditions: (1) risks of nuclear escalation; (2) resistance by people in poor or weak countries; (3) uncertain and possibly negative effects on the achievement of economic goals; and (4) domestic opinion opposed to the human costs of force. (KEOHANE & NYE 2001: 268)[92]

The declining importance of military force increases the importance of other issue areas, notably that of the economic sector. Keohane and Nye focus primarily on the politics of economic interdependence between nations. Interdependence can be characterized by the possibility of joint gains and joint losses. They distinguish between power potential in terms of resources (capabilities) and effective power in terms of outcomes (influence). They refer to the political process – bargaining[93] – as the

[90] I have argued that in the last instance power resides fundamentally in the ability to kill and to protect oneself from being killed (HÖHN 2008a: 3–4; also section 16.8).
[91] Klaus Knorr popularized the distinction between putative power (war potential) and actualized power (mobilized military strength) in his many books on power. Knorr himself admits that the concept of war potential [potentiel de guerre] was developed in the early 20th century (KNORR 1956: 3).
[92] An underlying reason (not mentioned by Nye) that the use of force has become more costly is the lower birth rate in advanced countries. For that reason the opportunity cost of risking the life of a child in conflict steadily increases. For example, if one imagines a society where families have four children, it may be more acceptable for families to lose a child or two in war. In a society where families have only one child, such sacrifice may prove unacceptable.
[93] The success of bargaining depends on skill, commitment, and coherence. In the case of a particular country this can be construed to refer to government ability and political will in terms of exercising and backing up its diplomatic dealings (KEOHANE & NYE 2001: 13, 196). Keohane and Nye use this intervening variable to explain the voluntary compliance of countries to the

intervening variable between the two. In a later article Nye generalized the term for the intervening variable to "power conversion" (NYE 1990b: 178):[94]



This scheme explains why capabilities and influence are not perfectly correlated.[95]

In the economic realm, especially asymmetrical interdependence, in which one side is more dependent than the other, can translate into influence depending on the more dependent country's sensitivities and vulnerabilities. A country's *sensitivities* refer to the immediate economic effects as in the case of a trade embargo on a certain commodity or raw material, whereas a country's *vulnerability* refers to the long-term ability and cost for a country to substitute for such deficiencies. The net results of political bargaining will vary in different issue areas, given that the linkages between the issue areas are not as consistent as realists assume (KEOHANE & NYE 2001: 9–13, 27, 46, 196). In effect this may mean that liberalism implies giving up the quest for a single, integrated measure for national power and adopting instead a multidimensional approach, applying different measures to different issue areas (compare BALDWIN 2002: 181).

8.5 Poststructuralism

The third school of international relations theory runs under many different names: constructivism, critical theory, deconstruction, feminism, neo-Gramscianism, neo-Marxism, postcolonialism, postmodernism, postpositivism, postrealism, poststructuralism, and so on. These diverse approaches have a tendency to emphasize the role of ideas, perceptions, discourses in structuring realities. The status quo in theory and debate is more often than not regarded as hegemonic. Poststructuralism in particular aims at deconstructing traditional concepts in international relations that have been taken for granted. Power is one of these concepts. Steven Lukes (born in 1941) published his major work *Power: A Radical View* in 1974 (LUKES 2005), in which he proposes three dimensions of power. Overall, within this school of international relations, it may be the one work that can be best related to the measurement of national power.

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rules and demands of international institutions: "The major advanced countries deal with each other on a large number of issues over an indefinite period of time. Each government could 'get away with' a particular violation. But viable regimes rely, in one form or another, on the principle of long-term reciprocity. No one trusts habitual cheaters. Over time, governments develop reputations for compliance, not just to the letter of the law but to the spirit as well. These reputations constitute one of their most important assets" (KEOHANE & NYE 2001: 295). This argument for reputation as an asset strongly relates to the debate on soft power and how to define it (section 9.2).

[94] As for viewing power conversion as a separate and important aspect, US intelligence analyst Sherman Kent had made this comment: "In my opinion the most egregious error in war-potential computation is the error of confining one's attention to resources and neglecting the country's power to combine them to get an appropriate end-product. On a straight numerical calculation of resources there is likelihood that India and China might emerge as a threat to the U.S. or U.S.S.R. No conclusion could be more useless" (KENT 1951: 48).

[95] R. J. Rummel writes: "Success and power are not highly correlated, except at the extremes. Tremendous power usually will overcome most opposing powers, while weak power will have little push against reality. In between, however, the success of power will depend on those powers of nature and others in opposition. *It will depend on the configuration and balancing of powers and one's resources*" (RUMMEL 1976: 166–167).

The first dimension of power was presented in an article by Robert Dahl in 1957, whose definition of power in general is cited in many works of international relations: "*A* has power over *B* to the extent that he can get *B* to do something that *B* would not otherwise do" (DAHL 1957: 202–203). This defines power as power over outcomes (influence) rather than power over resources (capabilities), the latter being the type of power that this study is mostly concerned with. Dahl mentions that there are definitions different from his own, notably that of John French, who wrote that "the power of A over B […] is equal to the maximum force which A can induce on B minus the maximum resisting force which B can mobilize in the opposite direction" (FRENCH 1956: 183), which is compatible with the notion of power over resources (capabilities). In any case, according to Lukes, this dimension of power focuses on concrete, observable behavior (LUKES 2005: 16–19), which appears to go along with the direct power that actors have in decision-making processes. Influence and capabilities could be seen as related, if not tantamount, in this specific context.

The second dimension was presented in an article by Peter Bachrach and Morton Baratz in 1962. This second dimension consists of institutional structures and norms and extends Dahl's definition of power. They state that "power is also exercised when A devotes his energies to creating or reinforcing social and political values and institutional practices that limit the scope of the political process to public consideration of only those issues which are comparatively innocuous to A" (BACHRACH & BARATZ 1962: 948). They contend that institutional structures and the rules of the game are set up in a way as to protect the vested interests (BACHRACH & BARATZ 1962: 949–950).[96] The problem in applying this to international relations is that many institutional structures are less formal than in domestic politics (for example major power relations in the form of the G7 or G20). As for international organizations with codified rules for majority votes, the power of countries can be measured by quantifying their effective voting power, but it is unclear how the exclusion of issues from voting could be systematically evaluated.

Lukes adds a third dimension of power to the aforementioned two dimensions. In his definition "[*A*] also exercises power over [*B*] by influencing, shaping or determining his very wants" (LUKES 2005: 27). In concreto he refers to thought control

> through the control of information, through the mass media and through the process of socialization […] to prevent people, to whatever degree, from having grievances by shaping their perceptions, cognitions and preferences […]. (LUKES 2005: 27–28)

A manipulated consensus may deprive segments of the population from seeing their real interests and from exercising their power accordingly. His analysis is not limited to totalitarian states: it applies to so-called Western democracies as well. The problem is how to objectively determine the people's real interests. Concerning the issue of national power, his analysis justifies attention to ideological factors

[96] Bachrach and Baratz quote Elmer Schattschneider to support their argument: "All forms of political organization have a bias in favor of the exploitation of some kinds of conflict and the suppression of others because *organization is the mobilization of bias*. Some issues are organized into politics while others are organized out" (Schattschneider, quoted in BACHRACH & BARATZ 1962: 949). As for institutions having a tendency to reflect power constellations of the past, one can also quote Karl Marx: "Men make their own history but they do not make it just as they please; they do not make it under circumstances chosen by themselves, but under circumstances directly encountered, given and transmitted from the past" (Marx, quoted in LUKES 2005: 26). The UN Security Council is an example of an institution that in its setup reflects the power constellations of the past.

such as national cohesion, shared purpose, and the like. In terms of measurement, it leads to interesting questions as to how the power of countries is perceived by different professions (e.g. military officers versus economists) in different countries, and to what degree different elements of power correlate to these different perceptions (section 16.1).

In some way his trisection of power appears to resemble the trisection in international relations theory. The first dimension appears to be more the focus of realists, the second dimension more the focus of liberals, and the third dimension more the focus of constructivists.

9. The Third Face of National Power

The first two categories for elements of national power are more or less straightforward to define and conceptualize. Military capabilities constitute the first face of national power, because they are immediately applicable in the case of war. Economic capabilities constitute the second face of national power, because they indicate the potential for the production and maintenance of military capabilities in a long-term conflict.[97] One can also use demography and geography as basic categories (compare chapter 3). Their use in the past in determining national power has been superseded by available data on military capabilities and economic capabilities. Demography has a direct effect on military capabilities in terms of available manpower, whereas geography has a less direct effect on economic capabilities via natural resources. A veritable problem remains the definition and conceptualization of the third category of national power, which can be provisionally termed as *psychological power* or *soft power*.[98] These latter terms may or may not be used synonymously. The different understandings and usages of soft power are anything but consistent. Psychological power was explicitly and systematically added as a third face of national power in the interwar period between WWI and WWII alongside the concept of total war. Neither the addition of this particular face nor the notion of total war was exclusively German. After WWII the treatment and inclusion of psychological factors in the discussions of national power were again more unsystematic, only returning in part to a more systematic treatment as a result of the US defeat in Vietnam.[99] Beginning in 1990 the fuzzy concept of soft power has been featured regularly as a third dimension of power. The challenge of psychological power and soft power does not only consist of definitions and applicability. The real challenge is its measurement, for the factors in this third category consist of many intangibles requiring subjective evaluation. In addition to that, some factors can be very unstable (e.g. popular opinion) and consequently unreliable for long-term analysis and predictions.

[97] "The time aspect of availability appears in the familiar phrase 'lead-time,' which stands for the period required to convert plans into production. Lead-time is a phase of the problem of potential power. That there is a difference between actual and potential power is obvious, but these two terms are too vague to be of much service. […] A fivefold classification of states of availability is here proposed: (1) power resources available immediately; (2) power resources available after activation; (3) power resources available after conversion; (4) power resources available after development; and (5) power resources available hypothetically" (JONES 1953: 428).

[98] Kenneth Boulding, among others, uses a classification scheme for three different faces of national power, which is similar to mine (compare BOULDING 1989: 15–34). According to Boulding, the first face is destructive power (politico-military), the second face is productive power (economic), and the third face is integrative power (social): "Destructive power is the power to destroy things. […] Productive power is found in […] in the idea, in the tools and machines that make things, […]. Integrative power may be thought of perhaps as an aspect of productive power that involves the capacity to build organizations, to create families and groups, to inspire loyalty, to bind people together, to develop legitimacy. Integrative power has a negative sense, to create enemies, to alienate people; it has a destructive as well as a productive aspect" (BOULDING 1989: 24–25). Whereas the first two faces are defined in a straightforward manner, the third one sounds more ambiguous. On the whole the third face of integrative power (or social power) seems to imply more or less what I refer to as psychological power.

[99] Many scholars implied as much when looking at the Vietnam War. For example: "The United States dropped more bombs on North Vietnam than it dropped on the Axis powers during the entire period of World War II. […] At any rate power can no longer be calculated simply by adding up a nation's physical capabilities. Psychology and will must be given as much weight as resources and hardware" (STOESSINGER 1990: 24).

9.1 Psychological Power

The advancement of military technology has caused an unremitting erosion of the boundary between civil and military matters.[100] Beginning with WWI persistent efforts have been made to view and pursue war in its totality, involving all resources at the disposal of a nation in the war effort, resulting in the concept of *total war*.[101] WWI stretched to the breaking point – and sometimes beyond – the psychological condition of the populations of all the major European countries involved. German army psychologist Karl Pintschovius writes: "The fighting will of the people has become the most sensitive spot of the front—that is due to the so-called 'total war', which pulls everything inside and makes the calculations that more difficult" (PINTSCHOVIUS 1942: 178).[102]

In Germany, in particular, the defeat was attributed to the decline and eventual collapse of national morale at the end of WWI and triggered the conceptual addition of the psychological category of power equal to the military and economic categories. British scholars added this third category as well. About the psychological pressure emanating from modern warfare, Rudolf Steinmetz, a pioneer in the sociology of war, writes "that victory can go only to those who can withstand this pressure for the longest time, and how terribly much of psychological forces, indeed of the highest moral forces, this requires of countless individuals" (STEINMETZ 1929: 227).[103] With regard to moral qualities, he emphasizes sexual morality, trust in leadership, intelligence, courage, discipline, as well as martial spirit, and the will to victory.[104] In addition to that, he asserts that the mental aptitude, education, and development of a population has a profound influence on its military force (STEINMETZ 1929: 248–257).

A sampling of other examples for this development towards emphasizing the psychological component can be given, though this is in no way comprehensive. In 1929 Colonel Hierl published the *Foundations of a German Defense Policy* [*Grundlagen einer deutschen Wehrpolitik*], in which he emphasizes that modern wars were people's wars [Volkskriege]. Military warfare is supplemented by economic warfare and in turn propaganda warfare (HIERL 1929: 8–9). Bertrand Russell, in his work *Power: A New Social Analysis* published in 1938, writes that "an individual may be influenced: A. By direct physical power over his body, e.g. when he is imprisoned or killed; B. By rewards and punishments, e.g. in giving or withholding employment; C. By influence on opinion, i.e. propaganda in the broadest sense" (RUSSELL 1938: 35–36). Likewise Edward Hallett Carr, in his work *The Twenty Years' Crisis 1919–1939* published in 1939, writes that "political power in the international sphere may be divided […] into three categories: (a) military power, (b) economic power, (c) power over opinion" (CARR 1946: 108).

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[100] For instance, the new military dimension of air power amplified the exposure of populations. In 1921 Italian General Giulio Douhet's published his major work *The Command of the Air*, in which he speculated among other things that permanent bombardment could demoralize populations.

[101] Moves towards the theoretical conception of total war were already well under way before WWI. In Germany, for example, Erich Ludendorff in 1910 and Helmut von Moltke (junior) in 1905 had thought in this direction (FERGUSON 1999: 130, 134). Hans Morgenthau writes that "total war presupposes total mechanization, and war can be total only to the degree to which the mechanization of nations waging it is total" (MORGENTHAU 1948: 301).

[102] German text: "Der Kampfwille des Volkes ist zur empfindlichsten Stelle der Front geworden—das verdanken wir dem sogenannten 'totalen Krieg', der alles hineinreißt und die Rechnung gewaltig erschwert."

[103] German text: "[…] daß der Sieg nur demjenigen zufallen kann, der diesen Druck am längsten aushält, und wie ungeheuer viel dieses an psychischen, ja an höchsten moralischen Kräften bei zahllos vielen voraussetzt."

[104] Stephen Jones writes: "Leadership and patriotism are like enzymes in metabolism. In the final analysis, without them there is no power" (JONES 1953: 425), "but one cannot expect patriotism to replace pay checks year after year" (JONES 1953: 436).

Guido Fischer, a specialist for defense economics, stressed in his 1936 book[105] that the next war would be a total war in which three tasks would have to be taken care of simultaneously: (1) the armed forces must succeed in their military actions, (2) the population, and its political leadership, must strengthen the nation's psychological forces (by which he means morale and the national will to resist as well as to succeed), (3) the economy must satisfy as far as possible the demands of both the armed forces and the population. Likewise Pintschovius writes: "The commander-in-chief is responsible for ensuring that three decisive horizons are constantly coordinated: military operation in the narrow sense, measures for armaments and food, resulting from the psychological examination of the situation" (PINTSCHOVIUS 1942: 68).[106]

Fischer recognizes that failure to meet the minimal economic demands of the population has serious psychological repercussions in lowering national morale and cohesion. He further underlines the role of propaganda in directing the public mood,[107] and that any social, tribal, and religious conflicts within the nation must be looked at carefully to preempt enemy propaganda aimed at taking advantage of these (FISCHER 1936: 8–11, 57). He looks at what factors the defense economy consists of, which can be considered a power inventory except for the excluded military factors, since it is exactly the purpose of the defense economy to serve and subordinate itself to the demands of the armed forces. The following table presents these ten factors (note that cultural standing refers to education). The three categories were added later in the 1939 article:

Table 7: Categorization of Factors in the Defense Economy [Fischer]

Category	Factors
I. political	1. geopolitical location of the state
	2. size of the state, number and density of the population
	3. organizational skills and cultural standing of people
	4. nature of national boundaries and disposition of neighboring nations
II. psychological	5. flexibility of the domestic economy and ingenuity
	6. perseverance, tenacity, adaptability of the population
III. economic	7. soil fertility and mineral wealth
	8. industrial organization and level of technology
	9. state of trade and transport facilities
	10. financial strength of the state and economy

Source: FISCHER 1936: 36, 1939: 519.

The political category is inconsistent. Factors 1, 2, and the first part of 4 are geographic-demographic in character. Factor 3 and the second part of factor 4 could be added to the psychological category. The disposition of neighboring nations relates to *soft power* in a sense of national attractiveness. In my interpretation 35% of factors are psychological intangibles, and 65% are geographic-demographic-

[105] The National Socialists considered Guido Fischer politically unreliable. He was put under severe constraints, if not persecuted, during this period.

[106] German text: "Der Oberbefehlshaber hat dafür einzustehen, daß die drei entscheidenden Gesichtskreise: militärische Operation im engeren Sinn, Rüstungs- und Verpflegungsmaßnahmen, Ergebnis aus der psychologischen Überprüfung der Lage[,] ständig aufeinander abgestimmt sind."

[107] British historian Niall Ferguson writes how "in the end the legitimacy of a state is bound up with such intangibles as tradition (the memory of past benefits), charisma (the appeal of present leaders), popular belief (faith in future rewards, material or spiritual) and propaganda (the state's use of available media to bolster all these)" (FERGUSON 2001: 422).

economic tangibles. This indicates the importance given to the psychological component in economics and war. According to Fischer, the convergence of material and immaterial factors determines the power of the national defense economy. These factors affect the defense economy to different degrees, making comparisons more difficult (FISCHER 1936: 42, 44). Regarding the operational measurement of power, the convergence of factors suggests a nonlinear, multiplicative approach ($A \times B \times C \times \ldots$), whereas factors affecting the defense economy to different degrees refer to the problem of weighting (sections 16.5–16.8).

As far as post-WWII international relations theory is concerned, R. J. Rummel (section 13.16) related human psychology and sociology to international relations. He defines "power as a force turning dispositions into manifestations" (RUMMEL 1975: [section 8.2]), proposing the following theoretical power equation for power in general (RUMMEL 1976: [section 21.1]):

$$P_g = C_g \times I_g \times W_g$$

P_g = power to achieve goal; C_g = capabilities to achieve goal; I_g = interest in achieving goal; W_g = will power to achieve goal

He emphasizes that "if any of these three aspects of power is zero, then a person's power to achieve his goal g is zero" (RUMMEL 1976: [section 21.1][108]). He also writes that "all the forms of power are present and active in a unified but invisible whole" (RUMMEL 1976: 195), hence his field approach is holistic.[109] His theoretical formula is comparable to Ray Cline's operational power formula from 1975, in which the sum of material capabilities is multiplied by the sum of psychological factors (evaluation scores), namely strategic purpose and national will (section 13.20).

9.2 Soft Power

In 1990 Joseph Nye coined the term "soft power" within the framework of neoliberalism (section 8.4). Soft power is cooptive (noncoercive) power. It means that a particular country seeks to attract other countries to share its goals and values, shaping the preferences of other countries. It is associated with intangible power resources such as cultural attraction, ideology (political values), and international institutions (foreign policy), though Nye prefers to define power more in line with outcomes than resources. In contrast, "hard power" is command power (directive), using coercion (or the threat thereof) and inducement (NYE 1990a: 155, 166–167, 1990b: 181, 2004: 11, 2006). The most obvious problem with this definition of soft power is that it sounds almost benevolent and reasonable from an American point of view. Conversely it is based on the conceited supposition that American culture is

[108] The power formula and the quoted sentence are included in the online version of Rummel's book, but not in the first print of the original, the first footnote in the online version stating that "the chapter has been extensively revised for this web site" (RUMMEL 1976: [notes]).

[109] In this regard he also quotes Emanuel de Kadt: "Power as such is never directly observable. What can be observed are the bases of power, those resources, values, or characteristics which contribute to the capacity of the individuals or groups to better their position in respect of the available alternatives for action. They provide the means which can be, and frequently are, mobilized to achieve the desired goals, and it is by observing these bases that parties estimate the effective power of opponents and the area in which it can be applied" (Kadt, quoted in RUMMEL 1976: 196).

indeed superior.[110] Fan Ying retorts that soft power is still power, hence "soft power too can breed resentment and bitterness" (FAN 2008: 154). Guo Jiemin talks of "cultural power, also called cultural hegemony, cultural imperialism and cultural colonialism" (GUO 2002).

There is not much new or innovative about Nye's concept of soft power defined as cooptive power (compare NYE 1990a: 167). R. J. Rummel had already written that much in 1976:

> The notion of influence adds nothing new to my discussion of power. For what is often meant by influence is a noncoercive ability to produce—or the production of—an effect, as through love, persuasion, or authority. This is covered by the altruistic, intellectual, and authoritative forms of power. (RUMMEL 1976: 196)

Rummel thinks of three status dimensions, which are wealth, power, and prestige. Accordingly, "the third status-component, prestige, reflects the esteem of others, the degree to which they look to you for help, advice, or as a model of what they want to be" (RUMMEL 1976: 137), which appears to suggest that influence and prestige go hand in hand. The concept of prestige (in the sense of reputation or esteem) is as old as international relations.[111]

Niccolò Machiavelli offers an eloquent realist reply concerning the issue of soft power defined as cooptive power for the purpose of attracting others:

> Here a question arises: whether it is better to be loved than feared, or the reverse. The answer is, of course, that it would be best to be loved and feared. But since the two rarely come together, anyone compelled to choose will find greater security in being feared than in being loved. […] Men are less concerned about offending someone they have cause to love than someone they have to fear. Love endures by a bond which men, being scoundrels, may break whenever it serves their advantage to do so; but fear is supported by the dread of pain, which is ever present. (MACHIAVELLI, *The Prince* XVII)

As for the purpose of being loved and feared simultaneously, Nye popularized the term "smart power" to refer to the combined use of hard power and soft power (NYE 2006). Practically it amounts again to placing new labels on old concepts, this time "smart power" being the trendy term for strategy.

Another critical line of thinking is that soft power is simply the soft face of hard power. Osama bin Laden once said "when people see a strong horse and a weak horse, by nature, they will like the strong horse" (LADEN 2001). In his 1990 article Nye stated that "the success of Japan's manufacturing sector provides it with an important source of soft power" (NYE 1990a: 169). Similarly R. J. Rummel had already pointed out three studies on prestige, notably that of Shimbori Michiya and colleagues (section 13.8), Simon Schwartzman and Manuel Mora y Araujo (section 13.11), and Norman Alcock and Alan Newcombe (section 13.14), which provided evidence that "in some societies, such as the

[110] It is clearly different from Samuel Huntington's take on this issue: "The West won the world not by the superiority of its ideas or values or religion, but rather by its superiority in applying organized violence. Westerners often forget this fact—non-Westerners never do" (HUNTINGTON 1996: 51).
[111] Harm Klueting states that Frederick II (1712–1786), King of Prussia, wrote in his political testament that the aim of foreign policy is the augmentation of possessions, power, and prestige (KLUETING 1986: 144).

international, prestige is almost wholly determined by wealth and power" (RUMMEL 1976: 137). In any case, even if a particular country actively strives to promote its culture in view of improving its image internationally, it needs the financial resources and know-how, once again depending on hard power resources (FAN 2008: 154).[112]

Given the link of soft power to intangibles, a particularly Chinese way of interpreting soft power is that "soft power can be called cultural power" (ZHU 2002), "soft power […] can also be called mental power" (ZHU 2002), "mental power […] comprises such soft elements as psychology and intelligence" (ZHU 2002), "mental power is contrasted to physical power" (ZHU 2002). Another frequent term for soft power is "intangible power" (ZHU 2002).[113] As such soft power is more or less defined as being synonymous with psychological power. Intelligence appears connected to human resources in line with scientific and technological progress, whereas psychology appears connected to social trust, value orientations, and national will. Chinese scholars most appreciate Ray Cline's power formula, in which the sum of material capabilities is multiplied by the sum of psychological factors based on evaluation scores (section 13.20). This effectively gives equal weight to soft power and hard power, defined as mental power and physical power. As a result soft power and hard power can only be meaningful (useful) in conjunction (XUETONG: 2006: 16; also ZHU 2002).

Another, perhaps more sophisticated, interpretation of soft power is to define it in terms of governance and strategy (power conversion). According to Nye, "some countries are better than others in converting their resources into effective influence" (NYE 1990b: 178). If governance and strategy aim at optimizing the combination of soft power (aimed at influence) and hard power (based on resources), then these circular processes of power conversion are consigned to Nye's "smart power" concept. Chinese scholars associate soft power with ancient notions of strategy (see the introductory part of chapter 14), infinitely repeating in various ways that "the ability of a strong country may be contained because of a weak one that has better ability to organize and concentrate" (ZHU 2002; compare FAN 2008: 149).

The term "soft power" constantly causes confusion.[114] The problem starts with the term itself, for "soft" can be interpreted as anything. The following table represents my attempt to construct a typology for the clarification of the problem (compare NYE 2004: 31):

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[112] Fan Ying promotes nation branding as a viable alternative to the fuzzy concept of soft power. According to Fan "a nation brand can be defined as the total sum of all perceptions of a nation in the mind of international stakeholders" (FAN 2008: 156). Moreover, "a nation's brand consists of three sub-brands: political brand, economic brand and cultural brand" (FAN 2008: 155).

[113] Zhu Majie sets out a whole paradigm in stating that "public opinion campaigns in politics, famous brand competition in economy, and the psychological battle in the military all belong to the competition and contest of cultural powers" (ZHU 2002).

[114] The following excerpt from a transcript illustrates the confusion surrounding the concept of soft power. In 2003 US Secretary of Defense Donald Rumsfeld gave the keynote address at the Eisenhower National Security Conference. Afterwards he was asked in a questions-and-answers session about soft power:
AUDIENCE MEMBER: Good evening, Secretary Rumsfeld. First, I'd like to thank you for coming and taking my question this evening. My name is David Houlihan. I'm representing [sic] American University this evening. I was wondering if you could tell us a little bit about your perspective about the [sic] soft power and its role that Mr. Nye discussed with us earlier today?
RUMSFELD: I wasn't here to hear Mr. Nye. I know who he is and he's a thoughtful person, but—what was his subject?
AUDIENCE MEMBER: He discussed like a difference between a hard and soft power, I was interested—I was kind of wondering what you thought about the role of soft power, being the secretary of defense?
RUMSFELD: I don't know what it means. I learned to say I don't know when I was very young. What is the difference between soft power and hard power?
AUDIENCE MEMBER: I'm afraid of slightly over simplifying, but he discussed hard power as more military and forceful power and soft power being more politically influenced and cultural.
RUMSFELD: Diplomacy.

Table 8: Typology of Hard Power and Soft Power

Areas	Hard Power (coercive)	Soft Power (cooptive)
Military	Skirmishes, War	UN Peacekeeping
Politico-Diplomatic	Threats	Confidence Building Measures exchanging information
Economic	Embargoes	Unilateral Free Trade
Psycho-Cultural	Cultural Infiltration movies, human rights, NGOs	Cultural Exchange tourism, foreign students

Source: Author's own categorizations.

The purpose of the table is to show that soft power, defined as cooptive power, is not simply the addition of a third category to the military and economic categories. It is a different dimension altogether. Military force and economic capability have soft power aspects *depending on the way they are used* and *for what purposes*. The same for the politico-diplomatic and psycho-cultural areas, they have hard power aspects in that they can be used in a coercive way. Clarification is needed that not all hard power is by necessity material and all soft power by necessity spiritual.[115]

In his 2004 work Nye uses about 20 proxy measures for soft power on an ad hoc basis to illustrate the strengths of different countries:

Table 9: Twenty Proxy Measures for Soft Power [Nye]

Categories	#	Variables
Culture	4	Book publications; export of films and TV programs; music sales; popular sports
Education	4	Foreign scholars; foreign university students; Nobel prizes; scientific and technical journal articles
Global Outreach	3	Internet hosts; internet sales; multinational corporations with global brand recognition
Health	1	Life expectancy
Foreign Relations	2	Overseas development assistance; public diplomacy
Technology	3	High-tech exports; patents; research and development expenditures
Travel & Migration	3	Air travel; foreign immigration; tourism

Source: NYE 2004: 33–34, 76–77, 85; author's own categorizations.

The 20 variables illustrate the absence of any coherence (compare section 14.17). The only thing in common is that wealthy (or sizeable) countries are most likely to perform better on most of these, suggesting that soft power is simply a façade for wealth (or size). Nye also utilizes some data from the

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AUDIENCE MEMBER: Diplomacy.
RUMSFELD: Oh, they're linked. I mean the last choice in the world is to have to use military power, to have to use kinetics; you don't want to do that. You want to do everything humanly possible through persuasion and diplomacy and economic activity and coalition building to try—I mean think what President Bush went through. There were 17 UN resolutions on Iraq and Saddam Hussein defied them. He then went to the UN; there was patience and then before he did anything with the coalition, he gave one last chance for Saddam Hussein to respond to the United Nations or leave. So, it is your absolute last choice. And on the other hand, simply passing resolutions, 17 resolutions, didn't do it. There needs to be sometimes a consequence and we were hopeful that we could through the build up of forces over a period of some five or six months, affect diplomacy favorably, that is to say support diplomacy and not have to use force. That was what the design was and that was the hope and indeed the prayer.
So I think that it's not easy to separate the two. I think that your last choice always is the use of force, and we need to always try to find ways to be persuasive and help countries. And people who wish ill of others or intend to invade their neighbors, find ways to persuade them short of the use of force, if it's humanly possible.
(CRAIG 2004: 159–160)

[115] For example, a library with millions of books is a quite physical embodiment of knowledge, and the number of books can be easily counted. Inversely a threat can consist of a mind game, but the threat does not therefore constitute soft power.

Pew Global Attitudes Project to graph how much the world likes the United States (NYE 2004: 36–37, 42, 69–72). It appears more appropriate as a proxy measure of attractiveness.[116]

[116] A whole new generation of soft power indexes has been appearing. Though related to conventional power indexes, they are not included in this study, one exception notwithstanding (section 14.13). In 2009 the Chicago Council of Global Affairs published a report on soft power in East Asia. The report includes a soft power index, consisting of equally weighted subindexes for each of five general areas of soft power: economic, human capital, cultural, diplomatic, and political. The subindexes were based on surveys in the following countries: United States, China, Japan, South Korea, Indonesia, Vietnam (WHITNEY & SHAMBAUGH 2009: 8, 35–36).

10. Statistics and National Power

Today nobody associates statistics with the state or political science, though the term "statistics" itself has visibly the term "state" in it. This chapter offers a brief and incomplete sketch of the history of statistics in relation to international politics. The primary purpose is to prove that the measurement of national power was the original aim of statistics,[117] before its application was broadened to include other fields as well. Around 1850, statistics separated from political science to turn into a methodological science in its own right. Statistics were then again featured by an emerging geopolitics, given that geopolitics had more of an empirical orientation as compared to the theorizations of a puristic political science. With the post-WWII advance of the computer age, statistics has found its way back into international relations, especially in the United States, where a viable community of quantitative scholars has come into existence, and where quantitative approaches are considered a legitimate method *within* international relations and political science.

10.1 Etymological Origin of "Statistics"

In the 17th and early 18th century any reference to the power of the state was uncommon. Rather one referred to the power of princes. The expression "state" for the body politic emerged in Germany after 1650, and it was only after 1740 that the "state" replaced the "prince" as the holder of power in the public discourse. It was also in the 18th century that "states" were increasingly referred to as "powers", for instance in the discussion of the *great powers* in political discourse (KLUETING 1986: 33–36). From 1748 Gottfried Achenwall (1719–1772) first popularized the term "statistics" ["Statistik"] in Germany, though the term had been in irregular use before that date (as in two book titles from 1672 and 1701). Achenwall traced the term back to "statista", which is the Italian word for *statesman*,[118] meaning that statistics was a discipline of statecraft [Staatskunst], hence related to political science or "state science" ["Staatenkunde"], as it was called at the time. The intention of statistics was to provide statesmen with the necessary knowledge of the internal conditions of states. Initially the term "statistics" ["Statistik"] was only used in Germany, though similar efforts existed in other countries as well. France then organized its Statistical Office [Bureau de Statistique] in 1801 and Prussia its Royal Statistical Office [Königliches Statistisches Büro] in 1805 (KLUETING 1986: 40–41, 51–53, 56).

Statistics, in the way understood today, had its origin in England with the works of John Graunt (1620–1674) and his friend William Petty (1623–1687). Petty started using the term "political arithmetic" as designation for his statistical work. In 1690 he published a work titled *Political Arithmetic*. The term "statistics" was first used in England in 1770 (JOHANNISSON 1990: 343), though it

[117] As a typical example of how closely statistics and international politics was related, one simply needs to look at the titles of those statistical works that consisted mainly of country descriptions that one finds nowadays in almanacs. For example Joseph Constantin Bisinger published one such work in 1818/1823 titled *Comparative Description of the Basic Power or State Forces of all European Monarchies and Republics* [*Vergleichende Darstellung der Grundmacht oder der Staatskräfte aller europäischen Monarchien und Republiken*] (BISINGER 1823). The titles of other statistical works were not less bombastic.

[118] Stuart Witt wrote a brief and concise discussion of the relationship between statistics and political science. He relates "statistics" to the Latin word "status" that derives from the verb "stare" (to stand), hence "status" referring to "position, posture, situation, condition, and social status" (WITT 1993: 1).

was John Sinclair starting in 1791 who popularized the term in his work titled *The Statistical Account of Scotland*. In explaining his motives Sinclair stated in volume 20 of his work:

> MANY people were at first surprised, at my using the new words, *Statistics* and *Statistical*, as it was supposed, that some term in our own language, might have expressed the same meaning. But, in the course of a very extensive tour, through the northern parts of Europe, which I happened to take in 1786, I found, that in Germany they were engaged in a species of political inquiry, to which they had given the name of *Statistics*; and though I apply a different meaning to that word, for by Statistical is meant in Germany, an inquiry for the purpose of ascertaining the political strength of a country, or questions respecting *matters of state*; whereas, the idea I annex to the term, is an inquiry into the state of a country, *for the purpose of ascertaining the* quantum *of happiness enjoyed by its inhabitants, and the means of its future improvement*; yet as I thought that a new word, might attract more public attention, I resolved on adopting it, and I hope that it is now completely naturalised and incorporated with our language. (SINCLAIR 1798: xiii–xiv)

This citation adds force to the point that the original intent of statistics was to look at the strengths and weaknesses of states.

10.2 Pre-1850 Statistics Focused on State Power

Data has been collected since antiquity in order to know military strength in case of war. In Rome and Greece all able-bodied men were registered. During the Middle Ages all able-bodied men were counted along with the population in general in order to determine the need for food in the case of a siege (MEIER 1940: 497). Niccolò Machiavelli (1469–1527) placed likewise great emphasis on having sufficient men for the army and sufficient food in the case of a siege. He wrote about it in a chapter titled "How the Strength of All Principalities Should be Measured" (MACHIAVELLI, *The Prince* X). Official statistics in terms of internal data collection were no new development. Rather the history of German statistics started with the creation of comparable profiles for a number of political entities, the type of country profiles one finds today in many almanacs.

Two Italian scholars set the beginning of preacademic statistics in this regard. In 1567 Francesco Sansovino (1521–1586) published his work titled *Government and Administration of Several Kingdoms and Republics, Both Ancient and Modern* [*Del governo et amministratione di diversi regni et republiche, cosi antiche come moderne*], in which he dealt with 22 states (KLUETING 1986: 43). From 1591 onwards Giovanni Botero (1544–1617) published four volumes of *Universal Relations* [*Le relationi universali*], John Hedley remarking that "this vast compendium of contemporary knowledge of the known world — physical, geographical, anthropological, economic, political, and religious — marked a new genre, namely that of political geography" (HEADLEY 2000: 1134). These works are mostly descriptive and contain only random numerical data at best.

Much closer to the modern understanding of statistics is a work of political arithmetic by the English statistician Gregory King (1648–1712). In 1696 he published a work titled *Natural and Political Observations and Conclusions upon the State and Condition of England* that contains a number of standardized, international statistics on England, France, and the Netherlands. These statistics had timely political relevance as the Nine Years' War was raging from 1688 to 1697. England and the Netherlands were two protagonists of the Grand Alliance, which also included Spain, Savoy, and the Holy Roman Empire. This Grand Alliance was in a war with France. Here are the more relevant statistics provided by King:

Table 10: General Account of England, Holland, and France in 1688/1695 [King]

Nation	Number of People	1688 General Income £	Public Revenue and Taxes £
England	5,500,000	43,500,000	2,000,000
Holland	2,200,000	17,750,000	4,750,000
Grand Alliance	7,700,000	61,250,000	6,750,000
France	14,000,000	84,000,000	10,500,000
Grand Alliance / France	55.0%	72.9%	64.3%

Nation	Number of People	1695 General Income £	Public Revenue and Taxes £
England	5,450,000	42,500,000	6,500,000
Holland	2,240,000	18,250,000	6,700,000
Grand Alliance	7,690,000	60,750,000	13,200,000
France	13,500,000	74,000,000	17,500,000
Grand Alliance / France	57.0%	82.1%	75.4%

Source: KING 1696: 68; author's own calculations.

As can be observed, the position of France vis-à-vis the combined total of England and the Netherlands had worsened in all three categories shown. In the end France was unsuccessful in gaining its objectives. Jacek Kugler and Marina Arbetman credit the work of Gregory King as "one of the first attempts to measure national power" (KUGLER & ARBETMAN 1989: 50). King can be credited for being one of the first to estimate national income, further he suggests that such data is "the most useful and necessary" in order to sustain the war (Nine Years' War 1688–1697), though he nowhere explicitly states that national income represents ipso facto national strength (KING 1696: 31, 61–66).

The development of statistics in Germany was more in the tradition of Sansovino and Botero. Harm Klueting wrote his postdoc habilitation thesis about German statistics in the 18th century, which he calls a "science of the power of states" ["Lehre von der Macht der Staaten"]. He claims that statistics developed in connection to the notions of the balance of power and raison d'état (KLUETING 1986: 16). He explains the relation of statistics [Statistik] to statecraft [Staatskunst]:

> Statistics and statecraft dealt with questions regarding the power of states and the factors affecting them. Whereas statistics – this contemporary term is used throughout this text in accordance with how it was understood in the 18th century – empirically

> pulled together knowledge about the power-potential of particular states, statecraft worked on systematic-theoretical principles about the power of states in general, formulated general statements about the nature and content of all power relevant to foreign policy, and discussed possibilities for influencing power relations as well as strategies for increasing or decreasing power. (KLUETING 1986: 17–18)[119]

This statement suggests how statistics can relate to political science even nowadays. Statistics tends to be more empirical-inductive and may as method complement a political science that often tends to be more theoretical-deductive.

Statistics was promoted primarily by academics with the patriotic intention of providing statesmen with a solid foundation of knowledge about their countries in comparison to others. States did not consider such activities helpful, because any information about any country could be considered a state secret [Staatsgeheimnis]. States did not release information they considered sensitive, as they were afraid of possibly endangering themselves by giving other states the opportunity to analyze weak points. Rough information had to be obtained by correspondence, travel writings, and so on (KLUETING 1986: 19, 24–25, 40, 63). Initially statistics did not provide many numbers, if any. It was more a standardization of categories for state descriptions in order to be useful for comparative purposes. For example Achenwall uses two broad categories: land and people.[120] The literal focus of statistics was to describe the idiosyncrasies of the various states [Staatsmerkwürdigkeiten]. Table statistics began in 1741 with the work of Johannes Peder Anchersen (1700–1765), though seven out of eight lines in his tables consist of description, with only one line providing numbers for the size of areas. From 1760 to 1797 one can observe a paradigm shift from the categorization of power to the quantification of power. As a result tables became increasingly numerical in content. This partially correlates to the scholarly perception of material-economic factors as being increasingly important compared to nonmaterial factors (for example the title of nobility, that is, whether the ruler is emperor, king, duke, prince, or whatever). In 1785 August Friedrich Wilhelm Crome (1753–1833) introduced the graphical depictions of quantities through diagrams, another important tool of modern statistics (KLUETING 1986: 27–28, 55–57, 69, 75–77, 80–82, 316).

The increasing availability as well as reliability of quantitative data eroded the notion of their being state secrets. The publicity of the data turned statistics into feedback mechanism for states in terms of having to compare their performance to that of other states. It went hand in hand with democratic emancipation, for it provided the means to allow citizens to hold their states more accountable (KLUETING 1986: 63–66, 69–71). The widespread success of statistics effected its separation from political science [Staatskunde] as it was increasingly used for other purposes than the

[119] German text: "Statistik und Staatskunst behandelten die Fragen nach der Macht der Staaten und den sie wirkenden Faktoren, wobei die Statistik – dieser zeitgenössische Name soll hier durchgehend gemäß dem Verständnis des 18. Jahrhunderts Verwendung finden – empirisch Kenntnisse über die Machtpotentiale der einzelnen Staaten zusammentrug, während die Staatskunst systematische-theoretische Maximen über die Macht der Staaten überhaupt erarbeitete, generelle Aussagen über das Wesen und die Inhalte der außenpolitischen relevanten Macht formulierte und Möglichkeiten zur Beeinflussung der Machtverhältnisse, Strategien zur Machtsteigerung oder Machtminderung, erörterte."

[120] The less known scholar Julius August Remer (1738–1803) suggested four categories of power: size, population, wealth, as well as the ability of the country to combine its strengths for undertakings (KLUETING 1986: 59–60).

measurement of national power. Felix Klezl looked at 116 definitions of statistics, he counted 45 that emphasized statistics as a part of political science [Staatswissenschaft], almost all of them falling into the period 1749–1850, and he counted 47 that emphasized that statistics is an independent methodological science, almost all of them falling into the period 1850–1935, most of the hybrid definitions falling into the period 1846–1854 (KLEZL 1940: 11–12).[121]

10.3 Geopolitical Statistics in German Geopolitics

With the emergence of statistics as an independent methodological science in 1850, it appears that the original intention of statistics to collect information and data about countries partially fell into geography, with political science returning its focus mainly to theoretical abstractions. In turn a more empirically oriented political geography emerged with the work of the geographer Friedrich Ratzel, so that later on geography and statistics merged with international politics to form geopolitics. A primary geopolitical focus has been the analysis of the elements of power (chapters 3, 5). The *Journal for Economic Policy* [*Wirtschaftsdienst Hamburg*] was founded in 1916 and specialized in economic issues, periodic country reports, world economic surveys, and statistics; it continues publishing to this day. The *Journal of Geopolitics* [*Zeitschrift für Geopolitik*] was founded in 1924. From 1925 to 1927 the *Journal for Economic Policy* supplied the *Journal of Geopolitics* with statistics. This cooperation was ended because the *Journal of Geopolitics* experienced financial difficulties in 1928 (MÖLLER 1987). The following statistics were featured as "geopolitical statistics" ["Geopolitische Statistik"]:

Table 11: Geopolitical Statistics 1925–1927 [*Journal of Geopolitics*]

1925	1926	1927
Demography (Marriages, Births, Deaths)	Coal Production	Extent of Tariffs
Immigration to the United States	Cotton Production & Consumption	Imports via Hamburg, Rotterdam, Antwerp 1910–1913
Iron & Steel Production	Oil Economy	External Trade of the United States
	Rubber Production & Consumption	Shipping Costs for German Imports
	Production & Distribution of Precious Metals	
	Metal Production & Consumption	
	Maritime Traffic in Main Canals & Ports	
	World Trade	

Source: *Zeitschrift für Geopolitik* 1925–1927.

The initial focus in 1925 was demography. Comprehensive updates on population trends were published in 1928, 1931, 1934, 1936, and 1941. In relation to demography, an important issue

[121] Klezl himself considers statistics to be applied mathematics. He argues for the reintegration of statistics into political science [Staatswissenschaft], partly because statistics cannot generate its own data: it needs to collect data from somewhere else. He also points out as a possible argument that one needs expertise in the field from which the data is collected. He criticizes the contempt for statistical methods he detects among scholars who are not so strong in mathematics, just as he criticizes the uncritical faith in the usage of statistics he detects among mathematical experts (KLEZL 1940: 15, 17–18, 20; see section 16.3).

discussed in 1925/1926 was the calculation of carrying capacity (compare section 13.1), which is the maximum population size that the soil of a given country can support. For this calculation one needs to estimate the average fertility of the soil. The focus shifted in 1925/1926 to the production of raw materials, which is geoeconomics in the original sense (section 7.2). Subsequently the focus shifted in 1926/1927 to world trade, German geopoliticians promoting the concept of relative autarchy (compare section 7.1). In 1930/1931 the statistician Karl Saenger took his turn in promoting statistics in the *Journal of Geopolitics*. He still considered statistics to be a part of political science [Staatswissenschaft] in the broadest sense. He also explained that statistics was originally intended for the administration of the state and not as an aid to great politics (SAENGER 1930: 255). He featured the following statistics as "geopolitical statistics" ["Geopolitische Statistik"]:

Table 12: Geopolitical Statistics 1930/1931 [*Journal of Geopolitics*]

1930	1931
Air Traffic	Merchant Fleet
Population	Maritime Traffic in Main Canals
Production of Raw Materials	
Agricultural Production	
International Trade	
Maritime Traffic	

Source: *Zeitschrift für Geopolitik* 1930/1931.

Saenger did not add any new field. Agricultural production was already touched upon by looking at carrying capacity, and air traffic can be seen as a technological extension of maritime traffic.

This brief review of geopolitical statistics shows that the geopoliticians in charge of the journal were primarily interested in (1) population trends, (2) agricultural production in relation to territory, (3) production of raw materials, and (4) trade dependencies.[122] It is a rather demographic-economic focus. Military statistics are noticeably absent from these featured geopolitical statistics, though German geopolitics has often been accused of militarism and the like.

10.4 Quantitative Approaches in American IR

From 1926 onwards an interdepartmental study on the causes of war was conducted at the University of Chicago. In 1942 Quincy Wright (section 13.4) published *The Study of War* that summarized and concluded this research project, the two volumes containing massive amounts of information, including statistical data. In his 1955 book *The Study of International Relations* Wright lists four methods for the study of international relations: (1) historical-descriptive, (2) analytic-rational, (3) synthetic-practical and (4) statistical-mathematical (WRIGHT 1955: 125–126). Other pioneering efforts in the quantitative direction were notably that of Pitirim Sorokin and Lewis Fry Richardson. Pitirim Sorokin (1889–1968) was born in Russia and emigrated to the United States in 1923. He uses a lot of

[122] This brief review was concerned only with articles that were explicitly featured as statistical. Other articles may, of course, also contain tables with numbers to support whatever arguments, yet they were excluded from this analysis.

quantitative and statistical data in his major work *Social and Cultural Dynamics*, the first three volumes of which were published in 1937 with the fourth following in 1941. Lewis Fry Richardson (1881–1953) was a British pacifist. In 1919 he wrote a text titled *The Mathematical Psychology of War*, and in 1949 he published *Arms and Insecurity*, followed by *Statistics of Deadly Quarrels* in 1950. In the two latter texts he statistically analyzes the causes of war.

A new era for humanity started with the event of the first operational computers in 1941, though it would still take a number of years of gradual improvement to make their presence felt in academia. The first transistorized computer was presented in 1953. Vacuum tubes were used before the invention of the transistor. The next big step for computer technology was then the invention of microprocessors in 1971. This rapid progress in computing technology enabled as well as encouraged an increased attention to empirical-quantitative approaches in political science (known also under the labels of "behavioralism" and "scientism") in the 1950s and 1960s.[123] The early phase of computer development caused a hype in the expectations of what could possibly be calculated. Models predicting the future attracted special attention (MAXEINER 1995; SCHMID 1999; also section 13.10).[124]

A number of quantitative projects in international relations were initiated in this period, but only some are mentioned here: In 1957 Harold Guetzkow initiated the Inter-Nation Simulation (INS) at Northwestern University that was relabeled Simulated International Processes (SIP) in 1964 and lasted until 1974 (section 13.6). In 1962 Karl Deutsch established at Yale University the Yale Political Data Program (YPDP), which also included Bruce Russet, one result being the *World Handbook of Political and Social Indicators*, published in 1964, 1972, and 1983 (RUSSETT et alia 1964; TAYLOR & HUDSON 1972; TAYLOR & JODICE 1983a, 1983b). R. J. Rummel directed the Dimensionality of Nations (DON) project that lasted from 1962 to 1975, and moved with him to the University of Hawaii in 1966 (section 13.16). In 1963 David Singer established the Correlates of War (COW) project, which experienced its heyday from the mid-1960s until the late 1970s (section 13.15). This sample of project names demonstrates how quickly quantitative approaches established themselves in the United States as a part of international relations, instigating a challenge to traditional approaches. In comparison, the development and usage of quantitative approaches in Europe remains weak to this day (MENZEL & VARGA 1999: 57–58).

10.5 The Second Debate in IR: Traditionalism vs. Science

In 1966 the British scholar Hedley Bull published the article "International Theory: The Case for a Classical Approach" (BULL 1966). The article initiated the second debate in international relations

[123] Oran Young emphasizes this role of computers in his criticism of empirical-quantitative approaches: "Despite its serious consequences, it is not difficult to understand why puristic induction so often becomes a trap. Collection of empirical data on this basis is a substitute for the production of creative ideas—a substitution that appears to be psychologically gratifying to many analysts. And the new toy of social science, the computer, presents an invitation to become preoccupied with puristic induction" (YOUNG 1969: 493).

[124] Harry Summers recounts in one of his books an illustrative anecdote that was circulating during the final days of the United States' retreat from Vietnam: "When the Nixon Administration took over in 1969 all the data on North Vietnam and on the United States was fed into a Pentagon computer—population, gross national product, manufacturing capability, number of tanks, ships, and aircraft, size of the armed forces, and the like. The computer was then asked, '*When will we win?*' It took only a moment to give the answer: '*You won in 1964!*'" (SUMMERS 1983: 11).

between those favoring the traditional/classical approach and those favoring a scientific/scientistic approach. The traditional approach "is characterized above all by explicit reliance upon the exercise of judgment […], that general propositions about this subject must therefore derive from a scientifically imperfect process of perception or intuition" (BULL 1966: 20). In the scientific approach the "propositions are based either upon logical or mathematical proof, or upon strict, empirical procedures of verification" (BULL 1966: 21). In the rest of the article Bull puts forward seven propositions in his argument against the scientific approach. A summary of these propositions:[125]

1. The scientific approach confines itself to what can be logically and or mathematically proved or verified according to strict procedures, therefore it limits itself to matters of marginal importance, unable to deal with the elusive substance of international relations, which requires intuition and judgment.
2. The scientific approach is at best helpful in producing illustrative analogies, but it is only the traditional approach that can produce the judgments valuable to theory.
3. The scientific approach relies on the uncertain promise of a unified, objective international relations theory in the future, which may never be the case due to complexity, impossibility of controlled experimentation, constant change, and a holistic interchangeability of subject/object as well as cause/effect. *This problematic applies fully to the construction of power formulas.*
4. The scientific approach uses models that oversimplify reality, therefore shifting the focus to the models away from reality, leaving the models with little explanatory power for reality.
5. The scientific approach counts quantities and thus ignores qualitative differences in the units counted, and assuming that these differences may not cancel each other out, the results may deliver a distorted picture of reality and in consequence be unreliable. *One of the greatest challenges in the construction of power formulas is how to weigh different variables (sections 16.5–16.8), taking into account that different variables differ in importance and not everything should be counted the same.*
6. The scientific approach demands rigor and precision, but this demand can be accommodated by the traditional approach, so terms should be defined, procedures should conform to logic, and assumptions should be made explicit.
7. The practitioners of the scientific approach choose to ignore philosophy and history, making a self-critical attitude towards their own assumptions impossible.

This criticism was thrown at the scientific approach in general, which includes complex models on foreign policy behavior and the like (system theory, games theory, et cetera). The quantification of national power is a more basic topic preceding all these models and the computer age. In any case, some of the enthusiasm for the scientific approach vanished because significant new results were not forthcoming, whereas the available results seemed to be of a mediocre sort confirming more or less

[125] Arguments in favor of the quantification of national power and by extension the scientific approach can be found in the beginning of this study (section 1.4). They are not repeated in this section.

already existing beliefs (see sections 13.16, 13.17). In 1985 James Lebovic wrote the following about the state of quantitative studies:

> A recent concern has been whether a nation's behavior can be more accurately predicted through knowledge of its physical attributes and those of the nations with which it interacts. While only a decade ago scholars enthusiastically embraced the techniques and promise of a new science of international politics, the direction of current research now reflects some disillusionment with the ambiguous statistical findings and unconnected generalizations associated with the scientific approach. (LEBOVIC 1985: 47)

Regarding the development of power formulas in the United States, the most active as well as creative period was from 1963 to 1984. From 1987 onwards the development of power formulas experienced a renaissance in China. In general, the United States is still the forerunner in quantitative studies.

11. Operational Power Formulas

Stephen Jones writes that "one of the most serious problems that beset the student of national power is how to avoid encyclopedism" (JONES 1953: 440). Chapters 12–15 are more or less encyclopedic in character. The power formulas in chapters 13–14 are in chronological order. Next to discussing some basic technical aspects like presenting the formulas themselves along with the variables and their respective weights, every effort has been made to enrich these analyses of power formulas by looking at some background information about the designers, their intentions, their theories, in order to get a basic explanation for some of the idiosyncrasies that make most formulas unique. Theoretical background can, of course, be only given if the designers stated their theoretical assumptions explicitly, or if those can be reconstructed from implicit statements as well as from information about the variables and method employed. Much attention is given to the feedback, if any, these power formulas received, especially as feedback given to past formulas can be useful for future designers of power formulas. This chapter offers a brief sketch of the history of power formulas. It defines operational power formulas as formulas ready for calculation, whereas theoretical power formulas are not made for calculation but for conceptual clarification. A number of the remaining ambiguities are discussed, along with how they have been dealt with, explaining according to what criteria the operational power formulas were selected for inclusion in this work.

11.1 Brief History of Power Formulas

The history of power formulas can be roughly divided into three time periods. The first time period refers to all power formulas created before 1960. I could trace only four, but there may well be many more. Typical for this time period is that no quantitative network existed to review and collect power formulas. The power formulas created in this time period were more or less randomly isolated incidents unconnected to one another through any form of collective awareness. Finding such formulas is extremely difficult. Indeed, it is little more than a matter of luck. The best bet is to read the works of scholars competent in the political literature published before 1960 in the hope that they mention in one of their footnotes an approach to measure power. The problem is not that political literature is lacking, nor that there was a lack of concern for national power and the discovery of meaningful numbers to approximate it. Quite the opposite: political literature is abundant, and concern for national power is ubiquitous (section 10.2). Yet the fulfillment of these two context conditions does not ipso facto guarantee the existence of a formula. There is far too much related material yielding far too little in the way of systematic research. It is rather for scholars such as diplomatic historians, who are immersed in the literature of the past for many reasons other than this specific one, to make a meaningful contribution to understanding how national power was assessed in the past,[126] and in this process some forgotten power formulas may come to light.

[126] Harm Klueting's postdoc habilitation thesis is an example for such a work on the assessment of national power in the 18th century (KLUETING 1986).

The second time period is from 1960 to 1987. In 1960 Frank Clifford German published his calculations of national power (section 13.5). The article has seven pages and is as such rather rudimentary. German explicitly admits the arbitrary and subjective way in which he pieced together the numbers. At some point he started working in journalism, so there is no record of further work on his part in this area. It seems mere coincidence that this article was noticed and subsequently cited by the Correlates of War (COW) network, founded in 1963, and led by David Singer. Continuous improvements in data collection and computing technology had enabled and encouraged a project like this to emerge (section 10.4). The COW gained increasing publicity in the late 1960s and early 1970s. This meant there was a network in place to keep referencing the German article once it had been cited by David Singer and colleagues, so much so that we can designate his formula as having become a grounded information piece in this collective network memory. Other efforts by other scholars to calculate national power, notably that of Wilhelm Fucks in 1965 (section 13.10), as well as the development of the Composite Index of National Capabilities (CINC) by Singer and colleagues in 1972 (section 13.15), were also fed into this collective network memory, helping to increase the level of interest and awareness attached to the calculation of national power.

The third time period started in 1987 and continues to the present. In 1987 the Japanese Economic Planning Agency (EPA) published a statistical report on the comprehensive national power (CNP) of Japan in comparison to five leading Western countries plus the Soviet Union (section 14.1). The report consisted of 203 pages filled mostly with statistics, proving at the very least that a considerable effort was involved in its compilation. This report seems to have been treated as just another statistical report by the government. It has hardly been discussed in Japan, which may also relate to the way Japan has purposefully kept a low profile since WWII (Yoshida doctrine). Given that the report was, obviously, in Japanese, there was little danger that it would attract the attention of Western scholars. Japan is closely watched by Chinese scholars with a mixture of jealousy and admiration. Somehow this report must have found its way into Chinese academic news channels, because since 1987 the number of academic articles published in China concerning CNP has exploded (see the introductory part of chapter 14). While in the West the effort to measure national power has stagnated, in China a renaissance of power calculations fueled by enthusiasm and ambition has occurred. Though seventeen CNP formulas are discussed here, there are most probably many more. The language barrier means this work needs to be done by a China expert.

The three time periods portray a general evolution, though in practice the formulas associated with each time period overlap in practice. Even today one can find randomly isolated attempts to measure national power, though new formulas are more likely to be noticed in the age of internet. In any case, all non-CNP formulas are grouped here in one section. The COW project continues to exist in name, but as the efforts at its heart have spread in many directions and reached many institutions, it nowadays represents a loose network. A quantitative community in international relations exists, though mainly in the United States and much less so in Europe. Correspondingly the collective network memory continues to function, and formulas as well as more theoretical approaches are still added if widely enough circulated and referenced. Examples are the CIA/IFs formula (section 13.38)

and the preoperational Tellis approach (TELLIS et alia 2000a, 2000b; further footnote #129 in next section). The start of the wave of CNP calculations can be dated to 1987, and, given certain group characteristics and common background, the CNP formulas were given their own chapter.[127] The Indian National Security Index (NSI) is a hybrid. It has both Western and Chinese roots (section 15.4). In terms of approach it can be most properly called a CNP index. The NSI has been published semiregularly since 2002 and has proven dynamic in changing variables and weights each time. In a sense it is the culmination of all the efforts – direct or indirect – to measure national power so far. Yet to this day it has not been elaborately discussed anywhere. For these reasons it receives here the most detailed analysis in a chapter of its own.

11.2 Defining Formulas as Operational

Power formulas are operational when actual numerical results are calculated. This way they differ from theoretical power formulas, which are not meant for direct calculations. Theoretical formulas serve primarily for the clarification of conceptual thinking. The difference is often made clear by the designation of variables used. Operational formulas use concrete variables, for example "nominal GDP + military expenditures". For a theoretical formula it suffices to indicate general areas as variables, for example "economy + military". These general areas remain operationally unspecified. Still some ambiguities remain:

- The definition of power is an issue.[128] The formulas purport to measure anything from military power to prestige. This listing of power formulas is based on content and not words. If, for example, a formula purports to measure military power but in terms of content includes nonmilitary components, then this indicates that this is a power formula operating in a broader context than military science. Ideally all power formulas should have one military and one economic variable to indicate that they are power formulas in the broader sense of international relations. This is not always the case. That is why the inclusion/exclusion of a number of formulas had to be based on arbitrary judgment based on the intentions put into the formulas as well as the usage of results.
- In general, power formulas may contain subindexes of diverse kinds. In a few cases the power formula is actually the subindex of a larger measurement. In these special cases the focus is put on the power subindex. Accordingly, it is this specific subindex and not the broader index that is treated and analyzed as a power index, though contextual information on the total index is provided as well.

[127] Pre-1987 conceptual precursors existed. For example the calculations on prestige by Shimbori and colleagues published in 1963 (section 13.8). Yet no string of awareness seems to exist between this work and the 1987 EPA study, which is why the calculations by Shimbori and colleagues were not included in the chapter on CNP formulas.

[128] "Definitions are of no value to science, because they are always inadequate. The only real definition is the development of the thing itself, and this is then no longer a definition" (Friedrich Engels, quoted in WITTFOGEL 1929: 515). German text: "Definitionen sind für die Wissenschaft wertlos, weil stets unzulänglich, die einzige reelle Definition ist die Entwicklung der Sache selbst, und diese aber ist dann keine Definition mehr."

- A few times the formula is operational in all but results, that is, the variables are specific and the data is there, but for whatever unknown reason the designer of the formula abstained from proceeding to calculation. In those cases the formulas were deemed operational and some results were calculated for presentation. This is then noted in the description texts.
- Sometimes a power inventory has been created for the explicit purpose of measuring power. Accordingly, most of the variables are already quantitative or inviting quantification. Only a final formula and weights are missing for whatever reason. In those cases the power inventories were deemed to be not equivalent to operational formulas.[129]
- In a few instances the text indicates that results were calculated but fails to give the numerical values of these results; in some cases not even the specific variables are given. In such cases the formulas have been deemed operational and every effort has been made to reconstruct as much as possible leaving the rest blank. A more specific variation of the same problem exists when the results are only available as graphs but not numbers. These problems are mentioned in the description texts. For that reason not all of the following sections on operational power formulas contain results.

All things considered, this attempt at uniformity has more often than not reached its limits, though – despite extremely diverse sources and approaches – every effort has been made to present the power formulas and indexes in a standardized way.

11.3 Scales of Measurement

In 1946 the American psychologist Stanley Smith Stevens (1906–1973) proposed a classification scheme consisting of four scales of measurement: nominal, ordinal, interval, and ratio (STEVENS 1946). Other people have suggested scales in addition to these four. For the purpose of this study,

[129] In five cases power inventories came close to operationalization: (1) The power inventory by George Bell Dyer and Charlotte Leavitt Dyer in 1958. Both had been members of US Army Intelligence. Later they together taught courses in intelligence methods and proposed an elaborate classification system for source material on international affairs, as part of which they divided national power into ten primary factors. These were further broken down into 97 secondary factors and still a much larger number of tertiary and even quaternary factors. The ten primary factors were: geographic, demographic, political, foreign affairs, economic, industry, transportation/communication, scientific, armed forces, and biographic. They suggested that an operations research team of experts would have to assign weights to the factors, the numerical values in each factor to be normed relative to the largest value. The ten primary factors were to receive equal weights initially (DYER & DYER 1960, further 1958); (2) RAND published the two works on the Tellis approach in 2000 (TELLIS et alia 2000a, 2000b). Ashley Tellis and colleagues wanted to measure national power, which was divided into three realms: national resources, national performance, and military capability. Each realm consisted of numerous variables, the appendix of the more detailed work listing 41 suggested indicators in total (TELLIS et alia 2000a: 179–182). The Tellis approach has not produced a working formula or results since that time, possibly due to quantification problems encountered in transforming a great deal of meticulously detailed theory (212 pages!) into practically useful calculations; (3) The power inventory by Venezuelan professor Makram Haluani in 2006. He titled his project "The Competitive Advantages of States: An Empirical-Comparative Appraisal of the Contemporary National Power of 190 Countries" ["Las Ventajas Competitivas de los Estados: Una Evaluación Empírico-Comparativa del Poder Nacional Contemporáneo de 190 Países"], for which he selected 65 variables for four areas: natural resources, human resources, national production, and military capacity (HALUANI 2006: 146–148; 2008: 24–31, further 2002). Eventually he gave up as the collection of data, which included the filling of many gaps, proved too much for him; (4) The power inventory by German professor Detlef Nolte in 2007. For his Regional Powers Network (RPN) project he compiled a sheet with 27 diverse indicators or indicator sets, eleven of which were quantitative with another four inviting quantification (NOLTE 2007: 16–17, further 2006: 16); (5) The power inventory by William Inboden from the Legatum Institute (known for their Prosperity Index) in 2009. His power inventory actually goes furthest towards operationalization as he has suggested weights for four different pillars of national power: 25% for economic strength, 20% for foreign relations, 15% for social capital, and 40% for military strength. These four pillars in turn summarize 79 suggested indicators, for which no weights are suggested. This power inventory is only one small step away from operationalization (INBODEN 2009: 19–21).

explaining these four suffices. Knowing the differences between these four scales of measurement is necessary for an adequate interpretation of measurement results, such as the results of power formulas presented in the various power indexes.

Nominal measurement is simply classification or categorization. It refers to the assignment of labels to different classes (classification). For example, in international relations, it is possible to define three theoretical schools in the US: realism, liberalism, constructivism. One could try to group theoretical articles in international relations in accordance with this classification (some articles could be included in more than one class). The statistical relevance of nominal measurement lies in the fact that the classifications enable one to count the number of cases in each class (frequency). Applied to the given example, one can count how many IR articles deal with each theory (realism, liberalism, constructivism). The table operationalizes this scale of measurement in an unsophisticated way:

Table 13: Frequency Distribution for Categorical Data

Search Item for Google Scholar	Articles
"international relations" + "theory" + "realism"	36,300
"international relations" + "theory" + "liberalism"	38,500
"international relations" + "theory" + "constructivism"	12,500

Source: http://scholar.google.com/ [1 August 2011].

Ordinal measurement involves some form of hierarchization or rank ordering. Nominal measurement is limited to applying designations to data. Ordinal measurement sets these designations in some form of relation to one another. For example, in international relations one can order countries according to some arbitrary status hierarchy: hyperpower, superpower, great power, regional power, middle power, small power. No consensus exists as how to define these terms and how to set clear boundaries for each rank. IR experts define ranks differently and rank countries differently. Nevertheless some common tendencies are observable. The basic idea still remains that a hyperpower is more powerful than a superpower, a superpower more powerful than a great power, and so on. The intervals between the ranks are not expected to be equal or consistent in any way.[130]

Interval measurement in turn requires these intervals to be equal. The best example is the solar calendar, so one year is more or less equal in length to the previous year. The problem of the interval scale is that it lacks any objective point zero. One can use the Christian calendar to say that it is the year 2011 or the Suriyakati calendar (Thailand) to say that it is the year 2554. One cannot make a statement that the year 792 is half as much as the year 1584. This would be nonsense. The same applies to temperatures in Celsius or Fahrenheit. One cannot say that 88° is twice as hot as 44° when using either unit. However, one can say that 88 is twice as hot as 44 in kelvins, because the Kelvin

[130] For example, George Modelski uses arbitrary thresholds on system-wide military expenditures in dealing with the issue of polarity: in a unipolar system one country has 50%+ of available military power, in a bipolar system two countries have at least 25% (but none of the two holding more than 50%), in a multipolar system three to seven countries have at least 5% of available military power (but none of the countries holding more than 25%) (MODELSKI 1974: 2). The intervals between 50–25–5 are not equal, whether in absolute magnitudes (25, 20) or ratios (2, 5).

scale starts at absolute zero (–273.15 °C or –459.67 °F). This point zero allows for ratios to be taken. For that reason the Kelvin scale is a ratio scale falling into the category of ratio measurement.

In the context of power formulas, it is important to distinguish between interval scales and ratio scales, because ignorance of this critical issue can lead to *stupid* interpretations. In order to demonstrate the difference, the following table presents "GDP (current $)" in absolute numbers (ratio scale) as well as the common logarithm (interval scale) for five countries:

Table 14: Ratio Scale and Interval Scale

Country	GDP (current $)	GDP (current $) logarithm with base 10
United States	14,582,400,000,000	13.2
China	5,878,629,246,677	12.8
Japan	5,497,812,568,086	12.7
Germany	3,309,668,874,172	12.5
Russian Federation	1,479,819,314,058	12.2

Source: http://databank.worldbank.org/ddp/home.do [2 August 2011].

The common logarithm of US GDP is around 13.2 and that of Russia around 12.2. It would be nonsense to interpret this to mean that the US economy is about 1.1 times the size of the Russian economy, when in fact it is ten times larger. An interval scale does not say how many times one country is more powerful than another. It cannot be inferred from the numbers. The same way that the GDP in absolute amounts cannot be inferred from the logarithm, if one does not know the base. An interval scale allows one to say that one country is more powerful than another, but not by how much. It is only in a ratio scale that one can say this country is so many times more powerful than another.

12. Single Variable Approaches

Single variable approaches are ubiquitous in international relations literature. It is impossible to list all the instances in which a single variable has been used to approximate power.[131] Richard Merritt and Dina Zinnes point out the advantages of single variable approaches, suggesting that "extensive multivariate datasets are unnecessary and complex mathematical manipulations are not needed" (MERRITT & ZINNES 1988: 143, or 1989: 14). Another argument is that "each element of power has different meanings in different areas and contexts" (CHO 2001: 12), so single variable approaches are appropriate when used to "represent relative and situational characteristics of power" (CHO 2001: 12–13). The counterargument to single variable approaches is that power in the real world is complicated, and that a single variable approach amounts to excessive reductionism. Bertrand Russell supports this view:

> The attempt to treat one form of power, say wealth, in isolation, can only be partially successful, just as the study of one form of energy will be defective at certain points, unless other forms are taken into account. (RUSSELL 1938: 11)

Harold Lasswell and Abraham Kaplan likewise reject "the pseudo simplification attained with any unitary conception of power as being always and everywhere the same (violence or economic power or …)" (LASSWELL & KAPLAN 1951: 92). Contrary to that they affirm that "power may rest on various bases" (LASSWELL & KAPLAN 1951: 85), insisting that "none of the forms of power can stand alone: each requires, for its acquisition as well as maintenance, the simultaneous exercise of other forms of power as well" (LASSWELL & KAPLAN 1951: 94). They also emphasize "that the forms of power are interdependent does not entail, however, that all the forms are always of equal importance" (LASSWELL & KAPLAN 1951: 93). The most common single indicator approaches are reviewed in what follows. No attempt at completeness is made here.

12.1 Territory / Population

The most obvious and available indicator of size is territory: one needs only to look at a map (SUPAN 1922: 46–47). Even today, regardless of how well or how badly countries like Russia and Brazil perform, based on maps they will always be countries with 'potential'. However, without permanent population, space is meaningless – the best example is Antarctica. It simply does not work for a single variable approach. Thus follows that the second most obvious and available indicator of size is population. In this context Auguste Comte (1798–1857) is often quoted for saying that "demography is destiny" (Comte, quoted in EBERSTADT 2004: 1). The pointed counterargument runs: "A healthy, skilled population may be a capability; an equally large but disease-ridden and illiterate population can be a

[131] Dariusz Michalik listed the following symptomatic indicators used for simple (single-variable) models: population, size, manufacturing (steel, electricity, cement), industrial production, the volume of exports, national income, military expenditures, manpower, production value, as well as the use of highly developed technology, number of patent applications, installed power of computers (MICHALIK 2010: 91). For a Vietnamese article apparently suggesting patents as a major measure of national power, see *Việt Báo Việt Nam* 2006.

load on a government's capacities" (MERRITT & ZINNES 1988: 143, or 1989: 14).[132] A hot spot where demographics still signify the destiny of power relations in the long run is present-day Israel-Palestine. The demographics indicate that before 2050 the Palestinians will constitute the majority in this area (KENNEDY & WATTENBERG 2004).

12.2 Armed Forces Personnel / Military Expenditures

For those interested in capabilities directly available for war, these two indicators are the most obvious when available.[133] A minor issue exists as to whether to look at military expenditures in terms of purchasing power parity (PPP) or official exchange rates (OER). Currently the mainstream preference is OER due to the arms trade.[134] Alexander Supan uses population to stand as an equivalent for power in order to calculate his pressure quotient, also he proposed military personnel as alternative (SUPAN 1922: 78; also section 3.8). Inis Claude "use[s] the term *power* to denote what is essentially military capability—the elements which contribute directly or indirectly to the capacity to coerce, kill, and destroy" (CLAUDE 1962: 6). Karl Deutsch defines power as "the ability to prevail in conflict" and correspondingly used military expenditures as a short-term indicator of national power (DEUTSCH 1988: 21–23). The counterargument runs: "Generals never tire of telling us that even the best-equipped army is ineffective without good leadership and morale" (MERRITT & ZINNES 1988: 143, or 1989: 14). Italian Lieutenant General Carlo Jean also talks about those important elements of power that "are not susceptible of quantification like prestige, credibility, cohesion, consensus, the ability to accept losses and privations, the quality of leadership and so on" (JEAN 1995: 62).[135]

12.3 National Income / GNP / GDP

Sherman Kent wrote that "some […] hope to find the answer to their prayers in the national income; that is, they are hoping to a find a way of correlating national income to war potential, so that when the former is known, the latter is known too" (KENT 1951: 51). The American demographer Kingsley Davis advocated the use of national income in the absence of anything better (DAVIS 1954: 207–208). Later AFK Organski acknowledged Kingsley Davis as having given him the idea of using national income as an index for national power (ORGANSKI 1958: 203). A decade later Organski switched to GNP, which is similar (ORGANSKI 1968: 209).[136] In 1967 Herman Kahn and Anthony Wiener speculated on the future

[132] For a short discussion on attempts to integrate health and education into a measure called "effective population", see footnote #342 in section 15.7.

[133] The use and measurement of seapower by George Modelski and William Thompson could be considered a variant of a military-type single variable approach (MODELSKI & THOMPSON 1988: 27–49). It serves as an indicator for "projectible national power in their historical studies on the 'long cycle' in international politics" (TELLIS et alia 2000a: 27). Long cycle theory refers to cycles of hegemony with one leading power dominating the international system. This cyclical concept can be traced, among others, to British geopolitician Halford Mackinder (1861–1947), who stated that "the great wars of history—we have had a world war about every hundred years for the last four centuries—are the outcome, direct or indirect, of the unequal growth of nations" (MACKINDER 1919: 1–2). Joseph Nye criticized Modelski and his long cycle theory for "vague definitions and arbitrary schematizations" (NYE 1990b: 191).

[134] Notably the study of military expenditures by Emile Benoit in 1968 is in PPP (BENOIT 1968).

[135] Italian text: "[…] non sono suscettibili di quantificazione, come il prestigio, la credibilità, lo coesione, il consenso, la capacità di accettare perdite e privazioni, la qualità della leadership e così via."

[136] Charles Hitch and Roland McKean used "GNP [as] a useful index of resource limitations" in their study of nuclear war (HITCH & MCKEAN 1960: 33) but not as a "as a single-variable indicator of power" as claimed by Ashley Tellis (TELLIS et alia 2000a: 27).

of international politics by doing a number of projections up to the year 2000. For their quantitative analysis they deem that "population, gross national product, and GNP per capita […] are useful to obtain an indication of potential for political importance" (KAHN & WIENER 1967: 131). At present Joshua Goldstein and Jon Pevehouse maintain that "the best single indicator of a state's power may be its total GDP" (GOLDSTEIN & PEVEHOUSE 2007: 57). Emilio Casetti takes GDP forecasts to look at power shifts (CASETTI 2003). He also calculated a long-term trend (1820–2000) indicating that economic capabilities have been increasing in importance relative to military capabilities (CASETTI 2008). Likewise in China some "authors rely on GDP as the foundation for their assertions of future power" (PILLSBURY 2000: 250).

British historian Paul Kennedy notes that "exceptions to the simplistic equation 'economic strength = military strength' exist" (KENNEDY 1987: 198). Klaus Knorr explains that GNP "is valued, in most countries at least, on the basis of the peacetime preferences of consumers […], the peacetime value of productive resources is not necessarily the same as their wartime value" (KNORR 1956: 222; compare section 13.2). A socio-cultural counterargument runs:

> A high national income (or national income per capita) can imply a country's long-term ability to influence others, but not if it means that the population is less willing and even less able than others to engage in activities such as wars that might jeopardize its high standard of living. (MERRITT & ZINNES 1988: 143, or 1989: 14)

A high standard of living more often than not also corresponds to lower birth rates. It can be reasoned that families with only one child are more averse to risking the life of their only child in conflict than families with many children.

12.4 Energy / Electricity

Kent wrote that whereas some put their hopes in national income, "others feel this way about kilowatt-hours" (KENT 1951: 51). In 1965 Bruce Russett had advocated GNP as "the best summary measure of national power that we have" (RUSSETT 1965: 2–3). In 1968, because of difficulties associated with currency conversion, he came then to the conclusion that total fuel and electric energy consumption might be "even better" (RUSSETT 1968a: 293). He notes that GNP and energy consumption are highly correlated whatever the case may be (compare HEISS et alia 1973: 106–107). The most attractive feature of using energy consumption[137] is that in this way power in international politics is identical to power in physics (energy / time). In 1973 Klaus Heiss, Klaus Knorr, and Oskar

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Indeed Hitch and McKean emphasized that "*in an all-out thermonuclear war the superior economic war potential of the United States is important only to the extent that it has been effectively diverted to security purposes before the war starts*" (HITCH & MCKEAN 1960: 15).

[137] A source of confusion is occasionally the difference between energy production and energy consumption. This is the case because of the difference between primary and secondary energy. Primary energy refers to the raw energy source found in nature, whereas secondary energy refers to primary energy that has been converted into another form of energy such as electricity. This means that secondary energy production is more in tune with energy consumption. Instead of secondary energy production, it is normally better and clearer to refer to electricity generation.

Morgenstern produced some long-term forecasts on power. For this purpose they considered a number of variables, including GNP, but then they settled for energy consumption:

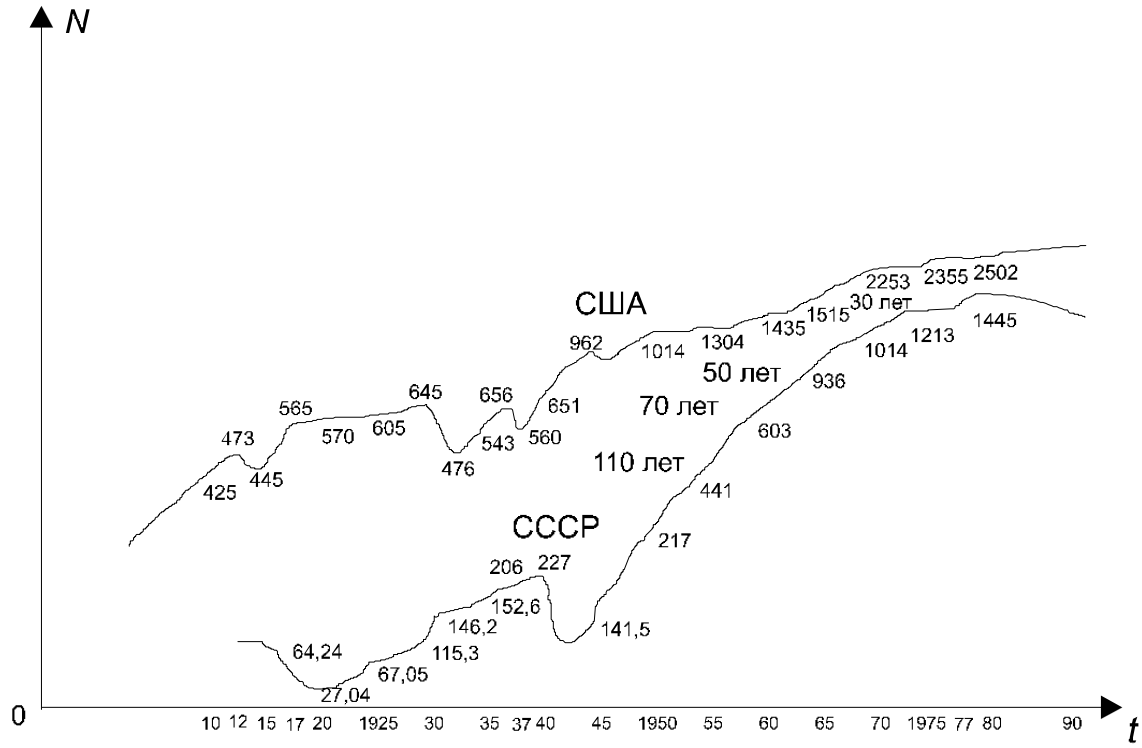
> […] we could not find any single material resource which decisively influences the economic and military power of any one nation or region, with one critical exception: *energy*. […] energy consumption is a reliable index of the economic development of nations. […] irrespective of whether agricultural production, industrial production, or services are emphasized within an economic system, all these require substantial amounts of energy. (HEISS et alia 1973: 103, 105, 111)

In another part of their book they briefly discuss the issue of a multivariate power index combining "population, GNP, and a few specific outputs" and note that "indicators used in aggregative prediction may not differ nearly as much as the evolving differences in their structural makeup" (HEISS et alia 1973: 180–181).

The Russian scientist and thinker Pobisk Georgiyevich Kuznetsov (1924–2000) measured power via energy consumption.[138] In the 1970s he participated in "Effektivnost", a secret scientific research project related to the measurement and projections for the economy (TENNENBAUM 2001). He coauthored *Space and Time in the Evolution of the Global System "Nature–Society–Man"* [*Система Природа–Общество–Человек. Устойчивое развитие*] that was published in 2001 (KUZNETSOV et alia 2000). The following chart illustrates the power of the Soviet Union and the United States:

[138] For two articles in Russian about the measurement of power and Pobisk Kuznetsov, see PUDENKO 2006a, 2006b.

Figure 3: Power of USSR [CCCP] and USA [США] 1920–1980 [Kuznetsov]



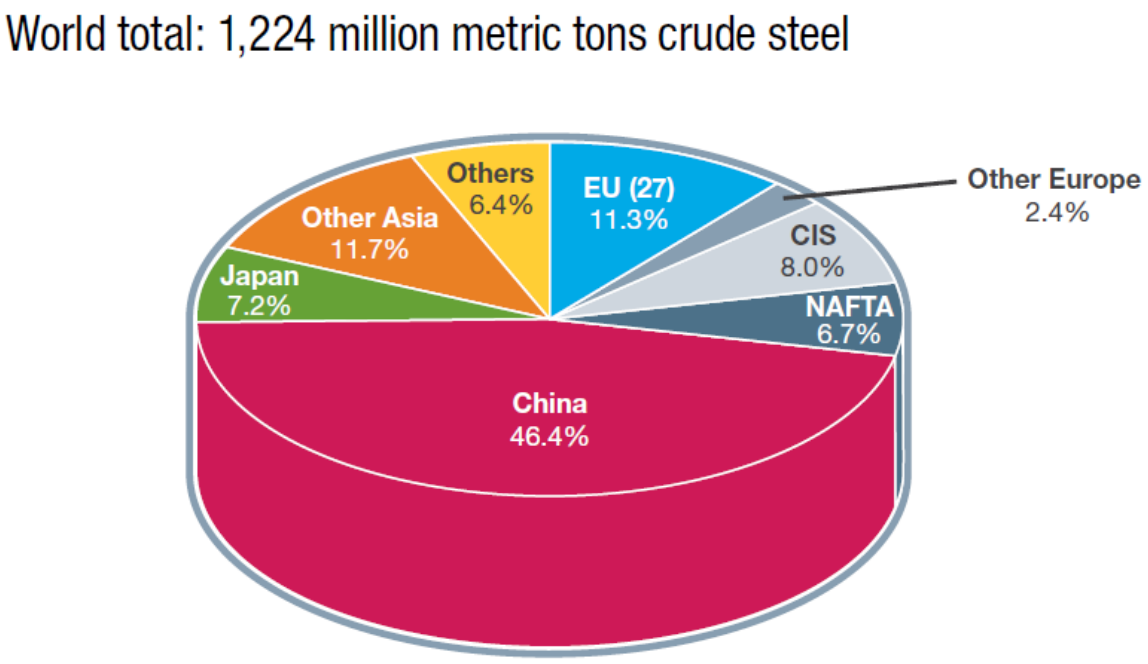
Source: KUZNETSOV et alia 2000: 691.

Given modern-day political pressure imposed by environmentalism, it could be argued that a more sustainable measure might be renewable energy resources. In that case Brazil and Canada would be two leading countries next to China and the United States.

12.5 Iron / Steel

Many times mentioned in conjunction with energy ("coal and iron") for the period of industrialization preceding WWII, especially the 19th century, and occasionally dealt with alone, steel can "often be compared as the national power index and is also the strategic fundamental industry of a country" (LEE 2007: 4). The problem is that "steel production is currently declining for some highly developed states, and many scholars argue that it is no longer a valid indicator of industrial activity" (GREIG & ENTERLINE 2010b: 37–38; further SUŁEK 2010b: 115). John Mearsheimer states that the role of steel began to decline sharply after 1970 (MEARSHEIMER 2001: 67). If taken as a single indicator, then that means that China is today the world's lone superpower:

Figure 4: World Steel Production 2009 [World Steel Association]



Source: World Steel Association 2010: 15.

This measure also implies that the United States is less powerful than India, which further demonstrates that iron and steel have become obsolete as indicators of national power.

12.6 Government Revenues / Expenditures

Steven Rosen chose government revenues as his measure of national strength (ROSEN 1972). His reason for doing so was that no GNP data for the time before 1930 was available in 1972. Nowadays the GDP-PPP dataset by Angus Maddison is available for the time period 1 AD–2008 (MADDISON 2010). In any case, Rosen used government revenues from the *Statesman's Yearbook* conjecturing that government revenues may be "even more sensitive than GNP as a gauge for the influence of wealth on war power" (ROSEN 1972: 171). This line of argument is developed further in the power index by AFK Organski and Jacek Kugler by considering government capacity to collect revenue a major component of power (section 13.25). The International Futures (IFs) model by Barry Hughes has government size (based on government expenditures normalized to the total level of government consumption) as one of nine optional, independent indicators for national power (section 13.38). The problem inherent in this variable is that it gives a bonus to welfare states over laissez-faire economies. The preference of people for such things as a private health care system, a private pension system, and so on, would imply the state to be less capable or powerful. In effect this variable is political, much to the liking of socialists and suspicious to conservatives. Regarding the target areas of government spending, Brian Moul makes the criticism that Rosen's "index neglects the variations in government spending: some spent much more on the military than did others, and spent much more on the military at some times than others" (MOUL 1989: 118).

13. Multivariate Power Formulas

Multivariate power formulas are formulas that contain more than one variable. This is not necessarily as clear as it sounds, as certain variables can be claimed to consist of more than one variable. Thus military expenditures consist of population multiplied by nominal GDP per capita as well as the percentage of GDP dedicated to military expenditures, and so could be claimed to represent three variables rather than one. If variables are of such a type as to be commonly expressed as one variable, then they are counted as one variable, so that the multivariate power formulas presented here are undoubtedly multivariate and not reinterpreted single-indicator approaches. Some were presented in the previous chapter. The titles of the following sections indicate the name of the designer or designers (and in a few cases the name of the institution when this appears more appropriate), the year that a power formula was first designed (or published), and the internet suffix of the presumed country of the designers/institutions.

13.1 Süßmilch 1741 DE

Johann Peter Süßmilch (1707–1767) was a German pioneer in the area of demography and population statistics. He studied law, medicine, and theology before becoming a pastor. In 1741 he published the first volume of his magnum opus *The Divine Order in the Transformations of the Human Race as Demonstrated through Birth, Death, and the Multiplication of the Same* [*Die Göttliche Ordnung in den Veränderungen des menschlichen Geschlechts, aus der Geburt, dem Tode und der Fortpflanzung desselben erwiesen*], reprinted in 1765 (SÜßMILCH 1765). His ambition was to gain a better understanding of God by looking at the world of His creation. He wanted to prove God's will in nature by looking at the lawfulness in natural phenomena through the means of statistical observations. For that purpose he analyzed demographic phenomena with self-designed statistical methods. His work received recognition: in 1745 he became a member of the Prussian Academy of Sciences. He also sent unpublished memorandums to the King of Prussia.

In the Bible God says to humankind: "Be fruitful and multiply, and fill the earth, and subdue it" (Genesis 1:28),[139] which basically sums up the prevalent pre-Malthusian paradigm on demographic policy. Especially from the time of Jean-Baptiste Colbert (1619–1683) to the end of the 18th century there was a consensus that the welfare and power of the state was directly proportional to its population.[140] If the aim of the state was to increase its power, then population had to be increased, and the state had to provide every possible incentive to make that happen. In some states the traditional inheritance laws regarding the indivisibility of farmland were changed to facilitate marriage. Emigration was made more difficult, at the same time as immigration was encouraged. Foreigners were hired to get killed as soldiers. Under Colbert it was decreed that if a father had ten living children,

[139] New American Standard Bible (Lockman Foundation 1995).
[140] Differences in the per capita national income of countries were relatively minor in preindustrial times (see MADDISON 2010), so this view was not unreasonable. The notion of national income was still in its infancy at the time of Süßmilch. In 1665 William Petty and in 1688 Gregory King (section 10.2) had supplied some first estimates on such.

he would be exempt from taxes and other duties. The first foundling homes were established for the purpose of maximizing population growth (WAPPÄUS 41–42, 64–65).

Süßmilch was an exponent of this view, and his formula falls into this context.[141] He writes in his work *The Divine Order*:

> If a country has as many inhabitants as one three times larger, so is its reputation, power and security three times greater, or the splendor of the latter three-times smaller. (SÜßMILCH 1765: 1/402)[142]

The assertion can be directly operationalized into a mathematical power formula:

$$\text{power} = \text{population} \times \text{population\_density}$$

or

$$\text{power} = \text{population}^2 / \text{area}$$

The formula uses the standard population density also known as arithmetic density.[143]

Süßmilch reasons that a larger territory implies more neighbors and thus more potential for conflict. In addition to that, a lower population density makes a country harder to control. His central argument is that, in general, a high population density implies higher development (SÜßMILCH 1765: 1/401–402). It is easier and faster logistically to implement measures in a small state with a high population than in a large state with a small population. Such measures include defense and security but also "concern for the preservation of good manners, virtue, bravery, military training and discipline" (SÜßMILCH 1765: 1/402).[144] Along a similar line of reasoning like that of Süßmilch, emphasizing issues of mobilization and centralization, Saul Cohen's index from 1963 (section 13.9) and David Singer's Composite Index of National Capabilities (CINC) from 1972 (section 13.15) contain urbanization as a positive element of state power.[145]

Süßmilch never calculated the results of his formula, though he made a great effort to compile the data that would go into it. The following table shows the results he would have obtained, if he had done those calculations:

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[141] Friedrich Ratzel mentions Süßmilch's work in his book *Political Geography* [*Politische Geographie*] as an example of how population size had been politically overvalued in the Age of Absolutism (RATZEL 1923: 303–304; compare section 3.5).

[142] German text: "Wenn ein Reich ebensoviele Einwohner hat als ein dreimal größeres, so ist desselben Ehre, Macht und Sicherheit dreimal größer oder die Herrlichkeit des letzteren dreimal kleiner."

[143] Some countries have vast tracts of nonhabitable land (e.g. Egypt). This could make it more appropriate to use the physiological density, which is total population divided by the area of arable land. Saul Cohen uses the physiological population density in his formula (section 13.9).

[144] German text: "[…] Sorge für die Erhaltung guter Sitten, der Tugend, der Tapferkeit, der Kriegsübung und Disziplin […]."

[145] Saul Cohen and David Singer are both Jewish, and it may have taken a Jewish pro-urban bias to properly realize and acknowledge the importance of urbanization as a factor. As for the strong tendency of Jews to live in urban habitats, Singer himself writes in the *American Jewish Year Book 2006*: "The overwhelmingly urban concentration of Jewish populations globally is evinced by the fact that in 2006 more than half (51.9 percent) of world Jewry lives in only five metropolitan areas—Tel Aviv, New York, Jerusalem, Los Angeles, and Haifa" (SINGER & GROSSMAN 2006: 598).

Table 15: The Power of Countries / Areas in 1765 [Süßmilch]

Country / Area	Population	English mi^2	Population / mi^2	Power
China	150,000,000	1,105,000	136	20,361,990,950
Asia (remainder)	383,000,000	7,898,487	48	18,571,784,697
India	100,000,000	1,116,000	90	8,960,573,477
Germany	24,000,000	188,684	127	3,052,723,071
Africa (remainder)	146,000,000	8,359,300	17	2,549,974,280
America	150,000,000	9,000,000	17	2,500,000,000
Japan	17,000,000	138,000	123	2,094,202,899
France	17,000,000	138,837	122	2,081,577,677
Netherlands	5,000,000	12,968	386	1,927,822,332
Italy	10,000,000	75,576	132	1,323,171,377
Poland-Lithuania	12,000,000	222,000	54	648,648,649
Great Britain	8,000,000	105,614	76	605,980,268
European Russia	24,000,000	1,031,550	23	558,383,016
Spain	7,500,000	148,218	51	379,508,562
European Turkey	8,000,000	212,240	38	301,545,420
Hungary	4,000,000	75,525	53	211,850,381
Latvia	2,000,000	25,939	77	154,207,949
Portugal	2,500,000	47,851	52	130,613,780
Egypt	4,000,000	140,700	28	113,717,129
Switzerland	1,000,000	12,884	78	77,615,647
Denmark (including Norway)	2,500,000	163,001	15	38,343,323
Sweden (including Finland)	2,500,000	228,715	11	27,326,585
Total	1,080,000,000	30,447,089	*35*	66,671,561,470

Source: SÜßMILCH 1765: 2/171–238; author's own calculations.

Subsequent Paradigm Reversal: Malthus and Carrying Capacity

Thomas Robert Malthus (1766–1834) studied mathematics and became a pastor. In 1798 he published a little essay that with its success turned the pre-Malthusian worldview upside down. He basically postulated what was to become later known in economics as the law of diminishing returns. When applied to agriculture this means that the rate of increase in the produce of the soil will gradually diminish (MALTHUS 1803: 11–20). The result is that uncontrolled population growth will outstrip agricultural production. Mathematically that could be graphed by a geometric progression where "the human species would increase as the numbers 1, 2, 4, 8, 16, 32, 64, 128, 256" (MALTHUS 1803: 19), and an arithmetic progression with "subsistence as 1, 2, 3, 4, 5, 6, 7, 8, 9" (MALTHUS 1803: 19). His thesis declares that all state policies that hitherto aimed at promoting population growth actually promoted poverty and misery. Another issue is the moral dimension. The pro-natal paradigm had the state actively interested in the welfare of its citizens in order to make them comfortable enough to reproduce. The anti-natal paradigm was radically anti-welfare, and the emigration of unskilled labor was encouraged.[146]

[146] "A man who is born into a world already possessed, if he cannot get subsistence from his parents on whom he has a just demand, and if the society do not want his labour, has no claim of *right* to the smallest portion of food, and, in fact, has no business to be where he is" (MALTHUS 1803: 249).

German geopolitics was to the highest degree concerned with population density but from a Malthusian point of view. The British blockade had caused starvation in Germany during WWI, and the country's defeat in WWI also meant a permanent loss of German colonies. The central question was about carrying capacity: how many people the territory of a country can support in terms of potential food production. This entails an assessment of soil quality in conjunction with climatic factors.[147] In 1925 Alois Fischer calculated estimates on the carrying capacity of various countries. He calculated a carrying capacity of 95/km^2 for Germany, while the actual population density stood at 134/km^2 (FISCHER 1925: 851–853). A year later Albrecht Haushofer revised estimates made in 1924 by Albrecht Penck, whose assistant he had been, and estimated a carrying capacity of 100/km^2 for Germany, while the actual population density stood at 135/km^2 (HAUSHOFER 1926: 791–793; further PENCK 1925, 1926). Both estimates showed that Germany was overpopulated, and that any further population increase would severely increase the general risk of starvation in times of trouble. The conclusion for the geopolitical scholars of the time was loudly to demand the peaceful return of the former German colonies (see OBST 1926).[148]

13.2 Friedensburg 1936 DE

Ferdinand Friedensburg (1886–1972) was a German politician and mineralogist. After spending a year on a mining apprenticeship, he studied law, political science, and geology. After WWI he went on to become a high-level bureaucrat. Politically he was active for the left-wing liberal German Democratic Party (Deutsche Demokratische Partei – DDP) but in 1924 failed twice to get elected to the national parliament. Through his various high-level bureaucratic positions he tried to fight the political extremism of the left and right. As a result he was dismissed from his position in February 1933 after the national socialists came to power.[149] Stigmatized by the new government, he dedicated himself to scientific research and returned to his original passion – the international mining industry. In 1936 he published his book *Raw Materials as Political and Military Power Factors* [*Die mineralischen Bodenschätze als weltpolitische und militärische Machtfaktoren*] (FRIEDENSBURG 1936), which also contains his implicit power formula. He built up his reputation in this field and was consulted by corporations and the army. In 1938 he was then expelled from the state-instituted Authors' Association [Reichsschrifttumskammer], which prevented him from being able to publish his writing. After WWII he went on to have a successful political career.

While regretting the widespread rearmament of countries in 1936, Friedensburg anticipated that the next war would be a total war, one that would require more focus on the economic dimension

[147] In 1785 Friedrich Wilhelm Crome had already emphasized that the quality of the soil is important to determine the natural potential for a state to be powerful and wealthy (KLUETING 1986: 81). As for information (in German) on the history of estimates on the total carrying capacity of planet Earth, see BIRG 2004, further WEIß 2004. Süßmilch had estimated a total carrying capacity for 14 billion people. In contrast Malthus estimated there to be space for one billion, which was near the actual world population in 1800 (BIRG 2004).

[148] The American biologist Raymond Pearl (1879–1940) wrote an article "War and Overpopulation" in 1936, in which he compares the population densities of the major powers. He argues that the inequality in the distribution of colonial territory is a major reason for war (PEARL 1936).

[149] A newspaper reported: "This message will cause great satisfaction for all national socialists, who must have seen in Mr. Friedensburg one of their fiercest opponents" (ZIRLEWAGEN 2006). German text: "Diese Nachricht wird bei allen Nationalsozialisten, die in Herrn Friedensburg einen ihrer erbittertsten Gegner sehen mussten, große Genugtuung auslösen."

in order to prepare a war economy capable of sustaining a drawn-out conflict. He discussed the decisive importance of raw materials in such a drawn-out conflict (FRIEDENSBURG 1936: 168–188).[150] For his calculations he assumed that every country could find itself in a strategic situation where it had to rely on itself completely, though he considered such a drastic situation improbable.[151]

In times of peace the price value of raw materials is determined according to mining costs relative to economic utility (supply and demand) on a worldwide level. In war such price values play negligible roles as (especially inelastic) needs determine the effort put into gaining raw materials ("any price is paid").[152] As such Friedensburg believes it is improper to look simply at the price value of the total national production of raw materials in peace time (for those numbers, see FRIEDENSBURG 1936: 64). Rather he estimates the domestic supply by creating an index (index total = 100) by weighing raw materials as needed for military supplies and operations. The weights are: "coal 40, oil 20, iron 15, copper, lead, manganese, sulfur compounds 4 each, zinc, aluminum, nickel 2 each, tin and the steel alloying metals counted together 1 each, mercury and antimony 0.5 each" (FRIEDENSBURG 1936: 182).[153] By applying these weights, he calculates a coefficient to determine the degree of self-reliance in terms of supply potential: 0 meaning no ability at self-reliance, 100 meaning complete self-reliance.

This in itself is not yet a power formula, but it becomes one when Friedensburg effectively suggests multiplying a country's estimated index number for supply potential by its population:

> In all cases it is only about the relative supply potential, i.e. the possibility of supplying the troop strength set up by the country concerned, which may be estimated at most with 7% of the population. The seemingly large supply prospects of Czechoslovakia (index number 48) would therefore, when related to the five times greater military strength of the German Empire, achieve only the fifth part. (FRIEDENSBURG 1936: 182)[154]

Hence the formula can be stated this way:

```
military_power = supply_potential_of_raw_materials × population
```

Aside from the example of Czechoslovakia relative to Germany, Friedensburg did not calculate any results. The following table shows the results he would have obtained if he had multiplied the numbers of the supply potential index by the population numbers of 1936. He calculated the supply potential index only for those countries listed:

[150] German theorists were not alone in their concern for the importance of raw materials in war. For a similar American view, see EMENY 1934, SIMONDS & EMENY 1939; also section 7.2.
[151] Though Germany had suffered from the blockade in WWI, it was still able to conduct important trade with a few remaining neutrals (FRIEDENSBURG 1936: 181).
[152] "The doctrine of limiting factors in biology means, for example, that a plant needing nitrogen is not helped by an excess of phosphate" (JONES 1953: 432).
[153] German text: "[…] Kohle 40, Erdöl 20, Eisen 15, Kupfer, Blei, Mangan und Schwefelverbindungen je 4, Zink, Aluminium und Nickel je 2, Zinn und die als Einheit gerechneten Stahllegierungsmetalle außer Nickel je 1, Quecksilber und Antimon je 0,5 […]."
[154] German text: "In allen Fällen handelt es sich nur um die relative Versorgungsmöglichkeit, d. h. um die Möglichkeit der Versorgung der allenfalls von dem betreffenden Lande aufgestellten Truppenstärke, die mit höchstens 7% der Bevölkerungsziffer geschätzt werden mag. Die scheinbar hohen Versorgungsaussichten der Tschechoslowakei (Kennziffer 48) würden also, auf die fünfmal größere Heeresstärke des Deutsche Reiches bezogen, nur den fünften Teil erreichen."

Table 16: Military Power of Countries in 1936 [Friedensburg]

Country	Supply Potential	Population	Military Power
Russia (future)	80	172,800,000	13,824,000,000
United States	90	127,520,000	11,476,800,000
Russia (current)	50	172,800,000	8,640,000,000
Germany	62	67,190,000	4,165,780,000
Japan	43	69,450,000	2,986,350,000
United Kingdom	55	50,140,000	2,757,700,000
France	48	41,975,000	2,014,800,000
Italy	19	42,500,000	807,500,000
Czechoslovakia	48	15,155,000	727,440,000
Belgium-Luxembourg	32	8,597,000	275,104,000
Total	*62*	768,127,000	47,675,474,000

Source: FRIEDENSBURG 1936: 182; EGER 1936: 810, 812–813; author's own calculations.

Hans Morgenthau mentions Friedensburg in his discussion of raw materials in *Politics among Nations* (MORGENTHAU 1948: 82–86). He writes that "the absolute importance of the control of raw materials for national power has increased in proportion to the mechanization of warfare" (MORGENTHAU 1948: 84). He cites Friedensburg's ratings of the relative importance of the various raw materials and emphasizes that this relative importance of specific minerals is constantly shifting. He is sure that in 1886 coal and iron would have received a higher weighting. By 1948 uranium had become enormously significant for its use in nuclear weapons.[155] Morgenthau notes that Friedensburg does not even mention uranium.

13.3 Stewart 1945 / 1954 US

John Quincy Stewart (1894–1972) was an American astrophysicist. Initially a civilian aeronautical engineer, Stewart went on to teach astrophysics at Princeton University from 1921 to 1963. In 1927 he coauthored *Astronomy: A Revision of Young's Manual of Astronomy*, which became the standard textbook on astronomy for two decades. He also became interested in social physics, which is the application of concepts from the world of physics to social phenomena.[156] In 1947 he coined a concept called "demographic gravitation" to apply the physical concept of gravitation to demographic behavior (STEWART 1948). His effort was typical of the spirit of the time in the way it tried to export real scientific method into what was considered the scientifically backward humanities and even the purportedly scientific social 'sciences' (see STEWART 1950: 239; compare MAXEINER 1995).

In 1945 Stewart wrote *Coasts, Waves and Weather for Navigators*, a book largely concerned with physical geography. Included are a few subsections on geopolitics, in which he adds his own ideas (STEWART 1945: 160–167). He mentions how geopolitics recognizes the political importance of spatial factors. From that he goes on to population density and the distribution of population while

[155] As for the importance of raw materials for the calculation of power, it is interesting to cite Morgenthau at length: "The release of atomic energy from the uranium atom and the use of that energy for warfare has at once modified the actual and potential hierarchy of nations from the point of view of their relative power. Nations which control deposits of uranium, such as Canada, Czechoslovakia, the Soviet Union, and the United States, have risen in the power calculations. Others, which neither possess nor have access to deposits of that mineral, have fallen" (MORGENTHAU 1948: 86).

[156] Auguste Comte (1798–1857) had developed the term "social physics", but when he discovered that Adolphe Quetelet (1796–1874) had usurped the concept, he changed the name to "sociology" as he opposed Quetelet's statistical approach.

asserting that "when sociologists count numbers of people, they are entering the province of *physical* science, because number is a physical thing" (STEWART 1945: 162). He then reflects on the influence of people, and he makes two common sense propositions: (1) the influence increases with the number of people, (2) the influence decreases with distance.[157] Accordingly, the 1945 formula can be expressed in this simplified way:

```
population_potential = people / distance
```

Population potential[158] is a geographic concept that refers to the average distance of a set of people to a certain point. Stewart prefers population potential to local population density, because the influence of population is not limited to its immediate vicinity (STEWART 1945: 162–165).

In 1954 he further developed these ideas[159] in an article titled "Natural Law Factors in United States Foreign Policy", in which he adds (3) social mass, (4) kilowatt-hours and (5) information bites. "The 'social mass' of a district is the tonnage of material in it which has been moved or fabricated for social purposes" (STEWART 1954: 130). It is unclear to what degree data for social mass was available. The variable itself is intended as a weighting factor in order to emphasize that humans differ in technological standing.[160] Two complementary alternatives are discussed, one is kilowatt-hours, the other is information bites as appropriate for the then-recently commenced computer age. Accordingly, the 1954 formula can be put this way:

```
influence = social_mass / distance
```

or

```
political_potential = technology × population / distance
```

It is not completely clear whether the distance should be squared or not. This relates to the difference between force and energy in Newton's gravitation law (see STEWART 1948: 32–34, 1954: 130).

What makes Stewart's formula stand out is that it is geopolitical in the truest sense, meaning that the power of countries changes with location (the 'geo').[161] For example, Germany is more powerful vis-à-vis Denmark than vis-à-vis New Zealand. "That is, the impact of one nation's power diminishes when the distance between this nation and impacted nation increases. Therefore, not all

[157] Stewart makes the argument that Germany had lost in Russia due to distance (STEWART 1945: 161). For the counterargument emphasizing that space is relative in view of technology, see VOWINCKEL 1941: 372–375, where Vowinckel compares the speed of movement and transportation in 1812 and 1939.

[158] The correct way to put the formula is this:

$$population\ potential, V_1 = \sum_{j=1}^{n} \frac{P_j}{d_{ij}} = \frac{P_1}{d_{i1}} + \frac{P_2}{d_{i2}} + \frac{P_3}{d_{i3}} ... + \frac{P_n}{d_{in}}$$

"where the population potential (V_1) at point i is the summation (Σ) of n populations (j) accessible to the point i divided by their distance (d_{ij}) to that point" (http://www.answers.com/topic/population-potential [16 August 2013]). Population potential is similar to market potential, which is useful for business to estimate the probable volume of sales at different locations.

[159] In the 1954 article Stewart gives credit to the American economist Henry Charles Carey (1793–1879) for suggesting that people exert a gravitational influence and that the distance factor matters politically (STEWART 1954: 129).

[160] Harold Sprout comments on Stewart's formula: "In a system such as the international political system of today, in which technological differentials among members of the system range from slight to enormous, the technological weighting factor may well be more significant than [population-size and distance] as a rough and ready indicator of relative levels of political potential" (SPROUT 1962: 204).

[161] Stephen Jones emphasizes the importance of location with regard to strategy and vulnerability. He writes that "no two states can have identical national strategies, if for no other reason than that they are geographically distinct. […] The power values of two factories may depend, after a war begins, more on their vulnerability than on their efficiency" (JONES 1953: 423).

nations will be under the same amount of pressure resulting from the national power of others" (XIERALI 2005: 1). The challenge may be to integrate all possible local power indexes into a uniform worldwide power index. Perhaps a gravity model could be designed where proximity matters and is accounted for.[162] For example, the power of Canada and that of Mexico seem partly diminished due to their close proximity to the US, whereas the power of Brazil and that of South Africa seem augmented due to the absence of a stronger player in their geopolitical regions of impact.

13.4 Wright 1955 US

Philip Quincy Wright (1890–1970) was an American political scientist and pioneer in quantitative war studies (also section 10.4). After teaching at Harvard University from 1916 to 1919 and the University of Minnesota from 1919 to 1923, he spent most of his career at the University of Chicago, where he was professor of political science from 1923 to 1931 and professor of international law from 1931 to 1956. In 1926 his colleague at the University of Chicago Charles Edward Merriam initiated an interdepartmental study on the causes of war that resulted in 40 dissertations and ten books on the topic. Wright summarized and concluded this research project in 1942 when he published *The Study of War*, whose two volumes contain massive amounts of information, including statistical data. In 1955 he published *The Study of International Relations* (WRIGHT 1955) as "the only major scholarly attempt to encompass the whole discipline of international relations" (RUMMEL 1975: 60). In the book he lists four methods to the study of international relations: (a) historical-descriptive, (b) analytic-rational, (c) synthetic-practical, and (d) statistical-mathematical (WRIGHT 1955: 125–126).

He developed a field theory of international relations "to conceive the world as a field of conditions, values, ideals, and attitudes, in continuous flux, but at any point and moment exerting influence upon the actions of individuals, associations, and nations" (WRIGHT 1955: 491; further RUMMEL 1975: 60–65; WRIGHT 1955: 540–553). He makes a distinction between a geographical field, in which actual time-space events take place, and an analytical field defined by coordinates that measure continua influencing choices, decisions, and actions. He distinguishes between two types of dimensions, one type representing the values of the system, and the other representing the capabilities of the system. Vectors describe tendencies in the system. Depending on the movement of vectors, one can recognize trends towards stability or instability. "It is an organic view of international relations emphasizing the interrelations of things and events" (RUMMEL 1975: 62).

Discussing the specifics of power (WRIGHT 1955: 138–141), he points out that the power position of countries usually depends on (1) armaments in being, (2) military potential, (3) national morale, and (4) international reputation.[163] He disagrees with the realist idea that states can rely only on their military force and military potential (includes economy) to secure their independence. Rather

[162] For a concise introduction into basic gravity modeling in geography, see HAYNES & FOTHERINGHAM 1984.
[163] He cites as his source a text compilation *The Foundations of National Power* edited by Harold and Margaret Sprout. After discussing a number of elements of national power, the Sprouts themselves produced a theoretical power formula: "[…] an estimate [of a nation's power potential] can be expressed in the form of a crude equation thus: manpower plus economic resources plus tools and skills plus organization plus morale equals power potential which, given time, can be transmuted into power in being" (SPROUT & SPROUT 1945: 30).

he takes the liberal position that the interest of states in their self-preservation may get a wider appeal through international law and international organizations, hence the importance of international reputation. Nevertheless he also concedes that "all politics is power politics" (WRIGHT 1955: 140). He lists many different manifestations of power and doubts that any common measure for political and social power comparable to kilowatt-hours in physics can be found. He recognizes how persuasive forms of power can be equated with coercive forms of power, and he acknowledges that coercion and persuasion go hand-in-hand.

He designed six field diagrams that graph the motion of vectors (WRIGHT 1955: 547–549, further 595–603). For that purpose he defines six value dimensions and six capability dimensions, one capability dimension called strength–weakness defined by military potential (war potential):

```
military_potential = population × energy_production
```

He does not provide any justification for making the formula this way. He only explains that he chose energy production rather than unexploited energy resources, because unexploited energy resources "could not be utilized in a major degree during the course of a war" (WRIGHT 1955: 600). He does not present the calculated results except as location values for the diagrams, yet he lists the data that went into those location values. The following table presents the recalculated results for all countries that he provided data for:

Table 17: Military Potential of Countries in 1954 [Wright]

Country	Population 10 million	Energy Production 10 mil tons bituminous coal	Military Potential
USA	16.0	62.1	993.6
USSR	20.0	14.1	282.0
World[164]	1.0	165.0	165.0
Germany	7.0	20.7	144.9
China	47.0	2.7	126.9
UK	5.0	22.6	113.0
India	36.0	2.5	90.0
France	4.2	5.4	22.7
Brazil	5.4	1.0	5.4
Italy	4.7	1.1	5.2
Egypt	2.0	0.4	0.8
Switzerland	0.5	0.8	0.4
Denmark	0.4	0.5	0.2
Total	149.2	298.9	1,950.1

Source: WRIGHT 1955: 587–588; author's own calculations.

[164] Wright measures the military potential of the "world" this way:

```
military_potential = world_citizens × energy_production
```

He explains that the indicator "world citizens" represents the number of people "being articulate in international institutions and associations" (WRIGHT 1955: 595–596). He estimated this number to be about 0.4% of the world population. The explanation follows: First, he estimates about 20% of the world population to be articulate on national affairs. In democratic countries these are the people who actually vote, in totalitarian countries these are the people who participate in party activities and civic organizations; Second, from press surveys he takes the information that 33% of political editorials in the leading papers of the leading countries deal with international affairs; Third, only 7% of these editorials deal with international symbols and institutions. 0.20 × 0.33 × 0.07 = 0.00462, hence the 0.4% (WRIGHT 1955: 586, 595–596).

R. J. Rummel used Wright's measure in his Dimensionality of Nations (DON) project (section 13.16), "population X energy production" that "includes the primary sources of energy" counting as variable number 63 among 236 variables (RUMMEL 1972: 124, 127).

13.5 German 1960 UK

Frank Clifford German has worked as a journalist. He did a master's degree at Cambridge University and briefly taught geography at the University of Michigan and Wayne State University. In 1961 he coauthored *A Geography of the U.S.S.R.* with the British political geographer John Peter Cole.[165] From 1961 to 1997 he worked for several British newspapers: *Financial Times*, *The Times*, *Daily Telegraph*, *The Scotsman*, and *The Independent*. In 1960 German wrote a seven-page article titled "A tentative evaluation of world power" (GERMAN 1960), in which he presented a complicated power index.

His major contention is that fighting force was the decisive factor in the past to determine the fate of nations, but that the Cold War is a broader conflict aimed at economic and political influence. He writes that "national influence bears a direct relationship to gross national strength; without that, the most exquisite statesmanship is likely to be of limited use" (GERMAN 1960: 138). As for the construction of his index, German admits that he is "applying selective and subjective criteria in order to reach the desired over-all impression" (GERMAN 1960: 139), which is a statement remarkable for its honesty. A simplified version of the formula is this (MERRITT & ZINNES 1989: 19):

```
G = N ( L + P + I + M )

G = national power; N = nuclear capability; L = land; P = population;
I = industrial base; M = military size
```

The five factors in this simplified formula summarize the 20 variables that go into the index.[166] German states that these factors are both comprehensive and interdependent. In the sum total of all countries, the five factors have these effective weights: 12.0% land, 11.1% population, 39.6% industrial base, 0.6% military size, and 36.7% nuclear capability. Something seems to have gone awry with military size, because errors abound in this category.[167] German speaks of "the relative unimportance of conventional weapons" (GERMAN 1960: 141), but in fact the weight is so abnormally low as to make the factor unnecessary altogether. The immense weight given to nuclear capability could be rationalized by the spirit of an age overshadowed by the threat of nuclear war: only two years later the

[165] John Peter Cole published the *Geography of World Affairs* in 1959. In the book he had used three variables separately to approximate the strength of countries: steel output, population, and area (COLE 1959: 301). All three variables can also be found in German's power formula. Given that in 1961 he coauthored *A Geography of the U.S.S.R.* with Cole, one can assume that German was familiar with Cole's work. In later editions Cole summarized variables into a power index (section 13.7).

[166] For land: (1) area, (2) population density, (3) rail density. For population: (4) working population, (5) technical efficiency, (6) manufacturing population, (7) "morale" bonus, (8) food supply deficit/surplus. For industrial base: (9) steel production, (10) coal production, (11) lignite production, (12) crude oil production, (13) hydroelectricity, (14) bonus for directed economy, (15) steel surplus/deficit, (16) oil surplus/deficit, (17) minerals surplus/deficit, (18) engineering surplus/deficit. For military size: (19) military personnel. For nuclear capability: (20) dummy variable that is 2 if nuclear armed, 1 if not.

[167] The military size of France is misrepresented as one tenth of the actual size, while the correct value is used for the calculation of the final score. The score values for the military size of the US and UK are not included in their respective final scores. I corrected these values in the table that follows.

Cuban missile crisis broke out. The following table presents the complete published results; the corrected values are in italics:

Table 18: Gross National Strength of Countries in 1959 [German]

Country	Land	Population	Industrial Base	Military Size	Nuclear Weapons	Power
USA	391.5	471.5	2,353.5	*26.0*	3,242.5	*6,485.0*
USSR	373.0	322.5	2,420.0	45.0	3,160.5	6,321.0
United Kingdom	49.0	148.5	428.0	*6.0*	631.5	*1,263.0*
China	325.0	320.0	319.0	35.0		999.0
West Germany	50.0	137.5	475.0	1.0		663.5
Canada	250.0	47.0	199.5	1.5		498.0
Japan	74.0	135.5	199.0	2.0		410.5
France	55.0	92.5	225.5	10.0		383.0
India	212.0	99.0	56.5	5.5		373.0
Poland	31.0	52.5	238.0	3.0		324.5
Australia	128.0	28.0	60.5	0.5		217.0
Brazil	142.0	22.0	37.0	2.5		203.5
Czechoslovakia	13.0	30.0	151.0	2.0		196.0
Italy	30.0	72.0	89.5	1.0		192.5
East Germany	11.0	48.0	113.0	2.0		174.0
Argentina	92.0	28.5	5.5	1.5		127.5
South Africa	51.0	23.5	47.5	0.5		122.5
Sweden	22.5	20.5	72.5	0.5		116.0
Belgium	6.0	22.0	83.0	1.0		112.0
Total	2,306.0	2,121.0	7,573.5	146.5	7,034.5	19,181.5

Source: GERMAN 1960: 142–143.

German's measure has attracted some attention and criticism. John Robert Victor Prescott criticizes German for not paying attention to the quality of leadership and location. He disagrees with German that territories with low or no population constitute liabilities (PRESCOTT 1972: 45). Harm Jan de Blij reprinted the entire German article in his book, while cautioning the readers that "the derivations Professor German makes are not necessarily of absolute validity" (BLIJ 1973: 60). Richard Muir criticizes that too much is still based on subjective estimates despite the many variables used (MUIR 1981: 149).[168] Kevin John Sweeney points out two subjective decisions German made. First, German designed a variable called "morale" to account for corruption, apathy, or poverty that may demoralize populations (GERMAN 1960: 139), so countries having good "morale" receive a bonus as a result of arbitrary judgment.[169] Second, German gives a substantial bonus to command economies arguing that they are more efficient at dispensing state capital (GERMAN 1960: 140).[170] Sweeney contends that history has proved German wrong on that one (SWEENEY 2004: 71–72). A consensus declares that

[168] Muir himself presents a table of power indicators without adding them into a composite index. These are: (1) area, (2) population, (3) steel production, (4) military personnel, and (5) nuclear submarines (MUIR 1981: 150).
[169] These days corruption indexes have become available that render German's subjective estimates in this area unnecessary. The widely known Corruption Perceptions Index (CPI) by Transparency International uses simplistic methodology (see LAMBSDORFF 2007: 236–255). The Worldwide Governance Indicators (WGI) by the World Bank is based on more sophisticated methodology (see KAUFMANN et alia 2009: 98–103). One of those six indicators measures corruption.
[170] The view was not untypical of the time. Bruce Russett made this argument: "The Soviet Union, for instance, is more powerful than its G.N.P. would indicate, because it is able, with its totalitarian system, to enforce a low level of consumption on its populace and turn the 'savings' into investment in heavy industry and military equipment" (RUSSETT 1965: 3).

German's measure is unnecessarily complicated (COX & JACOBSON 1973: 441; MERRITT & ZINNES 1989: 22; ROSEN 1972: 170–171; SULLIVAN 1990: 110–112).[171]

13.6 [Guetzkow] [1963] US

Harold Steere Guetzkow (1915–2008) was an American political scientist. As a pacifist, he received the status of conscientious objector during WWII. In 1948 he got his PhD in psychology at the University of Michigan. From 1957 until his retirement in 1985 he was professor of political science, psychology, and sociology at Northwestern University. In 1957 Guetzkow initiated the Inter-Nation Simulation (INS) that was relabeled Simulated International Processes (SIP) in 1964 and lasted until 1974. The INS used simulation games for the purpose of theory-building. In a sense war games can be regarded as their historical precursor, as they have been in use for millennia as a training device (SUŁEK 2010b: 198–199).

In the initial INS groups of students represented imaginary nations in hypothetical situations with a simplified set of variables, based on which the groups were to make their decisions (GUETZKOW 1959). Two of these variables are basic capability units (BCs) and force capability units (FCs) assigned to each nation (NOEL 1963: 52–57). BCs consist of physical and human resources to provide a measure of production capacity and as such wealth. FCs consist of all goods and services that enhance the military capabilities of the nation. William Coplin explains that no adequate schemes had then existed to relate elements of power to the ability to achieve objectives and the exercise of political control, nor did the INS attempt to provide one (COPLIN 1966: 573).

In 1967 Charles Hermann and Margaret Hermann published their article "An Attempt to Simulate the Outbreak of World War I" that delivers BCs and FCs for the major players at the beginning of WWI. They acknowledge that there had been an earlier report on this project in 1963. This indicates that these values must have been calculated in 1963 or before. It is not clear who actually designed and calculated the BCs and FCs. It can be speculated that Guetzkow may have played a leading role as the principal investigator in the INS. BCs are calculated for the situation in 1914 by combining (1) steel production, (2) national income, and (3) total population weighted by male literacy. FCs are calculated for 1914 by combining (1) regular peacetime armies and (2) capital ships. Exact formulas and weights are not given, and it is possible to speculate that indicators had equal weights and were added together. The following table presents the capabilities for all nations listed:

[171] Michael Sullivan himself designed a very simple measure (section 13.29) to compare it with German's, this way making a case for simplicity.

Table 19: National Profiles for 1914 [Guetzkow]

Nation	Basic Capability Units	Force Capability Units
Germany	120,000	24,500
England	86,940	25,000
Russia	78,660	23,000
France	62,100	20,800
Austria-Hungary	45,540	14,560
Serbia	4,140	1,700
Total	397,380	109,560

Source: HERMANN & HERMANN 1967: 402

Mirosław Sułek explains that "simulation plays an important role in the teaching process in schools of all types and levels, the training of troops, rescue services and the population" (SUŁEK 2010b: 198;[172] compare HITCH & MCKEAN 1960: 202–204). Nowadays many computer games are also viable simulations of international relations albeit for the commercial purpose of providing entertainment (section 13.31), though not necessarily limited to that alone (section 13.43).

13.7 Cole 1963 UK [AU]

John Peter Cole is a political geographer who was born in Australia in 1928 and lived most of his working life in the United Kingdom. He studied geography and Spanish at the University of Nottingham, where he later became professor of regional geography until his retirement in 1994. His special interest has been Latin America and the Soviet Union (he also speaks Russian). In 1961 he coauthored *A Geography of the U.S.S.R.* with Clifford German (section 13.5). In 1968 he copublished *Quantitative Geography: Techniques and Theories in Geography*, a work that indicates competence and interest in quantitative matters. His major work is the *Geography of World Affairs*, which went through six editions from 1959 to 1983 (COLE 1959, 1963, 1964, 1972, 1979, 1983), and which contains his power index and two revisions thereof.

In the first edition of the *Geography of World Affairs* Cole's initial concern is the reduced importance of the United Kingdom in a world defined by Russian-American bipolarity (COLE 1959: 299–309). He nostalgically remembers that the United Kingdom had been not too long ago the largest empire in human history. He then proceeds to measure strength by steel output, population, and area,[173] picturing each percent of the world total a country has by a little square in three columns as appropriate for the three variables. This illustration optically invites the reader simply to add the squares of the three variables for each country. Cole does not himself proceed to do so, as a result it is as yet not quite a power index. Given that British power had been related to its industrial capacity, he uses pig iron to demonstrate the rise and fall of British industrial capacity 1800–1950.

[172] Polish text: "Symulacja odgrywa ważną rolę w procesie dydaktycznym w szkołach wszystkich typów i szczebli, w szkoleniu wojsk, służb ratowniczych oraz ludności."
[173] He emphasizes that the three indicators are only a rough guide. The relevance of steel for military power depends on its use, population figures do not account for variation in the mental capacities of different races, and area does not pay attention to whether the land is useful for agriculture (COLE 1959: 300).

In the second edition of his book Cole abandons some of the nostalgia and puts more focus on the United States and the Soviet Union (COLE 1963: 272–282). He explains that power can be assessed either as military strength or economic capacity. Given that military strength was concentrated in the hands of the United States and Soviet Union, he prefers to focus on economic capacity. He mentions German's power index along its results and states that his own index is simpler and more approximate in comparison.[174] In his power index he adds (1) area, (2) population, and (3) energy consumption.[175] The third edition leaves the section with the power index unchanged (COLE 1964: 272–282). In the fourth edition he presents his power index in two sections (COLE 1972: 68–74, 370–376). In chewing over whether to include military strength, he decided this time to add it. From then on the updated index includes (4) steel consumption, (5) GDP, and (6) military strength.[176] He clarifies that military strength is very approximate without revealing which variables he used to assign military points. The following table represents the weights Cole allocates to factors; the weights of factors in the sixth edition (for 1980) are unknown:

Table 20: Weights of Factors [Cole]

Factors	1963	1972	1980
Total Area	25%	20%	x
Total Population	25%	20%	x
Steel Consumption		10%	
Energy Consumption	50%	10%	
GDP / GNP		20%	x
Natural Resources			x
Military Strength		20%	x
World Power	100%	100%	

Source: COLE 1963: 282, 1972: 373, 1983: 228.

The fifth edition contains no power index (COLE 1979). The sixth edition includes a revised power index (COLE 1983: 227–229). The surrounding section and discussion look truncated. The revised power index is based on (1) area, (2) population, (3) GNP, (4) natural resources, and (5) military strength (as shown in the table above). He neither clarifies what weights those factors have nor what variables like natural resources and military strength consist of. Unlike past indexes, in which he rounded to per mille of the world total, here he rounds to a multiple of five per mille of world total in order to avoid, as he claims, spurious precision. It all indicates that Cole has lost confidence in the viability of calculating national power. His concluding statement is that "it is unrealistic to give a precise quantitative measure to the overall strength of world powers" (COLE 1983: 228). The following table presents the complete list of results for the three power indexes:[177]

[174] He mentions German's power index in the second, third, and fourth edition (COLE 1963: 280, 1964: 280, 1972: 371–372).
[175] He also looks at the United Nations in the section of his book containing the power index. He calculates what voting shares certain countries and regions would have in the General Assembly if based on any of the three factors as compared to the present one-country-one-vote principle (COLE 1963: 279, 1964: 279). He concludes that the big countries are vastly underrepresented. Note that Arvind Virmani designed his power index to be used for the apportionment of votes in the General Assembly (VIRMANI 2004; also section 13.37).
[176] He further proposes a gravity model to predict theoretical interaction. For that the mass of country would be multiplied by the mass of another country and divided either by distance or distance squared (COLE 1972: 372–373; compare section 13.3).
[177] Furthermore, in the sixth edition an entire table spanning six decades is available, plus another row of values for 1980 that represents the same factors but military strength excluded.

Table 21: Shares of World Power 1963–1980 [Cole]

Country	1963	1972	1980	Country	1963	1972	1980
World Total	**1,000.0**	**1,000**	**1,000**	Pakistan	7.5	10	
				Spain	7.5	9	
USA	206.0	222	165	Argentina	7.5	8	
USSR	137.0	177	185	South Africa	7.5	8	
China	120.0	80	85	Czechoslovakia	7.5		
India	46.0	44	50	Turkey	4.0	7	
Canada	31.0	27	35	Congo	4.0		
West Germany	29.0	28	25	Nigeria	4.0		
Japan	20.0	31	30	Sudan	4.0		
UK	34.0	29	15	Netherlands	4.0		
Brazil	22.0	22	30	Iran	4.0		
France	19.0	28	15	Ethiopia	4.0		
Australia	18.0	17	25	Egypt	4.0		
Italy	10.0	16		Venezuela	4.0		
Poland	12.0	12		Belgium	4.0		
East Germany	11.0			Romania	4.0		
Mexico	11.0	10		Colombia	4.0		
Indonesia	11.0	9		Burma	4.0		

Source: COLE 1963: 282, 1972: 72, 373, 1983: 228.

The obvious thing to note is that the Soviet Union is deemed more powerful than the United States in 1980, reflecting the spirit of the time after the lost war in Vietnam (compare section 13.20). The table also shows how changing weights may have affected the score of China – though not India.

13.8 Shimbori / Ikeda / Ishida / Kondô 1963 JP

Shimbori Michiya (born in 1921) is a Japanese sociologist. He did his PhD on the sociology of Emile Durkheim. He was professor of sociology at Hiroshima University. In 1963 he published together with Ikeda Hideo, Ishida Tsuyoshi, and Kondô Motô two articles on the measurement of national prestige. The first article reports on a survey they conducted with 1019 Japanese primary and middle school students (SHIMBORI et alia 1963a), whereas the second article reports on a survey they conducted with 595 Japanese high school and college students (SHIMBORI et alia: 1963b).

Their focus is on national prestige, which encompasses people's evaluation and attitude towards other nations connected in part to wealth and power. They assume nations to be nationalistic, that is, sensitive and competitive as to their relative position vis-à-vis other nations. In the first article they categorize prestige into eight components. The six components for the *national image* are (1) physical aspects, (2) economic factors, (3) internal politics, (4) military matters, (5) artistic and scientific matters, (6) international relations. The two components for the *attitude of the people* are (7) the way of life, and (8) national character. For their proposed index they use only components 2–6. The primary and middle school students were asked to decide what nation can most properly be called a first class nation,[178] and then rank the five components in order of importance as pertaining to

[178] With regard to the survey question on what can be most properly called a first class nation, the results were: 60.8% USA, 20.7% USSR, 5.8% Switzerland, 4.7% UK, 2.9% Japan, and 5.1% others (SHIMBORI et alia 1963a: 32). It is interesting to

their decision for a particular nation. They use then this ranking as the basis to weigh each component by taking some type of median in the distribution, further they propose to multiply those weights with the inversed ranks[179] of importance given to each component for each nation. They do not publish results for this national prestige index, though they provide all the data to calculate it oneself. The following table presents the results that can be reconstructed for the United States, the Soviet Union, and the "Others" group:

Table 22: National Prestige Index for 1961 [Shimbori et alia]

Weights	3	3	1	4	2	13
Country	Economic	Political	Military	Artistic & Scientific	International	Prestige
USA	2,748	2,685	511	3,820	1,396	11,160
USSR	747	852	180	1,236	356	3,371
Others	756	1,077	143	1,160	462	3,598

Source: SHIMBORI et alia 1963a: 33–34; author's own calculations.

In their second article on high school and college students, they change the designation for "artistic and scientific" to "cultural", and they replace "way of life" by "attitude", which stands for how much a rater likes or dislikes a nation.[180] Moreover, they use paired comparison instead of the ranking method, that is, all eight variables were compared in 28 pairs, the rater determining which one of two components is more important (compare section 13.23). They subsequently use z-scores[181] to determine the weights of components from the matrix of paired comparisons. The result is for the economic a rounded weight of 7, political 5, international 5, cultural 4, physical 4, national character 4, military 4, and attitude 2 (SHIMBORI et alia 1963b: 67). In contrast to the previous article, they do not specify how these weights are to be used nor do they provide any ranking data for any nation or group of nations, and so no results can be determined.

13.9 Cohen 1963 US

Saul Bernard Cohen (born in 1925) is an American political geographer. He studied geography at Harvard University. Afterwards he taught geography at Boston University from 1952 to 1965, Clark University from 1965 to 1978, and Hunter College from 1986 to 1996. He has written many books and articles, achieving some fame as a leading scholar of post-WWII geopolitics. He directed much of his focus on *shatterbelts*, which "are strategically oriented regions that are both deeply divided internally and caught up in the competition between Great Powers of the geostrategic realms" (COHEN 2009: 44). The Middle East is an example.

observe that Switzerland had such high prestige at the time. An American prestige study in 1966 also had Switzerland ranked second place after the United States in a list of 35 countries, albeit including one fictional country (ARMER 1966: 6–7).

[179] Inverse ranks means that the ranks 1–5 are reordered 5–1. Accordingly, the first rank gets a score of five points, the second rank four points, the third rank three points, the fourth rank two points, and the fifth rank one point.

[180] That can be compared to Japanese scholar Tanabe Shunsuke defining national prestige as the "the honor and deference accorded a nation in international society, as well as the general desirability of that nation" (TANABE 2009: 270).

[181] Statisticians use z-scores (standard scores) for the purpose of normalization in order to make different sets of values (variables) comparable. The z-score itself indicates how many standard deviations a score is above or below the arithmetic mean of the given set.

In 1963 Cohen published the first edition of *Geography and Politics in a World Divided* (COHEN 1963). The second edition followed in 1973 (COHEN 1973). He defines the "differentiation of political phenomena from place to place [as] the essence of political geography" (COHEN 1963: 6, or 1973: 6). Discussing the essentials of political geography (COHEN 1963: 3–23, or 1973: 3–28), he explains various approaches to the study of political geography. In 1963 he described four approaches: (a) power analysis, (b) historical, (c) morphologic, (d) functional. In 1973 he added two more: (f) behavioral, and (g) systemic (COHEN 1963: 7, 1973: 7).

The **power analysis** approach comes from international relations and looks at geography as one of several power resources. For that he looks at six categories: (1) the physical environment, (2) movement (transportation and communication),[182] (3) raw materials, semifinished and finished goods, (4) population, (5) the body politic, and (6) space. From that he goes on to design a power inventory, from which he calculates a composite index. The following table shows the elements of the power index in 1963 and that of the revised power index in 1973.[183] The effective weights were calculated from the sum total of all elements and countries:

Table 23: Effective Weights of Elements [Cohen]

Elements	1960	1968
Total Area	5.2%	11.1%
Total Population	25.9%	10.6%
Physiological Population Density (reciprocal)[184]	11.4%	17.1%
Urban Population	12.4%	
Percentage of Urban Population	5.4%	11.1%
Cultivated Land	5.2%	
Persons Engaged in Manufacturing		10.0%
Steel Production	34.5%	11.0%
Electrical Energy Production		9.7%
Armed Forces Personnel		9.7%
Students Enrolled in Secondary Schools		9.7%
National Power	100.0%	100.0%

Source: COHEN 1963: 11, 1973: 11; author's own calculations.

As a shortcoming he mentions that "this method cannot quantify the ideological strength, motivation, policies, and goals of the political units" (COHEN 1963: 10, or 1973: 10). He puts a lot of justification into urbanization, which he thinks to be a good index for technology, national cohesiveness, centralized authority, and higher productivity. He acknowledges that there are situations where urbanization can mean greater instability. The complete published results of the two indexes are

[182] In 1994 Cohen expanded on the topic by arguing that the movement of people, goods, and ideas recharges countries with energy. In his view closed systems lose power due to entropy, whereas open systems gain power due to negative entropy (COHEN 1994: 23–28). Entropy can be defined as a gradual decline into disorder.

[183] In both editions he also proposes each time three alternative indexes that exclude various elements of the main index (COHEN 1963: 12, or 1973: 12). These alternative indexes are not considered here. It indicates some indecisiveness on the part of Cohen regarding the proper composition of his power indexes.

[184] Physiological density is the total population divided by the area of arable land. Cohen uses the reciprocal of physiological population density for the calculation of index scores, which means the area of arable land divided by total population. He judges a lower population density positively. This is in direct opposition to Süßmilch and German, who had judged a higher population density positively. However, he then uses urbanization along the same line of reasoning that Süßmilch and German used in judging a higher population density positively.

presented here. The nonstandardized scores are directly from Cohen. I standardized them to make the results of these two power indexes directly comparable:

Table 24: National Power of Countries / Regions in 1960 & 1968 [Cohen]

Country	nonstandardized		standardized	
	1960	1968	1960	1968
United States	12.5	174	0.199	0.206
Maritime Europe[185]	12.8	155	0.203	0.183
USSR	11.2	166	0.178	0.196
China	8.9	97	0.141	0.115
India	5.8	56	0.092	0.066
Canada	4.4	96	0.070	0.113
Brazil	2.9	42	0.046	0.050
Japan		60		0.071
Total	58.5	846	0.929	1.000

Source: COHEN 1963: 12, 1973: 12; author's own calculations.

His more recent book *Geopolitics: The Geography of International Relations* from 2008 indicates that Cohen has abandoned altogether the effort to construct a power index (see COHEN 2009: 47–50). Instead he constructs a purely subjective ranking of countries into five levels based on "value and political behavior characteristics that reach beyond the traditional emphasis on population, area, economic resources, and military expenditures and technology" (COHEN 2009: 47).

13.10 Fucks 1965 DE

Wilhelm Fucks (1902–1990) was a German physicist. He studied physics at the University of Munich and did a PhD at RWTH Aachen University. In 1938 he became professor of theoretical physics at the RWTH Aachen University. In 1940 he became professor of theoretical physics at the Berlin Institute of Technology, and in 1941 he returned to RWTH Aachen University to become professor of experimental physics until his retirement in 1970. From 1958 to 1970 he was simultaneously director of the Institute of Plasma Physics at the Nuclear Research Center Jülich. In 1965 he published *Formulas for Power: Predictions on Populations, Economics, Potentials* [*Formeln zur Macht: Prognosen über Völker, Wirtschaft, Potentiale*] (FUCKS 1965, 1966), which has received international attention to this day, though it was never translated. His 1978 follow-up *Powers of Tomorrow: Force Fields, Tendencies, Consequences* [*Mächte von Morgen: Kraftfelder, Tendenzen, Konsequenzen*] (FUCKS 1978) is hardly known at all. He applied mathematical analysis to literature and music as well, thus contributing to quantitative linguistics and the quantitative study of literature.

In discussing the design and reasoning of his 1965 formula in *Formulas for Power* (FUCKS 1965: 120–133, or 1966: 120–133), Fucks clarifies that he wants to calculate power potential, which for him is economic power, and that he excludes the aspect of military strength from his calculations.

[185] Cohen's definition of Maritime Europe is synonymous with noncommunist Western Europe at the time (COHEN 1963: 75, or 1973: 77).

He thinks that military power and economic power will eventually become proportional, with inequalities in the distribution of armaments (especially WMDs) diminishing over time. The prime variable for Fucks is population. Besides that he chooses steel production and energy production as basic goods representing matter and energy (FUCKS 1965: 86, or 1966: 86). He mentions food production as a basic good, then he moves on to infer that this is already approximated in the size of the population. He creates two sets of equations: one time he multiplies population by steel production, another time he multiplies population by energy production. In each set he plays around by applying different exponents on the two factors to give them different weights. Comparing the results of applying different exponents, he arbitrarily judges which results look most plausible to him. He then combines one formula from each set and takes the arithmetic average. The formula is:

$$economic\_power = (p^{1/3} \times st + p^{1/3} \times e) / 2$$

p = population; st = steel production (USA = 1000); e = energy production (USA = 1000)

The following table presents the complete published results from the two editions of *Formulas for Power* as calculated by Fucks;[186] combined values like that for the European Economic Community (EEC) are excluded:

Table 25: Power of Nations in 1960/1963 & 1963/1964 [Fucks]

Country	1960/1963	1963/1964	Country	1960/1963	1963/1964
USA	**1,000.00**	**1,000**	Romania	11.80	12
Soviet Union	674.00	673	Spain	9.50	9
China	405.00	236	Sweden	7.30	7
Japan	143.00	155	Hungary	7.30	7
West Germany	147.00	149	Netherlands	7.00	7
Great Britain	120.00	120	Yugoslavia	6.30	6
France	71.00	68	Austria	6.10	6
India	67.80	67	Bulgaria	1.96	2
Poland	43.30	42	Turkey	1.66	2
Italy	36.80	32	Norway	1.14	1
Canada	30.60	33	Switzerland	0.83	0
Czechoslovakia	26.20	25	Denmark	0.62	0
East Germany	19.50	19	Portugal	0.57	0
Belgium	16.40	17	Greece	0.28	0
Union of South Africa	12.60	13	Total	2,875.56	2,708

Source: FUCKS 1965: 129, 1966: 129.

The one noticeable difference between the values of the two indexes is in the case of China. Possibly Chinese steel production and energy production had been overestimated.

In discussing the design and reasoning of his revised 1978 formula in *Powers of Tomorrow* (FUCKS 1978: 121–146), Fucks first defines power as ability to force your will on somebody, which is

[186] Klaus Heiss, Klaus Knorr, and Oskar Morgenstern calculated their own values for 1960/1963 and 1970 (HEISS et alia 1973: 33). Their 1960/1963 values slightly differ from those of Fucks for 1960/1963. Karl Deutsch recalculated values for 1950, 1963, 1973, 1990, and 2010, the latter two being projections (DEUTSCH 1988: 27). His values slightly differ from those of Fucks.

politico-military power. He mentions the importance of the psychological disposition and ideological orientation of a population as well as the decisive role of the quality of leadership. After considering these factors, he returns to what he considers the demographic-economic base of power, which he now calls *virtual power*. He prefers virtual power because military power is less useful for prediction as military expenditures as percentage of GNP vary enormously. As for the reason he does not use GNP, he mentions problems of currency conversion associated with comparability. On using multiplication rather than addition, he argues that a powerful country must have both a large population as well as sizeable production, onesidedness being insufficient. He justifies taking the cubic root of the population by the law of diminishing returns, the logic of this justification sounds a bit contrived. Because steel production has grown more rapidly in the Soviet Union than in the United States, he considers that steel production has become less adequate as an indicator. As a result energy production is given three times the weight of steel production in the revised 1978 formula:

$$virtual\_power = (p^{1/3} \times st + 3 \times p^{1/3} \times e) / 4$$

p = population; st = steel production (USA 1960 = 100); e = energy production (USA 1960 = 100)

Fucks also designed an industry index, which gives steel production and energy production equal weight and disregards population. It is unclear as to what the precise formula is. The following table contains the complete published results for virtual power from *Powers of Tomorrow*, including projections; results are also available for the industry index (FUCKS 1978: 146):

Table 26: Index of Virtual Power 1960–2000 [Fucks]

Country	Scores				
	1960	1970	*1980*	*1990*	*2000*
USA	**100.0**	157.0	*202.0*	*241.0*	*270.0*
Soviet Union	52.0	96.0	*138.0*	*179.0*	*216.0*
China	34.0	41.0	*77.0*	*144.0*	*238.0*
Japan	9.6	35.8	*52.0*	*64.0*	*75.0*
West Germany	14.0	21.0	*23.0*	*28.0*	*33.0*
India	5.0	9.0	*14.0*	*21.0*	*36.0*
Brazil	1.3	3.0	*7.0*	*16.0*	*39.0*
Total	215.9	362.8	*513.0*	*693.0*	*907.0*

Source: FUCKS 1978: 144.

Richard Muir misrepresents the formula of Fucks in his book (see MUIR 1981: 149, 253). If it were not clear from the text that this is a mistake, it could pass as a modification, if not a formula of its own:

$$power = production^{3} \times population^{0.5}$$

Criticism of *Formulas for Power* has come from Daniel Michaels, who commented that Fucks had "ignored the potential of entire continents, including South America, Africa, and the Indian subcontinent" (MICHAELS 1966: 310). In 1965 Fucks had focused primarily on the expected rise of

China. In 1978 he broadened his attention to include India and Brazil.[187] Another critic, Tuomas Forsberg, has commented that "Fucks' power analysis of the 1960s, based on measurement of the production of steel and coal, relied on experiences of the Second World War, and was severely outmoded already when it came out, not to mention its predictions that reached until the 21st century" (FORSBERG 1997: 178).

The special feature of Fucks' two books is his prediction of the future of power in accordance with what he calls "exact scientific" modeling imported from physics. Klaus-Peter Schmid mentions exactly those predictions in order to mock them, as Fucks had predicted for the year 2000 that China would have a population of 1.7 billion and a steel production of 600 million tons, whereas in fact the population was then 1.2 billion and the steel production 100 million tons (SCHMID 1999: 2; compare MAXEINER 1995: 2; SUŁEK 2010b: 114–119). Fucks had predicted that China would surpass the Soviet Union in 1975 and the United States in 1980 to be five times as powerful as either power in the year 2000 (FUCKS 1965: 133).[188] In 1978 he moderated his predictions (see table above).

As for political significance, in 1966 Helmut Schmidt (subsequently Chancellor of West Germany 1974–1982) has commented on Fucks' *Formulas for Power*. He says that while this work is useful to read, the formula is too arbitrary, ignoring "national character, religious and ideological stance, level of education and technology, political system, quality of the power elites and so forth" (SCHMIDT 1966: 82).[189] He also criticizes the predictions for China as exaggerated. In the 1980s Huang Shuofeng (section 14.3) in turn criticized Fucks' formula for consisting only of material factors, ignoring intangibles (PILLSBURY 2000: 225).

13.11 Schwartzman / Mora y Araujo 1965 BR / AR

Simon Schwartzman (born in 1939) is a Brazilian sociologist. He studied sociology, political science, and public administration at the Federal University of Minas Gerais and did his master's degree in sociology at the Latin American Social Sciences Institute (FLASCO) in Santiago de Chile, before completing his PhD in political science at the University of California in Berkeley in 1973. He has been working and teaching at the Getulio Vargas Foundation (FGV) and at the University Research Institute of Rio de Janeiro (IUPERJ). He was also professor of political science at the University of São Paulo. From 1994 to 1998 he was president of the Brazilian Institute of Geography and Statistics (IBGE), the Brazilian equivalent of the US Census Bureau. Manuel Mora y Araujo is an Argentine sociologist. He also did his master's degree at FLASCO in Santiago de Chile. He has been director of his own company and is rector of the Torcuato di Tella University, a private nonprofit university.

[187] The soft cover edition published in the same year changed in fact the title from *Powers of Tomorrow: Force Fields, Tendencies, Consequences* to the less abstract *China, India, Brazil: Power Centers of the 21st Century?* [*China, Indien, Brasilien: Machtzentren des 21. Jahrhunderts?*].

[188] As for a more detailed treatment of Fucks' method of prediction in English, see HEISS et alia 1973: 27–48. Reviewing this work, W. D. Nordhaus comments that "Fucks' work is […] highly simplified, perhaps oversimplified, but also quite interesting" (NORDHAUS 1975: 665).

[189] German text: "[…] Volkscharakter, religiöse oder weltanschauliche Grundhaltungen, Bildungsstand und allgemeine Technologie, politisches System, Qualität der Machteliten und so fort."

Schwartzman and Mora y Araujo were both active at the International Peace Research Institute, Oslo (PRIO) as part of Program 21 titled "The Structure of the World Community" under the direction of Norwegian mathematician and sociologist Johan Galtung. In 1966 Schwartzman and Mora y Araujo published two articles, one with Galtung and one without (GALTUNG et alia 1966a, or 1966b; SCHWARTZMAN & MORA Y ARAUJO 1966a, or 1966b). The purpose of their study was to look at international stratification in Latin America at the time. For that purpose 327 Latin American students were surveyed, primarily from Argentina, Brazil, and Chile, plus a control group of 35 students from Norway. Their approach and perspective on stratification is sociological. They see a feudal interaction structure in Latin America corresponding to the rigid stratification in the international system. This structure fosters dependence and exploitation rather than cooperation and integration.[190] This in turn fuels nationalism, and the competitiveness encourages the development of stereotypes, especially among near-equals.[191]

They use two methods to assess stratification and propose a third. First, they develop an objective index for the relative position of countries by adding the scores of countries in ten variables. For each variable, countries are ranked and then divided into three groups of approximately equal size. Those of high rank then receive two score points, those of middle rank one score point, and those of low rank no score point, so that the index range is 0–20. The method itself is essentially a variation of summed ranks. The three variables meant to represent power are (1) GNP, (2) population, (3) area. The seven remaining variables meant to represent average development are (4) urbanization, (5) industrialization, (6) communication, (7) literacy, (8) relative size of middle strata, (9) relative size of high strata, and (10) percentage of white population. Second, they use the surveys to develop a subjective index. Third, they propose to look at the establishment of embassies and other diplomatic legations.[192]

The following table presents the results for the objective and subjective power indexes; scores of the subjective indexes differ slightly in the four publications. No information was given on the scores of the ten variables themselves, so that no scores solely for a power subindex (consisting of the first three variables) can be determined:

[190] Dependencia theory gained prominence in the 1960s. It predicts that exploitation increases the wealth of the rich countries as well as the poverty of the poor countries due to differences in bargaining power and other problems. An important policy feature that resulted from dependencia theory was the idea of import substitution through high tariffs in order to reduce imports and stimulate local industrial development. Overall it can be seen that "the many varieties of dependency theory combine elements of traditional Marxism with economic nationalism" (GILPIN 1987: 282; also KNORR 1975: 279–282).

[191] Schwartzman and Mora y Araujo write: "Rank incongruence implies lack of a common ground of contact. The combination of rank-incongruence and rank equivalence, as the combination of poor white and rich Negro, tends to be the most potentially explosive situation. The fact that Argentinians reduce the levels of Brazilian literacy and whiteness more than the others do seems to indicate a competition that might be stronger if these two countries were not oriented mainly out of the system" (SCHWARTZMAN & MORA Y ARAUJO 1966b: 239–240, or 1966a: 202).

[192] Schwartzman and Mora y Araujo borrowed this idea from David Singer and Melvin Small, who did a ranking of nations according to diplomatic importance (SINGER & SMALL 1966; also section 13.15). Singer contributed comments on their article with Galtung.

Table 27: Index of International Position for 1964 [Schwartzman/Mora y Araujo]

Country	Objective Index Score	Subjective Indexes	
		Latin Americans	Norwegians
Argentina	20	2.78	2.96
Chile	18	2.38	2.77
Cuba	18	2.13	2.18
Venezuela	17	2.23	2.50
Brazil	16	2.70	2.89
Uruguay	16	2.35	1.82
Colombia	15	1.70	1.97
Mexico	14	2.77	2.64
Peru	11	1.79	2.03
Costa Rica	11	1.38	1.25
Panama	9	1.40	2.24
Ecuador	8	1.32	1.64
Bolivia	6	1.25	1.88
Paraguay	6	1.21	1.60
Dominican Republic	5	1.20	1.35
El Salvador	4	1.11	1.19
Guatemala	2	1.18	1.62
Nicaragua	2	1.18	1.25
Honduras	1	1.11	1.38
Haiti	1	1.08	1.49

Source: SCHWARTZMAN & MORA Y ARAUJO 1966a: 66, or 1966b: 228.

The objective index is consequently only to 30% a power index. The other 70% measures per capita development rather than total size.[193]

Rolando Franco criticizes in particular the tenth variable on the percentage of white population as ethnocentric (FRANCO 1966: 285–286, 293). Kurt Jacobsen calculates the index for the Nordic countries Denmark, Finland, Iceland, Norway, and Sweden. He replaces (8) relative size of middle strata and (9) relative size of high strata with (a) education and (b) life expectancy as variables. He drops the tenth variable altogether as being irrelevant in the case of Nordic countries. He uses inverse ranks from 0–4 for scoring each country in each variable, providing the scores for each country on each variable as well as the subtotal for size (JACOBSEN 1967: 143). Hence this size subtotal characterizes power according to Schwartzman and Mora y Araujo:

Table 28: Power of Nordic Countries in 1964 [Jacobsen]

Country	Area	Population	GNP	Size Total
Sweden	4	4	4	12
Finland	3	2	1	6
Denmark	0	3	3	6
Norway	2	1	2	5
Iceland	1	0	0	1

Source: JACOBSEN 1967: 143.

[193] National sum totals and per capita rates should not be added, because this violates dimensional consistency (see section 16.3 for discussion).

In the wider context of Galtung's rank theory, which posits that the higher the total rank of a pair, the more the units in the pair interact, James Lebovic multiplies the total military rank of a pair by the total economic rank of a pair as he assumes interaction in these two capability dimensions (LEBOVIC 1985: 54). This is of no particular importance except to note that ranking methods may not automatically avoid the issue of addition versus multiplication.

13.12 [Anonymous] [1967] [US]

Jack Sawyer was associated with the Dimensionality of Nations (DON) project (section 13.16). In 1967 he published an article explicating three major dimensions: size, wealth, and politics. In the article he writes: "GNP *multiplied* by population […]. This product, and similar ones, have been suggested as measures of national power, which reflects that powerful nations are not only rich but large" (SAWYER 1967: 157). A similar formula by Quincy Wright is population multiplied by energy production (section 13.4). It was used as one of 236 variables in the DON, so Sawyer must have been familiar with it. He does not cite who suggested multiplying GNP by population. As a result the designer is unknown.[194] A diagram with logarithmic scaling suggests what such an index may look like (SAWYER 1967: 158). The following table presents recalculated numerical values in order to reconstruct how such a power index may have looked at the time:

Table 29: National Power of Countries in 1964 [Anonymous]

Country	GNP million $	Population thousands	National Power
United States	443,270	183,742	81,447,316,340
China	46,256	694,200	32,110,915,200
USSR	121,920	218,000	26,578,560,000
India	28,648	442,195	12,668,002,360
United Kingdom	61,379	52,925	3,248,483,575
West Germany	49,906	54,027	2,696,271,462
Japan	27,844	94,050	2,618,728,200
France	41,563	45,960	1,910,235,480
Brazil	17,950	73,238	1,314,622,100
Italy	25,003	49,455	1,236,523,365
Indonesia	11,148	95,655	1,066,361,940

Source: RUSSETT et alia 1964: 18–20, 152–154; author's own calculations.

Sawyer doubts that such an index can be a complete index of national power because military strength is missing. The high ranking of China and India in such an index indicates to him that it is more an index of prominence than of national power.

[194] It is known that Nazli Choucri and Robert North used "population times national income" as a "multiplicative variable representing the interactive effect of home population and national income" (CHOUCRI & NORTH 1975: 169; also CHOUCRI 1973: 20). However, as for national power itself, their explicit approach was different: "Our analysis focuses on five types of attributes indicating capability or potential capability: (1) population, area, density—denoting *territory*; (2) national income, per capita national income, level of production—denoting *productivity*; (3) military expenditure and men under arms—denoting *military capability*; (4) degree of diplomatic recognition—denoting *national status*; and (5) level of trade—denoting *commercial capability*" (NORTH & CHOUCRI 1968: 128).

13.13 Shinn 1969 US

Allen Mayhew Shinn (born in 1937) is an American political scientist. He was assistant professor of government at the University of Texas at Austin. In 1969 he published an article titled "An Application of Psychophysical Scaling Techniques to the Measurement of National Power" (SHINN 1969) that contains his power formula. A year later he published part of his research with the similar sounding title *The Application of Psychophysical Scaling Techniques to Measurement of Political Variables*. In 1974 he contributed a chapter "Relations between scales" to an edited volume titled *Measurement in the Social Sciences: Theories and Strategies*.

Psychophysics is a subdiscipline of psychology that investigates the relationship of physical stimuli to subjective perceptions. In the article Shinn explains that psychophysics had progressed especially in the 1930s as a response to a commercial need to have a scale for subjective loudness as compared to the objective sound pressure level measured in decibels. Averaging the perceptions of a number of people, a smooth curve could be depicted, which indicates that the subjective perception often follows certain psychophysical laws. He uses such an approach on national power. He explicitly refuses to define national power, though he considers national power to be connected to (1) demographic size, (2) economic development, and (3) militarization, everything else to be excluded.

He conducted a survey of 27 students in two advanced courses in international politics at the University of North Carolina, of whom 25 produced consistent data that was averaged to be used for subsequent analysis. Instead of real countries, students were asked to assign power units to hypothetical countries with differences in population, GNP per capita, and military spending as percentage of GNP. Using multiple regression analysis he comes up with a linear, additive model delivering a squared Pearson correlation coefficient of 0.787 with regard to the averaged perceptions of the 25 students, and a nonlinear, multiplicative model delivering a squared Pearson correlation coefficient of 0.984.

As a result the first model is dismissed in favor of the second one. Applying threshold corrections that raise or lower all values in a particular variable by an equal amount, he comes up with this formula:

$$Pt = 0.37 \times POP^{0.41} \times GNP^{0.62} \times MIL^{0.28}$$

Pt = total power; POP = population; GNP = per capita GNP; MIL = military spending as percentage of GNP

This formula makes for a squared Pearson correlation coefficient of 0.962 in relation to the averaged perceptions of the 25 students. He does not construct a real world index based on the formula, hence no results supplied from Shinn himself.

Thomas Saaty and Mohamad Khouja later developed an index of world influence (section 13.23), largely inspired by Shinn's approach, and to compare their approach to that of Shinn in terms of numerical results, they simulate a normalized index using Shinn's formula. The following table presents the complete results of this simulated index calculated from the variables Shinn had chosen.

Besides that, the table also presents the complete results of a normalized eigenvector power index, which is based on human resources, economic strength, and military strength. The latter uses Saaty's and Khouja's approach and was made solely for comparison. It should not be confused with the index of world influence by Saaty and Khouja:

Table 30: Power Indexes for 1973 [Shinn]

Country	Population	GNP	Military Spending	Normalized Index Using Shinn's Formula	*Normalized Eigenvector Power Index*
USA	210	1,167	85.2	0.435	*0.424*
USSR	242	635	65.8	0.294	*0.241*
China	800	120	4.5	0.081	*0.077*
Japan	105	294	3.5	0.057	*0.096*
West Germany	59	257	11.1	0.057	*0.077*
France	50	196	8.5	0.042	*0.063*
UK	46	154	8.7	0.035	*0.062*
Total	1,512	2,823	187.3	1.001	*1.040*

Source: SAATY & KHOUJA 1976: 45

The calculated values appear reasonable on an intuitive base, and that is exactly their purpose. The approach transforms the averaged subjectivities of people into a rational formula. The high squared Pearson correlation coefficient proves that subjective perceptions do not come from nowhere but are indeed automatic responses to objective, external stimuli. Another attractive feature of the index is that it is based on the three most basic and widely available variables that by themselves have been used as single-indicators in the past. It would be fascinating if a replication study could be done on this one to see to what degree perceptions may have changed in the last 37 years.

13.14 Alcock / Newcombe 1970 CA

Norman Zinkan Alcock (1918–2007) was a Canadian nuclear physicist. He studied engineering at Queen's University in Kingston, Ontario, and he did a master's degree in electrical engineering at the California Institute of Technology. In 1949 he got his PhD in physics from McGill University. In 1961 he founded the Canadian Peace Research Institute (CPRI) dedicated to peace research. It ceased operation in 1981. Alan G. Newcombe (1923–1991) was a Canadian chemist. He did his PhD in chemistry at McMaster University. In 1962 he joined together with his wife the CPRI. In 1976 they founded then the Peace Research Institute – Dundas (PRID). In 1970 Alcock and Newcombe published the article "The perception of national power" (ALCOCK & NEWCOMBE 1970) that presents their formula for approximating national power.

After emphasizing the ubiquitous importance of the concept of power in political science, they proceed to declare that "if international relations is to become a science it will have to establish a definitive quantitative measure for its most basic variable—national power" (ALCOCK & NEWCOMBE 1970: 335). They admit that differences may exist between real power and the subjective perception of it, though they insist that objective and subjective power must be based on measurable facts. As for

the application of power formulas for promoting peace, they suggest that quantified power should be used as the basis for weighted voting in the UN General Assembly, instead of the floundering "one nation, one vote" principle (compare sections 13.7, 13.37).[195]

They liken their approach to the previous efforts of Simon Schwartzman and Manuel Mora y Araujo (section 13.11). Similarly they asked 38 Canadian citizens to rank 122 nations,[196] and they calculated the average rank order of countries. They decided on three factors of national power: (1) population, (2) GNP per capita, and (3) area divided by population, which is the reciprocal of population density (compare section 13.9). They ranked those three factors, and then they used multiple regression analysis to arrive at this formula:

$$relative\_power = -16.1 + 0.69\ POP_{rank} + 0.49\ (GNP\ /\ POP)_{rank} + 0.08\ (area\ /\ POP)_{rank}$$

POP = population

Given the low importance of the third factor, they drop it, and arrive at this formula:

$$relative\_power = -8.85 + 0.67\ POP_{rank} + 0.47\ (GNP\ /\ POP)_{rank}$$

POP = population

Another multiple regression analysis using GNP instead of GNP per capita produces this formula:

$$relative\_power = 9.4 - 0.09\ POP_{rank} + 0.93\ GNP_{rank}$$

POP = population

This last formula is almost the same as GNP with a Spearman correlation coefficient of 0.995. The ranking based on the last formula and GNP rankings correlate the same with the ranked perceptions, the Spearman correlation coefficients being in both cases 0.85. Ranked military expenditures correlate much better with the ranked perceptions, the Spearman correlation coefficient being 0.92.[197] They acknowledge that military expenditures reflect especially well the power of nations at war. The following table presents the complete list of results of the last formula. There appears to be a mistake in ranking, the questionable rankings (68–70) are in italics:

[195] In 1971 Newcombe developed the theme further by looking at 20 proposals for weighted voting in the UN General Assembly (NEWCOMBE et alia 1971: 455; compare STRAND et alia 2005). One proposal came from Alcock, who suggested multiplying the square root of the population by the square root of GNP. More often than not proposals for weighted voting of countries are similar to power formulas. A major difference is that these proposals usually contain a bonus of sorts for smaller countries so as to keep the "one nation, one vote" principle but with more limited impact.

[196] "The ten most powerful nations were to be rated separately, the remainder into four groups of decreasing power; each such group comprised 28 nations. The nations were then scored from 1 to 10 if they were in the first group, 24.5 if in Group B, 52.5 if in Group C, 80.5 if in Group D, and 108.5 if in Group E" (ALCOCK & NEWCOMBE 1970: 337–338).

[197] This raises the question: Why do they choose not to include military expenditures in their multiple regression analysis? The realist answer may well be that the resulting power formula would then not be conducive to peace. If voting in the UN General Assembly were based on such a power formula, the more militarized states would have more voting power – and the less militarized an incentive to become more militarized.

Table 31: Rank Ordering of Nations in 1967 [Alcock/Newcombe]

Country	Canadian Perception	Relative Power	Country	Canadian Perception	Relative Power	Country	Canadian Perception	Relative Power
USA	1	1	New Zealand	32	36	Lebanon	70	71
USSR	2	2	Colombia	64	37	Guatemala	93	72
UK	3	3	Egypt	20	38	Singapore	80	73
West Germany	6	4	South Korea	49	39	Kenya	62	74
France	4	5	Chile	56	40	Sudan	82	75
Canada	7	6	Cuba	16	41	Afghanistan	79	76
China	5	7	Greece	26	42	El Salvador	101	77
Japan	8	8	Bulgaria	41	43	Jamaica	91	78
Italy	11	9	Malaya	68	44	Luxembourg	81	79
India	12	10	Nigeria	58	45	North Korea	38	80
Brazil	28	11	Thailand	61	46	Tanganyika	84	81
Australia	9	12	Portugal	40	47	Cambodia	54	82
Poland	18	13	Iran	44	48	Costa Rica	96	83
Belgium	25	14	Israel	10	49	Madagascar	102	84
Sweden	14	15	Algeria	42	50	Haiti	97	85
Indonesia	43	16	Peru	67	51	Panama	74	86
Netherlands	19	17	Ireland	52	52	Trinidad	99	87
East Germany	13	18	Taiwan	59	53	Honduras	98	88
Argentina	34	19	Morocco	75	54	Nepal	95	89
Czechoslovakia	15	20	Uruguay	69	55	Bolivia	63	90
Switzerland	35	21	Ceylon	78	56	Albania	55	91
Mexico	36	22	Kuwait	73	57	Cyprus	72	92
Spain	22	23	Congo	57	58	Nicaragua	92	93
Rumania	48	24	Ghana	50	59	Jordan	47	94
South Africa	17	25	Iraq	51	60	Paraguay	86	95
Turkey	30	26	Rhodesia	66	61	Guyana	94	96
Philippines	71	27	Saudi Arabia	46	62	Liberia	87	97
Denmark	27	28	Ethiopia	65	63	Somalia	100	98
Pakistan	37	29	Burma	77	64	Laos	60	99
Venezuela	39	30	South Vietnam	45	65	Iceland	85	100
Hungary	23	31	Syria	53	66	Libya	88	101
Austria	29	32	Ecuador	90	*68*	Togo	103	102
Yugoslavia	21	33	Dominican Republic	89	*69*	Mongolia	83	103
Norway	24	34	North Vietnam	33	*70*			
Finland	31	35	Tunisia	76	*70*			

Source: ALCOCK & NEWCOMBE 1970: 336–337.

Countries with major discrepancies between the perception ranks and calculated ranks are highlighted. In the three major cases where a country is underestimated (Indonesia, Philippines, Brazil), it can be observed that these are relatively large developing countries in terms of population. As for the four major cases where countries are overestimated (Israel, Cuba, North Vietnam, North Korea), it can be observed that these countries are small but militarily active. Over- and underestimation are relative categories in relation to the calculated results. The patterns indicate that it is not the perception that is flawed but the formula that needs adjustment.

Contemplating the issue of whether power perceptions may differ across cultures and political systems, Charles Doran, Kim Hill, Kenneth Mladenka, and Wakata Kyoji replicated the study by Alcock and Newcombe in 1974 (DORAN et alia 1974, also 1979). For that purpose they surveyed Finnish, Japanese, and American university students. The Spearman correlation coefficients between the three national groups plus the Canadians surveyed by Alcock and Newcombe are all 0.90 or above. This demonstrates that perceptions are fairly reliable and consistent.[198] Like Alcock and Newcombe, they also extend their analysis to the Latin American subset of Schwartzman and Mora y Araujo.

As for determining correlates of national power, their approach differs from Alcock and Newcombe in that they use six variables in their analysis rather than three, using factor analysis[199] to distill three factors out of the six variables. The following table displays the degree of association of each variable with the three factors:

Table 32: Factor Scores [Doran et alia]

Variable	Factor I	Factor II	Factor III
Population	0.93	−0.20	0.16
Military Expenditures	0.89	0.39	0.11
Armed Forces	0.90	0.19	0.19
GNP	0.84	0.48	0.15
GNP per capita	0.14	0.98	0.05
Population Density[200]	0.20	0.06	0.98

Source: DORAN et alia 1974: 440.

Based on these factors, they use multiple regression analysis to arrive at this formula:

```
power = 0.774 factor_I + 0.492 factor_II + 0.076 factor_III
```

No results for this formula were published.

13.15 Singer / Bremer / Stuckey 1972 US

Joel David Singer (1925–2009) was an American political scientist and major contributor to quantitative international politics (QIP). He served in the US Navy during WWII and the Korean War. He studied at Duke University and in 1955 he got his PhD at New York University. He taught at the University of Michigan from 1958 to 1960 and the U.S. Naval War College in 1960. He returned to the University of Michigan in 1964 as professor of political science and stayed there until his retirement in

[198] These correlations could be misleading, as demographic size accounts for a big part of it. For example, the United States will always be perceived as more powerful than Tuvalu simply because of population size. In this regard correlations for perceived power *per capita* might prove more informative.
[199] Factor analysis is a mathematical method to explain variability among observed variables by determining a potentially lower number of unobserved variables called factors.
[200] Alcock and Newcombe use the reciprocal of population density, which gives a higher score to low population densities, whereas Doran and colleagues use population density for their calculations, which gives a higher score for high population densities. Since the two usages are direct opposites, it marks an important difference.

2002. In 1963 Singer initiated the Correlates of War (COW) project that set out to accumulate quantitative data on wars since 1816. As such it built upon the pioneering efforts of Pitirim Sorokin, Lewis Fry Richardson, and Quincy Wright (section 10.4, also 13.4). The COW experienced its heyday from the mid-1960s to the late 1970s, and it continues to function nowadays as a loose network.[201] The COW runs nowadays as a loose network. In 1972 Singer coauthored a major publication, *The Wages of War, 1816–1965: A Statistical Handbook*. Towards the Cold War he took a quasi-pacifistic position, which was controversial.

In 1966 Singer tried to determine the status ordering of states by ranking their diplomatic importance based on the number and ranks of accredited missions in their respective capitals for the time period 1816–1940, which was later extended to 1970 (SINGER & SMALL 1966, 1973).[202] He thinks that power capabilities and status are more often than not correlated, but because status is attributed by the international system, this is not necessarily so (SINGER & SMALL 1966: 238). In the later extension he clarifies that by measuring diplomatic importance "we are not trying to measure power, capability, or influence" (SINGER 1973: 579). Renato Corbetta comments that these "early attempts to capture a 'reputational' hierarchy among states […] have not proved exceedingly fruitful and have not been updated" (CORBETTA 2006).

In 1972 Singer published an article together with Stuart Bremer and John Stuckey (SINGER et alia 1972) that proposed the Composite Index of National Capabilities (CINC) as a basis for an analysis of how capability distribution and uncertainty affect the incidence of major power war. As for the analysis, he assumes that all nations are concerned with their relative prestige and power,[203] with prestige referring to diplomatic importance. Geographic proximity plays a role, because states are less concerned with the power of other states that are far away than with the power of their neighbors. Still his focus remains on the major powers that compete globally.[204] As for the construction of the CINC, he refers to Clifford German (section 13.5) and Wilhelm Fucks (section 13.10) as earlier efforts to measure national capability. Singer equates national capability with war potential. The CINC then combines six variables:

[201] Website: http://www.correlatesofwar.org/ [16 August 2013], also http://eugenesoftware.org/ [16 August 2013].
[202] Depending on the status of a country, there used to be a hierarchy of rank among heads of foreign missions, which went into the calculation. Accordingly, an ambassador was counted as three points, a minister was counted as two points, and a chargé d'affaires was counted as one point (SINGER & SMALL 1966: 253). In the course of time most heads of foreign missions were eventually styled as ambassadors, which made the distinction of rank meaningless. This assignment of points based on ranking was dropped in the later revision without much effect on previous rankings. Other measures were considered but found inadequate, they were budget share, proportions of secretariat personnel, and elected officerships in various intergovernmental organizations (SINGER & SMALL 1973: 584–585). For a study showing that GDP seems to be the best predictor for the size of foreign diplomatic missions in the United States, see XIERALI 2005.
[203] Back in 1963 Singer had already observed that "students of international politics often state that power is to us what money is to the economist: the medium via which transactions are observed and measured" (SINGER 1963: 420). David Baldwin wrote a direct response to this quote arguing that power resources are actually incomparable to money because of lower fungibility, though some power resources may be more fungible than others (BALDWIN 1971, 1979).
[204] A problem is that major power status and material capabilities as measured by the CINC do not match perfectly (SINGER 1988: 58–59; further CORBETTA 2006; compare section 13.28).

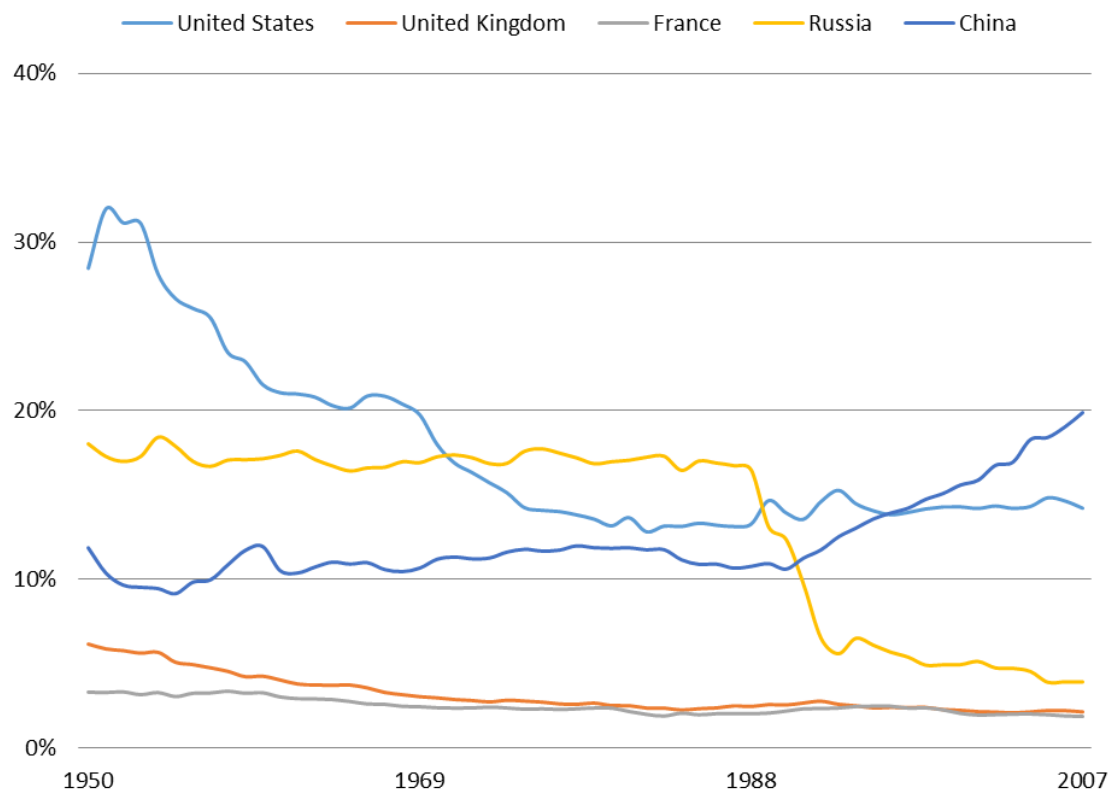
```
CINC = ( %ME + %MP + %IS + %NRG + %UP + %TP ) / 6

%ME = military expenditures as percentage of world total; %MP = military
personnel as percentage of world total; %IS = 1816-1895: iron production as
percentage of world total, 1896-present: steel production as percentage of
world total; %NRG = energy consumption as percentage of world total;
%UP = urban population as percentage of world total; %TP = total population as
percentage of world total
```

The six variables are equally weighted and standardized as percentages of world totals. The resulting arithmetic mean as such also represents a percentage of the world total. The six variables represent three dimensions: (1) the military dimension is represented by military personnel and military expenditures, (2) the economic dimension by energy consumption and iron/steel production, (3) the demographic dimension by urban population and total population. Singer adds that he "considered the need for separate indicators of social organization, national unity and motivation, and technical skills, but concluded that each of those was adequately reflected in one or more of the six variables" (SINGER et alia 1972: 26).[205] Stuart Bremer emphasized that the three dimensions differ in the timing of their applicability. Military resources stand for realized power, economic resources for intermediate potential, demographic resources for long-range potential (BREMER 1980: 60).

[205] Later he considered these variables to be factor modifiers contributory to national power to the extent that they affect the efficiency with which national capabilities are utilized, but they are not national capabilities by themselves (SINGER 1988: 55). In this regard it is important to note that Singer originally conceived of the CINC as a power index. It is later on that he made the distinction between national power and national capabilities. In 1972 he referred to the six variables, which in turn are grouped into three dimensions, resulting in one composite index (6+3+1) as "the ten power indices for each nation" (SINGER et alia 1972: 26). Afterwards a more careful distinction was made between power and capabilities. In the current COW manual it is said that "'power' – here defined as the ability of a nation to exercise and resist influence – is a function of many factors, among them the nation's material capabilities. Power and material capabilities are not identical; but given their association it is essential that we try to define the latter in operational terms so as to understand the former" (GREIG & ENTERLINE 2010b: 1).

Figure 5: The CINC for Five Major Powers 1950–2007 [Singer et alia]



Source: GREIG & ENTERLINE 2010a.

James Lee Ray features the CINC in his book *Global Politics* when discussing the measurement of power along geopolitics (RAY 1983: 132–146). As limitations of the CINC he notes that it ignores geography, alliance ties, and intangibles such as skill, will, and purpose. Given that the Soviet Union by the time had surpassed the United States in all variables but fuel consumption, he wonders whether the economic dimension should be given greater weight vis-à-vis the military dimension. Jacek Kugler and Marina Arbetman compare the CINC with GNP. Further, they compare the CINC with GNP multiplied by Relative Political Capacity (RPC), a power index in its own right (section 13.25). Kugler codeveloped RPC with AFK Organski, and they had used GNP alone as a proxy of national power before developing RPC. Their empirical comparison is unsurprisingly favorable to GNP and GNP × RPC. Kugler concludes that GNP is somewhat superior to the CINC on account of parsimony, and that the RPC is superior to the CINC because political elements are more relevant than military effort (KUGLER & ARBETMAN 1989). Bruce Russett makes the criticism that the CINC misses out on the quality of human resources and high technology (RUSSETT et alia 2004: 110–111).

Minor Operational Modifications: Doran / Parsons 1980, Mesquita 1981, Moul 1986, Nau 2005

The CINC is the most used power index, not because it is superior in quality, but because it is supported by a huge dataset for a large number of countries for all years 1816–present (compare RUSSETT et alia 2004: 110). In his analysis of status inconsistency, Michael Wallace used the CINC

variables (except energy consumption) individually for achieved status, and Singer's index on diplomatic importance for ascribed status (WALLACE 1971: 25–26). In this context it can be noted that the CINC minus energy has been available from EUGene (Expected Utility Generation). Apparently energy values for the United Kingdom were not available for all years in the period 1816–1854 (see BENNETT & STAM 2007: 6, 87). Also modifications have been made in attempts to improve the CINC. Charles Doran and Wes Parsons used basically the same variables as the CINC with the exception of military expenditures (DORAN & PARSONS 1980: 953–954; also CHAN 2005: 691–692). Bruce Bueno de Mesquita adjusted the CINC for distance in order to emphasize that countries differ in their power at different locations (MESQUITA 1981: 103–108).[206] William Brian Moul excluded the two variables of the demographic dimension (total population and urban population), because he does not consider long-range potential as applicable to cases of serious dispute (MOUL 1988: 246, 1989: 111–112).[207]

Some time prior to 2005[208] Kevin Sweeney added soft power variables to the CINC to compose a "Composite of Hard and Soft Power". The number of foreign exchange students hosted and the number of tourist visits functioned as variables signifying cultural appeal. The number of scientific patents applied for, the number of radios, televisions, and telephones in use functioned as variables signifying technological endowment. The results are available (CHAN 2005: 694). In 2005 Dylan Kissane proposed a similar modification of the CINC, but he failed to find adequate measures for soft power (see KISSANE 2005: 84, 86, 142). The same year Allison Nau added soft power with equal weight to the hard power as measured by the CINC. As for using the CINC on hard power, he modified the CINC by multiplying military capability by 1.75 when a country has nuclear weapons. The idea came almost certainly from German's formula (section 13.5). For soft power he found four measures, namely (1) recorded media exports, (2) newspaper, journal, magazine exports, (3) number of internationally dispatched letters, and (4) number of foreign students in the country (NAU 2005: 7–12). The results are available (NAU 2005: 25–30).

The Geometric Index of National Capabilities (GINC) 2004

A technical modification is the Geometric Index of National Capabilities proposed by Kelly Kadera and Gerald Sorokin (KADERA & SOROKIN 2004). The difference between GINC and CINC is that the CINC uses the arithmetic mean and the GINC the geometric mean. The formula is:

[206] The formula is:

$$Adjusted\_Capabilities = Composite\_Capabilities^{\log [\ (\ miles\ /\ miles\_per\_day\ )\ +\ (\ 10\ -\ e\ )\ ]}$$

The variable "miles" refers to the distance from a country's locus of power to a certain place, "miles per day" refers to the transport range, which for 1816–1918 was 250 miles per day, for 1919–1945 was 375 miles per day, and after 1945 is 500 miles per day, e represents Euler's constant (2.71828…).

[207] For the results of this CINC variation, see Moul 1989: 119–121. Four of the six variables of the CINC had been tested as a predictor of victory in interstate war 1816–1976, and it was found that steel production, military personnel, and military expenditure were significant, whereas total population was not significant (WAYMAN et alia 1983: 506–507). Michael Sullivan calculated a Spearman correlation coefficient of 0.93 for the CINC as it stands and the CINC without the two population indicators for the 1950–1970 time period (SULLIVAN 1990: 116–117).

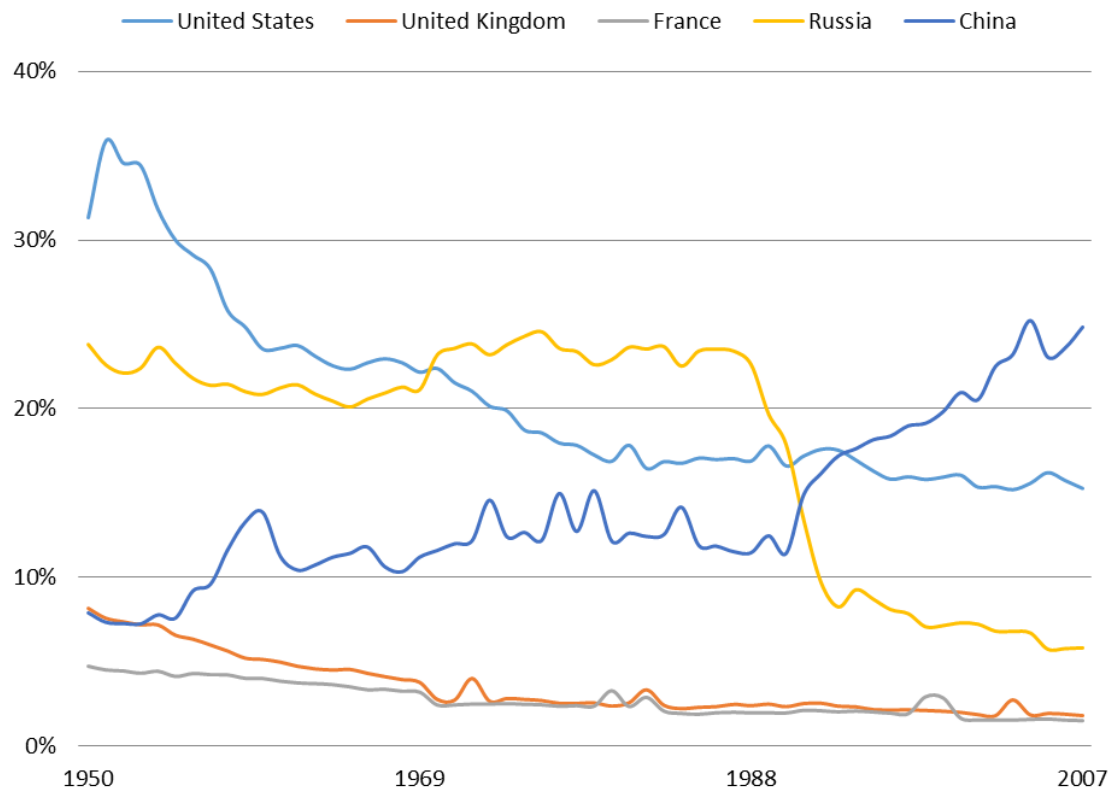
[208] The exact year is unknown as it relates to an unpublished manuscript.

$$GINC = (\%ME \times \%MP \times \%IS \times \%NRG \times \%UP \times \%TP)^{1/6}$$

%ME = military expenditures as percentage of world total; %MP = military personnel as percentage of world total; %IS = 1820–1895: iron production as percentage of world total, 1896–present: steel production as percentage of world total; %NRG = energy consumption as percentage of world total; %UP = urban population as percentage of world total; %TP = total population as percentage of world total

All six variables have equal weights and *can* be standardized as percentages of world totals as in the CINC, though standardization is *not* necessary. The advantage of the GINC is that it can also be used for subsets of countries using subset totals and still calculate values that are exactly in the same proportion to one another as when one is using world totals. The ratios of each country's relative power vis-à-vis others stay constant regardless of the number of countries considered. Conversely, the CINC is altered by changing subset totals, so each entry or exit of a country from the subset changes the power of all included countries relative to one another.

Figure 6: The GINC for Five Major Powers 1950–2007 [Kadera & Sorokin]



Source: GREIG & ENTERLINE 2010a; author's own calculations.

One thing to observe is that the graphs in the diagram of the CINC are much smoother (more stable) than in this diagram. This can be expected due to the increased sensitivity of the geometric mean as compared to the arithmetic mean. The geometric mean increases the calculated power of countries

that are well-balanced across all six elements. For example, the impact of population is diminished in the case of China, especially in the 1950s. Given that both CINC and GINC depict China for some period already as the most powerful country in terms of capabilities, this demonstrates how both CINC and GINC have become obsolete as measures for this day and age (compare SUŁEK 2010b: 112).

13.16 Rummel 1972 US

Rudolph Joseph Rummel (born in 1932) is an American political scientist. After teaching at Indiana University in 1963 and Yale University from 1965 to 1966, he spent most of his career at the University of Hawaii, where he was professor of political science from 1966 to 1995. He directed the Dimensionality of Nations (DON) project that lasted from 1962 to 1975. The DON began with a grant to Harold Guetzkow (section 13.6), who was professor at Northwestern University, and Rummel did his PhD there at the time. In 1972 he published *The Dimensions of Nations* that presented much of the data he had calculated (RUMMEL 1972). From 1975 to 1981 he followed up on the theoretical front by publishing the five volumes on *Understanding Conflict and War*. His conclusion was that the best way to eliminate war is to promote democracy. As such he became a major contributor to democratic peace theory. He also got into the quantitative study of mass murder by government, for which he coined the term "democide". While libertarian on domestic issues, he advocates an interventionist stance in foreign policy.

He took part of his inspiration from the work of Quincy Wright (section 13.4, further section 10.4) (RUMMEL 1975: 60–65). The aim of DON was to delineate the major dimensions of nations by mapping and analyzing the complex relations among 236 social, economic, and political variables (RUMMEL 1972: 11–15; SAWYER 1967). The 236 variables were collected for 1955 for all then-independent 82 nations with a population of more than 800,000. One result was to determine three dimensions that account for 40.1% of the variation in the 236 variables: economic development (wealth), political orientation, and size (RUMMEL 1972: 269).[209] Economic development (wealth) relates mainly to variables on a per capita basis, political orientation relates mainly to ideological alignment (communist, capitalist, or neutral), and size relates mainly to variables on an aggregate basis (total size or gross size) (compare sections 16.3, 16.4).

For size, he regards national income as the basic indicator; for wealth, energy consumption divided by population; and for politics, the freedom of opposition enjoyed by groups (RUMMEL 1972: 306). He suggests that "the size dimension may also be interpreted as a power bases dimension" (RUMMEL 1972: 225). The size dimension has a Pearson correlation coefficient of 0.91 with Quincy Wright's measure for national power multiplying population by energy production (section 13.4) and 0.90 with national income (RUMMEL 1972: 231).

He classifies nation types by looking at clusters in a space of equally weighted dimensions (RUMMEL 1972: 299–324), the idea being that similar nations will be closer together in terms of

[209] For a listing of other attempts to define the basic dimensions of nations, see SAWYER 1967: 155–156; RUMMEL 1972: 65–74, 244–259. For using dimensions to delineate international regions, see RUSSETT 1967, 1968b.

distance whereas dissimilar nations will be further apart (compare section 13.44). He uses the connectedness method to group nations.[210] When using the three primary dimensions, he comes up with two factor groupings, one of which consists of countries "that are usually considered the Great Powers in international relations" (RUMMEL 1972: 321), the other factor grouping consisting of the rest. "Coefficients measure the similarity of each nation with the group and range from 0 to 1.00" (RUMMEL 1972: 308). The following table presents the group of great powers with their respective coefficients, which appear to function like a measure of power as well:

Table 33: Great Powers in 1955 [Rummel]

Country	Coefficient	Country	Coefficient
USA	0.68	West Germany	0.54
USSR	0.59	India	0.45
United Kingdom	0.59	Canada	0.45
France	0.56	Japan	0.42
China	0.55	Italy	0.41

Source: RUMMEL 1972: 322.

Besides that, when testing the hypothesis that posited that the power of a nation was related to its foreign conflict behavior (the results showed little relationship), he used eight variables separately as a proxy for power: national area, population, GNP, energy resources potentially available, railroad length, military personnel, defense expenditure, and political centralization (RUMMEL 1972: 368).

13.17 Ferris 1972 US

In 1972 Wayne Harry Ferris got his PhD in political science at the University of Pennsylvania. A year later he was working for the International Research Group in Washington. In 1975 he was the coauthor of the book *Energy policies in the European community* published by the International Research Group. There is no publicly available information about his career after 1975. In any case, the title of his dissertation (accepted in 1972) was *A theoretical-empirical analysis of the power capabilities of nation states related to involvement in international conflict and war*. The substance of this dissertation went into the book *The Power Capabilities of Nation-States: International Conflict and War* published in 1973 (FERRIS 1973). Among others he acknowledges the work of Quincy Wright (sections 10.4, 13.4) and David Singer (section 13.15) as having been valuable for his research. In addition, he acknowledges R. J. Rummel (section 13.16) for having provided criticisms and suggestions on his work.

The stated purpose of his research is to combine the power capabilities of countries into a single index and then correlate power capabilities with the occurrence of international conflict and war. He defines power capabilities as those factors that enable one entity to threaten and exact sanctions vis-à-vis another (FERRIS 1973: xxii, 6). Three of his fourteen hypotheses are clearly supported by the

[210] "The connectedness method […] adds an object to a group if the distance between the object and any member of the group is smaller than that between the object and the others not in the group" (RUMMEL 1972: 304).

end of his research: (1) that the side with the greater capabilities tends to win the conflict, (2) that a wider disparity in the power capabilities of states increases the probability of involvement in intense conflicts, and (3) that larger changes in power capabilities increase the probability of involvement in intense conflicts (FERRIS 1973: 115–116).[211]

Nevertheless he sees power capabilities as subservient to more potent motivational factors. Discussing the technicalities of developing his index (FERRIS 1973: 33–50), his basic assumption is that one indicator is insufficient to measure the power capabilities of states as each possible indicator contains some error. As such he supports a multivariate approach in the hope that the effect of error can be mostly cancelled out. He selected eight indicators to measure power capabilities with the following weights ("trade value per capita" was excluded for low significance):

Table 34: Weighting of Factors [Ferris]

Factor	Weighting
Government Revenue	0.1905
Defense Expenditure	0.1885
Trade Value	0.1589
Armed Forces Personnel	0.1122
Defense Expenditure per capita	0.1120
Population logged[212]	0.0998
Government Revenue per capita	0.0762
Area	0.0615
Power Capability	0.9996

Source: FERRIS 1973: 50.

Ferris' index is exceptional for being a multivariate index with a nonarbitrary weighting scheme, even as the selection of the indicators remains arbitrary (compare section 16.6). Given that the importance of indicators varies over time, he squared the average factor loadings from the principal component analyses[213] of the nine indicators done for 24 sample years divided by five-year increments ranging from 1850 to 1965. He justifies this by assuming that the indicators that correlate highest with the principal component over time are therefore more important and representative of the phenomenon sought after (power capabilities). He admits that this method may not be ideal, but he draws attention to the challenge to devise a better alternative weighting scheme on logical grounds. He rejects the simplistic, arbitrary method of giving all indicators equal weight, because he considers it most unreasonable to act as if all indicators are of equal importance. He sums up the dilemma faced by designers of power formulas in stating that

> neither common sense nor logic provides clearly defined principles for arriving at weights which precisely represent the relative importance of the variables. Are armed

[211] The last point supports in part the power transition theory of AFK Organski (section 13.25).
[212] The logarithm of population was taken to reduce the importance of very large populations. Moul comments that "because the factor analysis is used to calculate 'weights' which are applied to the absolute values, the log trans formation might well increase rather than reduce the impact of population in the final index values" (MOUL 1989: 104).
[213] Principal component analysis is a mathematical method to determine principal components in a number of possibly correlated variables. The first principal component should account for as much of the variability in the data as possible, each succeeding principal component doing likewise with the remaining variability. As for factor loadings, by squaring them one can determine the amount of variation that the indicator has in common with the principal component.

> forces twice or only one and a half times as important as area? On what grounds? Merely to raise the question is to appreciate the difficulty of rationally assigning exact weights to the various indicator-variables. (FERRIS 1973: 45)

The following table presents the power capability scores for the ten highest-scoring states; power capability scores for the ten lowest-scoring states are also available (FERRIS 1973: 56):

Table 35: Power Capability Scores for Ten Highest-Scoring States 1850–1960 [Ferris]

Country	1850	1875	1900	1930	1960
Russia / USSR	12,306	11,343	12,651	5,755	12,709
United States	4,668	6,487	8,387	11,755	21,942
United Kingdom	12,728	10,730	12,515	10,524	5,024
France	11,737	10,897	9,473	6,710	4,019
Austria-Hungary	7,379	5,859	5,792		
Prussia / Germany / West Germany	4,523	7,228	8,062	5,345	3,034
China		4,203		5,510	4,476
Italy		4,974	4,180	4,184	1,660
Japan				3,269	
Spain	3,314	3,755		2,038	
Turkey	3,528	2,932	2,391		
Netherlands	2,626		2,940		
Canada				2,473	2,871
Uruguay	2,545				
Belgium			2,234		
Sweden					1,620
Australia					1,582

Source: FERRIS 1973: 56.

Charles Doran and Wes Parsons briefly comment on Ferris' weighting scheme that weights derived from the squared factor loadings are relatively equal. They argue that weightings do not usually alter the nature of the final index (DORAN & PARSONS 1980: 953–954). These illogical claims appear to be arguments of convenience to justify themselves giving equal weight to indicators. Doran and Parsons used basically the same variables as the CINC with the exception of military expenditures (section 13.15). William Brian Moul, who used a variation of the CINC excluding the demographic dimension (also section 13.15), discusses Ferris' index more elaborately (MOUL 1989: 103–107). He criticizes the use of ratio variables (in this case per capita rates) and that statistical outliers (large countries) cause erratic behavior in the factor loadings over the 24 sample years. He also criticizes the index for lacking historical validity. For example, France clearly ranks superior to Germany even after its disastrous defeat in the Franco-Prussian War 1870–1871.

13.18 Cox / Jacobson 1973 CA / US

Robert W. Cox (born in 1926) is a Canadian political scientist. He did a master's degree in history at McGill University. From 1947 to 1972 he worked for the International Labour Organization (ILO). Afterwards he became professor of international organization at Columbia University. In 1977 he

returned to Canada to become professor of political science at York University. There he became radicalized, becoming a leading advocate of neo-Gramscianism.[214] Harold Karan Jacobson (1929–2001) was an American political scientist. He studied history at the University of Wyoming and went on to do a PhD at Yale University. He spent most of his career as a professor of political science at the University of Michigan. His research interests were decolonization, environmental protection and climate change, as well as international institutions and democracy.

Cox and Jacobson edited *The Anatomy of Influence: Decision Making in International Organization* published in 1973 (COX & JACOBSON 1973). The book focuses on the working of influence in UN specialized agencies (ITU, ILO, UNESCO, WHO, IAEA, IMF, GATT, UNCTAD). They first assume and then find a strong relationship between the power of a state in the international environment and the influence of a state in international organizations. For that purpose they calculated a power index to compare the ranking of states in the international environment with the rankings of states in each specific institution (COX & JACOBSON 1973: 27–28, 409–414). They define power as capabilities, and influence as the ability to modify the behavior of another actor (COX & JACOBSON 1973: 3–4).

Discussing the specifications of their index (COX & JACOBSON 1973: 437–443), they emphasize that power resources could be material and *psychic*. As material resources they regard economic and military capabilities. As psychic resources they regard reputation, prestige, and morale. Cox and Jacobson briefly discuss Clifford German's index (section 13.5) but regard it as unnecessarily complicated and Clausewitzian in terms of viewing power ultimately as military capabilities.[215] They wish to emphasize that they view power less from a military-strategic angle and more in terms of potentiality for influence in world affairs. For the index they use score ratings in five indicators:

Table 36: Score Range of Indicators [Cox/Jacobson]

Indicator	Score Range
GNP	1–12
Per Capita GNP	1–4
Population	0–5
Nuclear Capability	0–3
Prestige	0–3
Total	2–27

Source: COX & JACOBSON 1973: 438–439.

As for nuclear capability being of importance, that is something they agree on with German. The trademark of their index is that it tries to capture prestige. As for the assignment of score points, the following criteria are used:

[214] For a critical treatment of the ideas of Cox and others, see MEARSHEIMER 1995: 37–47.
[215] This interpretation of German's index is false. As the section on German's measure demonstrates, the effective weight of 0.6% for military size excluding nuclear capabilities is abnormally low. German had stated explicitly that the exclusive focus on fighting forces is a thing of the past (GERMAN 1960: 138).

0 nonindependent foreign policy

1 alliance-aligned

2 neutral or nonaligned, independent foreign policy

3 leader of alliance system or recognized leadership of a group of states or active independence in a hostile environment

(COX & JACOBSON 1973: 439)

They comment that "our composite index gives some—but probably not enough—weight to prestige" (COX & JACOBSON 1973: 443), adding that more sophisticated measures of prestige should be devised. They also mention that influence can come from weakness, when a country manages to make other countries concerned with its developmental state. In effect their index and concept of psychic power is a precursor to what is today called soft power.[216]

The following table presents the complete list of published results for three sample years; the calculated scores of some countries were not published, because their scores were deemed too small (COX & JACOBSON 1973: 40):

Table 37: Power Scores of Countries 1950–1967 [Cox/Jacobson]

Country	1950	1958	1967	Country	1950	1958	1967
United States	24	25	26	South Africa	9	10	12
USSR	21	23	24	Mexico	9	10	11
United Kingdom	17	18	19	Poland	8	9	12
France	16	17	20	Austria	6	9	13
China	15	17	19	Pakistan	8	8	12
West Germany	14	16	18	Czechoslovakia	8	9	11
India	14	16	16	Denmark	8	9	11
Japan	12	13	19	East Germany	7	9	11
Canada	14	14	16	Israel	7	9	11
Italy	11	14	17	Norway	8	9	10
Sweden	11	12	14	Turkey	8	8	10
Brazil	11	12	13	United Arab Republic	8	8	10
Australia	11	11	13	Venezuela	8	9	9
Switzerland	11	11	13	New Zealand	8	8	9
Belgium	11	11	12	Philippines	8	8	9
Spain	10	10	13	Cuba	6	8	10
Netherlands	9	10	13	Finland	7	7	9
Argentina	9	11	12	Nigeria	5	5	9
Indonesia	10	11	11	Luxembourg	6	6	6
Yugoslavia	9	9	13				

Source: COX & JACOBSON 1973: 439–441.

They explain that they are not using a ratio scale. Values indicate ranks but are not directly comparable. This means just because Switzerland has a score of 13 and the United States 26, this does not then imply that the United States is only twice as powerful as Switzerland (COX & JACOBSON

[216] Joseph Nye was one of the participants in the book edited by Cox and Jacobson. He wrote the chapter on UNCTAD. In 1990 he coined the term "soft power" (NYE 1990a; also section 9.2).

1973: 439). The index essentially shows European recovery after WWII in addition to Japan, which gained the most in this index.

13.19 Rosecrance / Alexandroff / Healy / Stein 1974 US

Richard N. Rosecrance (born in 1930) is an American political scientist. He studied at Swarthmore College and did his master's degree and PhD at Harvard University. He taught at Cornell University and the University of California in Berkeley, and is now professor of public policy at Harvard University. His focus has been on the link between economics and international relations. He is a proponent of the liberal school in American IR theory. Alan Alexandroff did a PhD in government at Cornell University. Brian Healy also did a PhD at Cornell University. Arthur Stein did his BA at Cornell University and his PhD at Yale University. Together they participated in the Situational Analysis Project (SAP) at Cornell University, a product of which was their 1974 paper *Power, Balance of Power, and Status in Nineteenth Century International Relations* (ROSECRANCE et alia 1974).

The paper focuses on the major European powers between 1870 to 1881. Their references point to an impressive awareness of previous efforts at measuring power, including those of Quincy Wright (section 13.4), Clifford German (section 13.5), Wilhelm Fucks (section 13.10), Simon Schwartzman and Manuel Mora y Araujo (section 13.11), Norman Alcock and Alan Newcombe (section 13.14), David Singer (section 13.15), and R. J. Rummel (section 13.16). They mention the idea of combining military strength with zeal, but they decide to refrain from subjective assessment and measure what they call the objective qualities of national power. For this they have a list of 25 variables divided into seven categories:

Table 38: Twenty-Five Power Variables [Rosecrance et alia]

Category	Variable
Military	Military Expenditure
	Percent of Budget Spent on Military
	Number of Military Personnel
	Number of Ironclad Warships
Demographic	Population
	Urban Population
Fiscal	Total Government Expenditure
	Total Government Revenue
	Surplus or Deficit in Government Budget
Trade	Surplus or Deficit with the Major Power

Economic	Pig Iron Production
	Steel Production
	Coal Production
	Telegraph Mileage
	Telegraph Mileage per capita
	Railroad Mileage
	Railroad Mileage per capita
Educational	Primary School Enrollment
	Primary School Enrollment per capita
	University Enrollment
	University Enrollment per capita
Financial	Bank Discount Rate
	Open Market Discount Rate
	Discount Rate—Yearly Spread
	Number of Changes in Discount Rate

Source: ROSECRANCE et alia 1974: 13.

As they want to relate power and status, they use as a measure for status the number of diplomats accredited to a nation's capital as well as the number of diplomatic recognitions accorded to a state. Part of the information for the latter is taken from Singer's index on the diplomatic importance of states (SINGER & SMALL 1966; also section 13.15). As for the power index, they rank the five major powers of Europe at the time in each of the 25 variables and then add these rankings together with equal weight for each variable (summed ranks). The following table presents the complete results; note that a smaller composite score means more power:

Table 39: Twenty-Five Variable Power Index 1870–1881 [Rosecrance et alia]

Country	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881
France	60	62	59	62	60	58	58	62	60	64	69	66
England	67	62	62	58	60	65	63	64	70	64	58	65
Germany	75	67	63	66	65	68	66	68	62	67	66	63
Russia	84	92	84	86	91	89	88	83	81	79	87	86
Austria-Hungary	93	98	102	95	94	94	96	85	95	96	88	94

Source: ROSECRANCE et alia 1974: 20.

Diplomatic historian Paul Schroeder lauds the effort but rips apart the index in his review of the paper (SCHROEDER 1977a: 12–17). The measure for status he finds almost worthless. The power index he criticizes (1) for not weighing variables, (2) for not refining variables, (3) for omitting geography, national composition associated with conflicts, and other factors,[217] and (4) for focusing on ranks rather than quantities. The results of the power index he finds historically incorrect, for "this index not only flies in the face of France's smashing defeat by Germany in 1870–1871, but renders inexplicable the diplomatic history of the whole succeeding decade" (SCHROEDER 1977a: 16). In a reply Rosecrance and colleagues agreed that the index could be further refined and developed but at the same time suggested that this would probably make no difference to the final rankings (ALEXANDROFF

[217] As for the issue of using only objective variables, Schroeder makes this analogy: "Is one being too cynical if he seems to find here the procedure of the drunken man who searched for a lost coin not where he probably lost it, but where the street lamp gave more light for the search?" (SCHROEDER 1977a: 14).

et alia 1977: 47–52).[218] In his reply to the reply Schroeder argued that even a bad weighting scheme was better than none, the same applying for theory. He also offered constructive help "by finding out how knowledgeable men in past times judged and weighted the various factors in national power" (SCHROEDER 1977b: 74). Reflecting on Schroeder's initial review, Melvin Small from the Correlates of War (COW) project (section 13.15) acknowledges that "problems arise over the way those indicators [of power and status] are used and the false precision they suggest" (SMALL 1977: 74).

13.20 Cline 1975 US

Ray Steiner Cline (1918–1996) was an American political scientist and CIA analyst. After studying at Harvard University and Oxford University, he joined the Office of Strategic Services (OSS) in 1943. The OSS was a precursor to the CIA, which was formally established in 1947. He held various high level positions related to intelligence until he retired from government service in 1973. He was an influential anticommunist hardliner in the CIA, who used his connections to play an important role in right-wing organizations like the World Anti-Communist League (WACL), which had been founded in 1966 in Taipei. From 1957 to 1962 Cline had been the CIA Chief of Station in Taiwan. From 1973 to 1986 he was the executive director of World Power Studies at the Georgetown University Center for Strategic and International Studies. He wrote a number of books, four of which are exclusively on his power formula (CLINE 1975, 1977, 1980, 1993).[219]

Looking at the background and essentials of his measurement of national power (CLINE 1975: 3–12, 1977: 1–35, 1980: 7–23, 1993: 23–34), it can be said that Cline bases his view on geopolitics. He focuses on geostrategic regions and constant change in power, which he calls "strategic drift". He defines power as the ability of one government to make another government do what it would otherwise not do via persuasion, coercion, or military force. National power as such not only implies war potential but political and economic competitiveness as well. He emphasizes that power rests ultimately on subjective assessments, and that his measures of perceived power reflect his arbitrary judgments on the situations of those particular years in which his index was published. He adds that governments act on perceptions and projections of power rather than real power, and that these perceptions of power are volatile and dependent on temporary situations as compared to concrete elements of usable power that most of the time change gradually.

The basic version of his formula is:

$$P_p = (C + E + M) \times (S + W)$$

P_p = perceived power; C = critical mass = population + territory; E = economic capability; M = military capability; S = strategic purpose; W = national will

[218] In the usual exchange of disregard bordering on contempt between quantitative and nonquantitative scholars, they further imply that diplomatic historians in general are retrograde and subjective in method (see ALEXANDROFF et alia 1977: 35–36).
[219] A 1978 conference paper basically summarizes his 1977 power index. It was published together with papers from other scholars in an edited volume (CLINE 1978).

Whereas this basic formula does not change for the four published indexes, the tertiary subcomponents do change, especially as pertaining to the measurement of minerals. The scores for strategic purpose and national will[220] are not based on any underlying variables taken from elsewhere. They solely reflect Cline's personal judgment. The following table gives a summary of elements and changing weights and coefficients and does not show tertiary subcomponents:

Table 40: Elements of Perceived Power [Cline]

Concrete Elements	1975	1977	1980	1992
Critical Mass	10.0	105	110	220
Population	5.0	50	50	100
Territory	5.0	50	50	100
Strategic Location Bonus		*5*	*10*	*20*
Economic Capability	20.0	200	200	200
GNP	10.0	100	100	100
Energy	2.0	20	20	
Minerals	2.0	20	20	
Industry	2.0	20	20	
Food Grains	2.0	20	20	
Trade	2.0	20	20	100
Military Capability	20.0	210	210	100
Nuclear Force	15.0	100	100	50
Conventional Force	5.0	100	100	50
Military Effort Bonus		*10*	*10*	
Capability Scores	50.0	515	530	520

Coefficients	1975	1977	1980	1992
Strategic Purpose	1.0	1.0	1.0	1.0
National Will	1.0	1.0	1.0	1.0
Commitment Coefficient	2.0	2.0	2.0	2.0

Source: CLINE 1975, 1977, 1980, 1993; author's own calculations.

The table above shows two major adjustments. With the end of the Cold War, the weight assigned to military capability is cut in half, and the weights previously given to energy, minerals, industry, and food grains are transferred all to trade. This demonstrates what Cline means by asserting that the perception of power depends on situations.

Cline's formula is from an international viewpoint the best known power formula ever produced. The Chinese especially have been inspired by the formula in their efforts to measure the comprehensive national power (CNP) of nations (PILLSBURY 2000: 211, 225–226). What Chinese researchers most appreciate is that "national power is a product rather than a sum of 'soft' and 'hard' powers [and] that 'soft' power is as equally important as 'hard' power in political reality" (XUETONG: 2006: 16). The multiplication of hard factors (C + E + M) and soft factors (S + W) means that if a

[220] "Strategic purpose (S) is the part of the global decision-making process that conceptualizes and establishes goals and objectives designed to protect and enhance interests in the international environment. National will (W) is the degree of resolve that can be mobilized among the citizens of a nation in support of governmental decisions about defense and foreign policy" (CLINE 1990: 97).

country scores zero in soft factors, it will score zero in total.[221] This is much more radical than the comparatively minor additive inclusions of soft power by Clifford German (section 13.5) and Robert Cox and Harold Jacobson (section 13.8). Chinese appreciation of his work is in a historical sense ironic given that Cline used the soft factors to reward the fully committed anticommunist allies Taiwan and South Korea with unrealistically high scores (CHANG 2004: 15). At the same time he used the soft factors to diminish the score of the United States relative to the Soviet Union, because he perceived the Vietnam War as a humiliating defeat brought about by misguided strategy and lack of resolve. As such the numbers were calculated to promote his policy recommendations. The following table presents the complete list of published results:

Table 41: Perceived Power of Nations 1975–1992 [Cline]

Country	1975	1977	1980	1992	Country	1975	1977	1980	1992
Maximum Possible	**100.0**	**1,030**	**1,060**	**1,040**	Sweden		35	15	50
					Chile		26	25	48
USSR / Russia	67.5	523	458	328	Norway		25	21	50
United States	35.0	421	304	550	Yugoslavia	5.6	25	13	
West Germany / Germany	27.0	168	116	364	Libya		36	18	36
Japan	17.0	144	108	434	Colombia		41	12	33
Brazil	20.8	122	137	216	Morocco		30	10	40
China	23.0	120	83	240	Yemen				24
France	24.0	101	74	240	Afghanistan		24		
United Kingdom	19.0	99	68	240	Peru		31	13	27
Canada	18.0	58	61	250	Finland			6	40
Australia	13.2	66	88	175	Syria			15	30
Indonesia	12.0	85	55	175	Bangladesh		20	11	34
Italy	12.0	57	34	220	Sudan		20	13	30
Iran	19.6	128	16	66	Singapore	3.0	1	2	48
Taiwan	12.0	37	49	195	Iceland				20
South Korea	9.1	53	46	180	New Zealand	3.0	11	18	20
India	12.8	58	36	147	Tanzania		30	9	15
Ukraine				88	Greece			6	28
Netherlands	12.0		23	102	Iraq		20	14	15
South Africa	11.0	60	40	114	Ethiopia		14	7	26
Egypt	9.9	72	46	99	Panama				14
Vietnam	14.0	58	39	77	Burma		15	4	22
Spain	8.0	53	39	140	Zambia		22	5	
Mexico	9.9	44	22	125	Cuba	3.2	3	2	14
Pakistan	11.0	62	22	84	United Arab Emirates			2	22
Austria				65	Kenya			9	15
Saudi Arabia	9.8	60	39	60	Niger				12
Nigeria	11.0	52	22	72	Portugal	1.2			10
Turkey	8.0	39	18	117	Belarus				10
Switzerland			11	105	Bulgaria			5	14
North Korea	9.6	31	21	77	Mali				9
Thailand		38	20	110	Mongolia		12	2	9
Kazakhstan				56	Malaysia			5	10
Poland	11.0	34	20	52	Zimbabwe			7	

[221] Michael Sullivan calculates a Pearson correlation coefficient of –0.17 for the hard and soft factors in Cline's 1975 index (SULLIVAN 1990: 114). This may also be due to the hard factors measuring national sum totals (total size or gross size), whereas the soft factors appear to be factor modifiers operating quasi on a per capita basis (compare sections 16.3, 16.4).

Israel	7.2	37	39	63	Hungary			3	10
Belgium-Luxembourg			9	94	Angola				6
Hong Kong				50	Chad				6
Argentina	5.0	36	32	72	Austria			5	
East Germany	10.0	22	17		Guinea			5	
Zaire	6.0	55	21	42	Kuwait			5	
Czechoslovakia	7.0		11		Surinam			4	
Philippines		33	24	63	Liberia			2	
Algeria		41	20	52	Albania			1	
Venezuela	9.0	26	9	20	Jamaica			1	
Romania	7.0	24	15	28	Portugal			1	
Denmark			17	50	Total	534.4	3,558	2,625	6,894

Source: CLINE 1975: 124–125, 1977: 173–174, 1980: 173–177, 1993: 107–112.

As for 1992, if one adds together the values of four of the countries that were once part of the Soviet Union (Russia, Ukraine, Kazakhstan, and Belarus), one arrives at 482, compared to 550 for the United States. This seems an unrealistically high value for an imploded empire. Another thing to observe is that there is a clear inflation when comparing the values of 1992 to 1980: all countries have higher scores than before, Russia (in the table treated as the successor to the Soviet Union) being the only exception. When one looks at the totals, one can infer that values have more than doubled on average, whereas there is a steep decline from 1975 to 1977 to 1980. Again this says less about the objective international situation than the overly arbitrary nature of Cline's calculations.

Cline's work is well known and has received many reviews. Richard Head suggests that the difference between potential and real power is mobilization (HEAD 1978: 669). Roy Melbourne wonders why manpower competence is a tertiary subcomponent only of military capability and not economic capability as well (MELBOURNE 1979: 140). Clark Reynolds thinks that Cline's formula is more a framework for discussion than a mathematical solution (REYNOLDS 1981: 210). Ilan Peleg notes that Cline deals only with power resources rather than influence (PELEG 1982: 446). In a theoretical article on power analysis, David Baldwin criticizes Cline for ignoring situational contexts, which means that power resources helpful in one situation may be useless or counterproductive in another situation (BALDWIN 1979: 171–173).[222] A consensus exists that the subjectivity in Cline's formula is problematical, one practical reason being that it makes the index difficult if not impossible to replicate (CHANG 2004: 7, 11; MERRITT & ZINNES 1988: 147, 1989: 18–19; SWEENEY 2004: 72–74; SULLIVAN 1990: 106–107; TABER 1989: 34; PILLSBURY 2000: 225; further FONTOURA 2006: 25; compare FORSBERG 1997: 179–180; KRAMER-DEBUCK et alia: 1978: 287).

Theoretical Modifications: Meira Mattos 1977 & Gołąb 1984

Brazilian General Carlos de Meira Mattos (1913–2007) was one of his country's leading geopolitical scholars.[223] He mentions Cline's formula frequently in his works. He advocates a theoretical

[222] Later Baldwin advanced his criticism that "if international relations researchers were to give up the search for a universally valid measure of overall national power, much useful research could be focused on measuring the distribution of power within specified scopes and domains" (BALDWIN 2002: 181).

[223] For some information in English on General Meira Mattos, also mentioning Cline, see CHILD 1979, KELLY 1984, further KATZMAN 1982. For an informative article on these matters in Hungarian, see *SZILÁGYI* 2007.

modification that he does not put into operational practice in recalculating Cline's values. He first proposed the theoretical modification in a 1976 article "The Evolution of the Concept of National Power and Its Evaluation" ["A Evolução de Conceito de Poder Nacional e Sua Avaliação"] published in the *Brazilian Military Review* [*Revista Militar Brasileira*]:

$$P_p = (C + E + M) \times (S + W + P)$$

P_p = perceived power; C = critical mass; E = economic capability; M = military capability; S = strategic purpose; W = national will; P = power of persuasion

The new P value corresponds to the force of persuasion [força de persuasão] and the capacity to convince [capacidade de convencer].[224] He uses the Vietnam War as an example of how the United States had isolated itself by being unable to convince its traditional allies to participate (MEIRA MATTOS 1976: 126, further 1977: 131–132, 1984: 143).

Another version of Cline's formula has been formulated by Polish US expert Zdzisław Gołąb in his book *War and the State Defense System* [*Wojna a system obronny państwa*] published in 1984:

$$P_p = (C + E + M) \times (S + W + R)$$

P_p = perceived power; C = critical mass; E = economic capability; M = military capability; S = strategic purpose; W = national will; R = political leadership

R refers to "the degree of political leadership of the country to raise the community and allies" (SUŁEK 2001: 67).[225]

Operational Modifications: Fukushima 1982 & Chang 2004

In 1982 Japanese scholar Fukushima Yasuhito [福島康人][226] had an idea rather similar to that of General Mattos (OU-YANG 2006: 71; EPA: 16; also CAS 2006: 15). He implemented the following modification of Cline's equation:

$$P_p = (C + E + M) \times (G + D)$$

P_p = perceived power; C = critical mass; E = economic capability; M = military capability; G = domestic political ability [政治力]; D = national diplomatic ability [外交力]

Fukushima also modified C to include natural resources (which Cline had included in E), E to consist of GNP, per capita GNP, and economic growth, as well as industrial strength, agricultural strength, and business strength. Ou-Yang Guo-Hua (section 14.8) mentions Fukushima's formula in his article. It is clear that results were calculated (see WANG 2006: 150; EPA 1987: 20).

[224] Russian Major General Vladimir Zolotarev understands Matto's P as "the degree of credibility of the leaders of the state" (ZOLOTAREV 2005). Russian text: "[…] степень авторитета руководителей государства."
[225] Polish text: "[…] stopień zdolności politycznego kierownictwa kraju do pozyskania społeczeństwa i sojuszników […]."
[226] The name 福島康人 was wrongly translated into English as "Fukunaka Kosai" by Ou-yang Guo-hua. I had also wrongly translated the name as "Kangren Fukushima" having used internet translation (HÖHN 2008a: 6). This demonstrates the desirability of keeping the original characters in brackets. It is sometimes the only way to keep things traceable.

In 2004 Taiwanese scholar Chang Chin-Lung also implemented modifications of Cline's equation in a conference paper (CHANG 2004), which in turn drew heavily on his PhD dissertation from 1999. In the paper, he is guided by Cline's equation but decides to drop the subjective elements that he considers problematic and difficult to replicate. He experiments with three models (CHANG 2004: 7–8). Model 1 is basically GNP by itself:

$$P = \%GNP \times 200$$

P = power; %GNP = GNP as percentage of world total

Model 2 is a hybrid between the CINC (section 13.15) and Cline's equation:

$$P = (\%POPU \times 100 + \%AREA \times 100 + \%GNP \times 200 + \%ME \times 200) / 3$$

P = power; %POPU = population as percentage of world total; %AREA = area as percentage of world total; %GNP = GNP as percentage of world total; %ME = military expenditures as percentage of world total

Model 3 is a variation of model 2, multiplying it with an energy coefficient:

$$P = Model\_2 \times \%ENGY$$

P = power; %ENGY = per capita energy consumption / world average

He calculates results for all models, and he judges that model 2 delivers the most convincing results. He admits the limitation of his index:

> In some sense, power, like beauty, is in the eye of the beholder. In reality, experimentation with one-on-one, all-out conflicts between nations, as the acid test for power equations, is virtually impossible (and indeed unthinkable). (CHANG 2004: 21)

Besides providing scores for the comparison for all three models (CHANG 2004: 12–15), he also provides an index of power scores based on model 3 that averages the years 1977–1993 (CHANG 2004: 31–34).

In their 1999 article the two Chinese scholars Zhu Xian and Xiao Lazhen extended Cline's formula to a degree that (arguably) takes their formula beyond mere modification. For that reason their formula has been given its own section in the chapter on CNP (section 14.9).

Prequel: Robert Thompson 1974

Robert Grainger Ker Thompson (1916–1992) was a British counterinsurgency expert who played a role in defeating the communist insurgency in Malaysia from 1948 to 1961. After that he served as head of the British Advisory Mission to South Vietnam (BRIAM) from 1961 to 1965. Later on in 1969 he became special advisor for pacification to US President Nixon. His sentiments were very much anticommunist and in support of a viable South Vietnamese state. In his 1970 book he criticized especially the Johnson administration's policy in Vietnam for obscurity of aim, failure in strategy, and

lack of control. He said it had gradually eroded the will of the American people through casualties, taxation, and dissent (THOMPSON 1970: 130). As the goal of a guerilla movement is to wear down the government in terms of inflicting suffering[227] and costs, his main message being that guerilla warfare is a contest of the will rather than a trial of numerical force strength (THOMPSON 1970: 12–13). To that effect he quotes the farsighted words spoken to him by South Vietnamese President Ngô Đình Diệm in 1962: "'Only the American press can lose this war'" (Diệm, quoted in THOMPSON 1974: 32; also NIXON 1980: 102).

In his 1974 book Thompson presents a theoretical formula. He claims that this formula represents the Russian understanding of power. It is unknown whether Cline read Thompson. The latter's theoretical formula is conceptually more or less identical to the operational formula that Cline published in his book a year later:[228]

```
power = ( manpower + applied_resources ) × will
```

The term "applied resources" seems to refer to economic resources that are either applied or can be applied to increase military power (THOMPSON 1974: 166). After briefly mentioning his formula, he also brings up the four factors which Zbigniew Brzezinski used in a 1972 work, that determine when the US is assertive or not, namely military power, economic power, international standing, and a supportive domestic policy base (THOMPSON 1974: 185–189; further BRZEZINSKI 1972).

In his 1980 book *The Real War* former US President Nixon mentions Thompson's theoretical formula three times (NIXON 1980: 6, 43, 306). This along with his favorable comments presents a wholehearted endorsement of the formula. He shares in the perception of Cline and Thompson that the defeat of the United States is attributable to weakness in the psychological factor, that the defeat in Vietnam put the Soviet Union in a stronger position, and that the United States is in dire need of recovering a clear sense of purpose along with the willpower to sustain it (NIXON 1980: 307–315). As for power itself, Nixon defines it this way:

> Power is the ability to make things happen, to influence events, to set the course of history. Some kinds of power operate effectively in the short term; some only over the course of generations. (NIXON 1980: 312)

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[227] Steven Rosen accentuates the willingness to suffer as complementary to national strength. A country is as strong as its capabilities multiplied by its cost-tolerance (willingness to suffer). This means a weaker country in a conflict may possibly compensate this weakness by a higher cost-tolerance (ROSEN 1972; further MACK 1975). Rosen's quasi-operational power formula is:

$$power\_ratio = CT_A \,/\, CT_B \times NS_A \,/\, NS_B$$

CT = cost-tolerance; NS = national strength; A = country A; B = country B

For a preliminary testing of his quasi-operational power formula, Rosen measures national strength by the revenue of the central government. While cost-tolerance can be also measured in many different ways, he chooses to measure it by soldiers killed in a conflict, either absolute or relative to population size. He notes that North Vietnam and the Viet Cong had lost around 800,000 men against a population base of more than 20 million, whereas the United States had lost fewer than 50,000 men against a population base of more than 200 million. This indicates that the North Vietnamese had a much higher cost tolerance.

[228] Thompson puts the formula without parentheses (THOMPSON 1974: 184):

```
power = manpower + applied_resources × will
```

Former US president Nixon understood the formula in such a way that the multiplication by will applies to both factors. He states that "[the Soviets] understand that if the will factor is zero the whole equation is zero" (NIXON 1980: 43). In conformance with Nixon's interpretation, the formula is thus presented with parentheses.

Nixon advocated a long-term view that encouraged perseverance in the ideological struggle with the Soviet Union, which he viewed as the embodiment of evil.

13.21 Midlarsky 1975 US

Manus I. Midlarsky is an American political scientist. He studied physical chemistry at the City University of New York, then did his master's degree in physics at the Stevens Institute of Technology, before getting his PhD in political science from Northwestern University in 1969. From 1967 to 1989 he taught at the University of Colorado in Boulder, and from 1979 to 1982 he was also a visiting professor at the University of Michigan.

In his 1975 book *On War: Political Violence in the International System* (MIDLARSKY 1975) he analyzes quantitatively the relationship of power and war. He thinks in probabilities and thus defines power as the capacity to reduce environmental uncertainty. He defines uncertainty as a set of alternate possible events (MIDLARSKY 1975: xviii–xix, 16–23, also 1976: 134–137). When analyzing status inconsistency and war (MIDLARSKY 1975: 94–122), he distinguishes between internal achievement (power) and external ascription (prestige), with the discrepancy between the two embodying status inconsistency.

Achievement consists of centralization and capability, where centralization refers to mobilization potential, whereas capability refers to war potential.[229] He measures centralization by (1) railroad mileage as indicator for transportation, (2) telegraph, telephone, mail flow as indicators for communication, and (3) number of persons in cities as indicator for urbanization. He measures capability by (4) GNP as indicator for economic development, and (5) number of persons as indicator for population. As the measure for external ascription (prestige) he uses David Singer's measure for ranking the diplomatic importance of states (SINGER & SMALL 1966, 1973; also section 13.15).

Midlarsky does not present the formula he is using for combining these measures. His tables in a subsequent chapter indicate that he must have calculated scores at least for centralization and capability, if not achievement (see MIDLARSKY 1975: 125, 126, 132, 139).[230]

13.22 Udell 1975 US

Jonathan Udell is an American sociologist. He studied psychology at the University of California in Los Angeles and did a master's degree in sociology at California State University in Northridge. He

[229] He acknowledges Quincy Wright (section 13.4) and R. J. Rummel (section 13.16) as his inspirations concerning the definition of capability (MIDLARSKY 1975: 114).

[230] In another work he also discusses how the notion of power over distance can be operationalized, for which he suggests this formula from the family of inverse power functions of distance:

$$p_i = cs_i^{-k}$$

where p_i is the power of a country at a certain place, c is a constant for capability, s_i is the distance of a country to a certain place, and k is an exponent estimated to be 0.5 (MIDLARSKY 1976: 137–142).

completed his PhD in sociology at Ohio State University. In 1973 he was appointed to the position of assistant professor of sociology at Winthrop College.

In 1975 he published an article titled "Social Exchange in International Relations: An Application of the Social Exchange Model" (UDELL 1975), in which he wants to determine what factors cause some nations to interact with other nations. Social exchange theory has its origin in economics, psychology, and sociology. Applied to international relations, social exchange theory simply posits that nations interact because they hope to gain benefits from doing so. This also implies possible costs for absence of interaction, which could mean voluntary self-deprivation or involuntary deprivation as a form of imposed penalty. A power relation is established when one country depends on another country for receiving specific benefits that cannot be obtained from other countries. A nonpower social relation exists when two sides mutually benefit and when these benefits can be sought for in other places. This means that the cost of terminating this relationship is minimal.

In order to compare interaction for different groupings of nations, nations are classified into superpowers, middlepowers, and smallpowers. For that purpose Udell devises a summary index that adds the 1963 ranks of nations on three variables. These are (1) military capability, (2) total population, and (3) GNP per capita. He does not state what military capability consists of, nor does he provide many results. The following table offers the skimpy information contained in his article; note that a smaller composite score means more power:

Table 42: National Power in 1963 [Udell]

Country	Military Capability rank	Population rank	GNP per capita rank	Composite Score summed ranks
Superpowers				
United States	1	4	2	7
Soviet Union				22
Middlepowers				
West Germany				
Great Britain				
France				
Canada				
Japan				
Smallpowers				
86 Other Countries				

Source: UDELL 1975: 108, 119.

While it is not known how military capability is quantified, it is clear that in this measure the United States must have been stronger than the Soviet Union.

13.23 Saaty / Khouja 1976 US / KW

Thomas Lorie Saaty (born in 1926) is an American mathematician. He studied mathematics and physics at Columbia Union College. He did a master's degree in mathematics and physics at the Catholic University of America. He did another master's degree in mathematics at Yale University,

where he also got his PhD in mathematics in 1953. For 15 years he worked for government agencies and also for private companies in the field of government-supported research. From 1969 to 1979 he was professor of statistics and operations research at the University of Pennsylvania. Afterwards he became professor of mathematics at the business school of the University of Pittsburgh. Mohamad W. Khouja studied business administration at Indiana University, where he also did a master's degree in economics. He got his PhD in economics from the University of California at Berkeley. From 1966 to 1971 he taught at Oklahoma State University. From 1969 to 1982 he was economic advisor to the Kuwait Fund for Arab Economic Development. From 1982 to 1987 he was principal advisor to the Kuwait Real Estate Investment Consortium. Since 1991 he has been chairman of the Wafra Investment Advisory Group.

In 1976 they published the article "A Measure of World Influence" (SAATY & KHOUJA 1976), in which they seek to quantify national power via the world influence of countries. They define power as the ability to do something, and influence as the ability to sway others in favor of one's own national interests. Influence benefits from certain forms of power. They are aware of the CINC (section 13.15) and the index by Wayne Ferris (section 13.17). They are especially influenced by the work of Allen Shinn (section 13.13). One difference to Shinn is that Shinn considered population in his formula to be always an asset. Saaty and Khouja think that a large population can also be a liability. As a result they use the notion of human resources rather than population per se. They see influence as deriving from five attributes, which are (1) human resources, (2) economic strength, (3) technology, (4) trade, and (5) military strength. They state that politics, social stability, culture, and communication could be added without difficulty, though they are not included.

In order to determine the values of their variables, they did a survey of those they described as "experienced people" (without providing further information on the latter), in which they asked them to assess via pairwise comparison of nations how important each attribute is for each pair (compare section 13.8), using a scale from 1–9 to determine to what degree (ratio). Saaty and Khouja's focus is on explaining their technically sophisticated processing of the data via eigenvalues and eigenvectors, which are properties of a matrix created by the data. The following table presents the complete list of eigenvector values of each variable for each country based on the survey, the weights calculated for each variable, and the final results for each country:[231]

Table 43: Relative Measure of World Influence in 1973 [Saaty/Khouja]

Weights	0.042	0.415	0.224	0.185	0.135	1.001
Countries	Human Resources	Wealth	Trade	Technology	Military Strength	World Influence
		normalized eigenvectors				weighted result
USA	0.345	0.427	0.332	0.456	0.436	0.409
USSR	0.126	0.230	0.042	0.067	0.302	0.163
China	0.058	0.021	0.020	0.019	0.071	0.029

[231] They also provide values for a normalized eigenvector power index in direct comparison to the values obtained by Shinn's formula. For this index, which is not be confused with their index of world influence, only three variables were taken, that is, human resources, economic strength, and military strength, in rough correspondence to Shinn, who had used population, GNP, and military spending (see section 13.13 for this index).

France	0.118	0.052	0.089	0.110	0.074	0.077
UK	0.118	0.052	0.070	0.110	0.069	0.072
Japan	0.118	0.123	0.239	0.119	0.023	0.134
West Germany	0.118	0.094	0.209	0.119	0.023	0.116
Total	1.001	0.999	1.001	1.000	0.998	1.000

Source: SAATY & KHOUJA 1976: 44–45.

They emphasize that their final scores are based on an absolute ratio scale, which means they can be added together without problem. For example, the scores of Japan and West Germany can be added together, showing them to have had more combined world influence than the Soviet Union at the time. George Rabinowitz provides a technical criticism of the method of Saaty and Khouja along with suggestions for alternatives (RABINOWITZ 1976).

13.24 Liu 1978 TW

Liu Ben-Chieh (born in 1938) is a Taiwanese economist. He first studied at National Taiwan University before taking a master's degree at Memorial University and a PhD at Washington University in 1971. His dissertation was an econometric study of regional growth and local government finance. In the 1970s he worked as principal economist for the Midwest Research Institute. From 1982 to 2001 he taught at Chicago State University, National Taiwan University, Delhi University, National Dong-Hwa University, and Chung-Yuan Christian University. He has been interested in energy, environmental issues, human resources management, and quality of life (QOL) studies.

The Human Development Index (HDI) was first published in 1990. Long before that attempts had already been made in this direction. The QOL index by Liu falls into this category.[232] There are still ongoing efforts by compilers of indexes to compete with or modify the HDI (see BANDURA 2008). The HDI is not necessarily the best index of development, though it is the most prominent due to its institutional backing from UNDP and its being published regularly. In 1973 Liu wrote an article on the QOL (LIU 1974), in which he questioned the adequacy of GNP to reflect the health of a nation and the well-being of its citizens. He proposed nine indicators for measuring the QOL: (1) the status of the individual, (2) individual equality, (3) living conditions, (4) agricultural production, (5) technological development, (6) economic status, (7) education, (8) health and welfare, and (9) state and local governments. The last factor measures among other issues the performance of government, but it is not quite a power index yet.

In 1980 he published a revised version of the QOL (LIU 1980),[233] which consisted of five primary components: (1) social, (2) economic, (3) health and education, (4) environment, and (5) national vitality and security. A sixth primary component in theory is the psychological, but he finds no adequate measurement for it. The five remaining subindexes are added according to their respective weights for the overall QOL index. The weights for the subindexes as well as the indicators they

[232] There are several unrelated QOL indexes floating around (BANDURA 2008: 11, 79). One is featured by the Economist Intelligence Unit (EIU), which is connected to *The Economist*. For more QOLs in this study, see sections 13.44, 14.13.
[233] Liu writes that an earlier version of the 1980 article was presented at two conferences in 1978 (LIU 1980: 1).

consist of are derived from an opinion survey published by Hadley Cantril (CANTRIL 1965: 34–66), though Liu does not elaborate on his method in doing so. For the purpose of his index he averaged the most significant individual concerns of people in the United States, West Germany, Yugoslavia, and Poland (LIU 1980: 9, 14, 17–18).[234]

The subindex for national vitality and security is a power index. It consists of (a) national carrying capacity, and (b) political stability and national security. National carrying capacity consists of natural resources, human capital, technology, and market stability. Political stability and national security consist of "factors demonstrating international power and strength such as military and trade potential" (LIU 1980: 7). In discussing the subindex, he mentions Ray Cline's 1975 and 1977 works on national power (section 13.20). As a Taiwanese he has reason to laud Cline's perception, and he agrees that the United States has lost some of its strategic-military influence and power vis-à-vis the Soviet Union. The subindex for national vitality and security consists of the following indicators with their respective weights:

Table 44: Indicators for National Vitality and Security [Liu]

Weights	Indicators
+1.16	National Carrying Capacity
+1.14	Human Capital: Percentage of Economically Active Population
+1.00	Natural Resources: Acres of Arable Land per capita
+1.04	Technology: Electrical Energy Production per capita
+0.82	Market Stability and Price Mechanism
–0.84	Domestic Price Stability: Percent Change in Consumer Price Index, 1970–1975
–0.63	Weighted Relative Living Cost Index
+1.00	Political Stability and National Security
+1.10	Numbers of Tourists Received per 1,000 Economically Active Population
+1.20	Armed Forces per 1,000
+0.75	Military Expenditure as Percent of National Income
+0.95	Export to Import Ratio

Source: LIU 1980: 18.

For calculating the results for this subindex, the z-scores of the indicators were multiplied by their respective weights. In comparison to other power indexes, it is important to note that this subindex is a *per capita* index. It measures the *per capita* national power of the average citizen rather than the total national power of a given country. The *per capita* perspective is rather unusual for power indexes but quite normal for development indexes. The following table presents the complete results of the QOL index, including all subindexes:

Table 45: Quality of Life Index for 1975 [Liu]

Weights	24%	20%	22%	15%	19%	100%
Country	Social	Economic	Health & Education	Environment	National Vitality & Security	Overall
USSR	–0.24	–1.07	0.01	0.58	0.76	–0.04

[234] The countries, for which opinion surveys are available but not used, are Brazil, Nigeria, India, Israel, Egypt, Cuba, the Dominican Republic, Panama, and the Philippines. Also results of a study on Japan by the Central Research Agency are included in Cantril's work.

Australia	0.07	0.68	0.38	2.90	0.58	0.78
Czechoslovakia	0.15	–0.26	–0.06	–0.30	0.54	0.03
Bulgaria	–0.04	–0.89	0.09	0.09	0.52	–0.05
Taiwan	–0.08	–1.15	–0.55	–0.62	0.51	–0.36
USA	1.87	1.13	0.47	0.53	0.40	0.93
East Germany	0.24	0.31	–0.00	–0.51	0.37	0.11
Canada	0.32	1.32	0.53	1.63	0.36	0.77
Norway	–0.01	0.98	0.68	–0.06	0.35	0.40
Hungary	0.08	–0.45	–0.31	–0.07	0.31	–0.09
Portugal	–0.41	–0.59	–0.62	0.11	0.30	–0.28
Romania	–0.25	–0.94	–0.33	0.04	0.27	–0.26
Sweden	0.37	0.85	0.78	0.02	0.16	0.46
Greece	–0.08	–0.09	–0.35	0.29	0.08	–0.06
West Germany	0.15	0.72	0.05	–0.86	0.04	0.07
Yugoslavia	–0.30	–0.69	–0.63	0.09	–0.06	–0.35
UK	0.29	–0.07	0.26	–0.89	–0.10	–0.04
Denmark	0.29	0.68	0.42	0.09	–0.11	0.29
Austria	–0.01	0.30	–0.09	–0.25	–0.12	–0.02
Belgium	0.17	0.44	–0.07	–1.20	–0.15	–0.10
Switzerland	0.34	0.36	0.67	–0.58	–0.16	0.18
Poland	–0.41	–0.11	–0.05	–0.27	–0.16	–0.20
Finland	–0.05	0.11	0.17	0.28	–0.21	0.05
France	0.09	0.34	0.14	–0.27	–0.22	0.04
Spain	–0.47	–0.20	–0.22	0.17	–0.30	–0.23
Japan	0.17	–0.41	0.64	–0.87	–0.32	–0.09
Italy	–0.25	0.14	0.11	–0.45	–0.39	–0.15
New Zealand	0.22	0.83	0.39	–0.03	–0.43	0.22
Netherlands	–0.22	0.31	0.60	–1.09	–0.44	–0.10
Argentina	–0.39	–0.95	–0.62	0.61	–0.44	–0.41
Ireland	–0.14	0.13	0.20	0.15	–0.50	–0.04
Uruguay	–0.32	–0.53	–1.28	0.18	–0.56	–0.54
Chile	–1.14	–1.22	–1.44	0.56	–0.84	–0.91

Source: LIU 1980: 11.

Taiwan is relatively strong *per capita*, though, in general, the communist countries perform better than capitalist countries in terms of *per capita* strength. Note that (mainland) China is missing.

13.25 Organski / Kugler 1978 US

Abramo Fimo Kenneth Organski (1923–1998) was an American political scientist. He studied at New York University, where he also did his master's degree and PhD (in 1951). From 1951 to 1964 he taught at Brooklyn College. In 1964 he moved to the University of Michigan, where he became professor of political science. He is widely known for his power transition theory, which states that the likelihood of war between major powers increases as the power of a dissatisfied challenger increases to parity with the dominant power (ORGANSKI 1958: 299–338, or 1968: 338–376).[235] Jacek Kugler studied political science at the University of California in Los Angeles, where he also did his master's

[235] Organski as such believed that an unequal distribution of power is more conducive to peace than a balance of power – in direct opposition to the views of Quincy Wright (section 13.4), Hans Morgenthau, and Inis Claude (FERRIS 1973: 111).

degree. In 1973 he did his PhD at the University of Michigan. Later he taught at Boston University and Vanderbilt University. He is now teaching at Claremont Graduate University.

In 1958 Organski published *World Politics*, which contains an enumeration of power indicators (ORGANSKI 1958: 116–218, or 1968: 124–220; also ORGANSKI & ORGANSKI 1961: 27–31). He defines power as something more than resources: it includes the ability to use these resources in a way that can influence the behavior of other nations in accordance with national interest. It is also something more than size and wealth: its essence is sovereignty. He lists three natural determinants of power, namely (1) geography, (2) natural resources, and (3) population. He adds three social determinants of power, namely (4) economic development, (5) political development, and (6) national morale.

He ranks the determinants according to importance, perceiving population to be the most important, followed by political development, economic development, national morale, natural resources, and geography. The six determinants share a complex interrelationship, so that change in one is accompanied by change in the others. He uses this observation to justify subsuming geography under population, national morale under political development, and natural resources under economic development. He proceeds to measure population by itself, and economic development by per capita GNP, whereas he concedes that no quantitative index of political development exists. Though initially he had conceptually rejected one-factor determinism, his index of power ends up being GNP. He takes GNP to mean the multiplication of two factors: population multiplied by per capita GNP (ORGANSKI & KUGLER 1977: 1347–1349).

In 1978 Organski and Kugler published an article that adds a subindex of governmental extraction as a measure for political development (ORGANSKI & KUGLER 1978, also 1980: 64–103, 227–233).[236] Tax extraction is not only the fiscal base for state activity but also indicates to what degree the government has penetrated society. Government revenues from other sources are therefore excluded.[237] The formula for the subindex is as follows:

```
Tax_Effort = Real_Tax_Ratio / Tax_Capacity
```

or

```
Relative_Political_Capacity =

                        Actual_Extraction / Expected_Extraction
```

The real tax ratio refers to actual tax extraction, whereas tax capacity refers to the level of tax extraction predicted for different levels and types of economic development using multiple regression analysis on a number of factors. The factors are (1) exports/GNP (2) mineral production/GNP, and (3)

[236] In the 1978 article they display awareness for the power indexes of Clifford German (section 13.5), Wilhelm Fucks (section 13.10), Ray Cline (section 13.20), as well as the CINC (section 13.15). They regard the CINC as the only other index next to GNP available for cross-temporal comparisons. Kugler has displayed a somewhat competitive attitude towards the CINC on a regular basis (see ORGANSKI & KUGLER 1980: 34–38; KUGLER & DOMKE 1986: 55; KUGLER & ARBETMAN 1989).

[237] Marina Arbetman-Rabinowitz makes the inaccurate claim that "Organski and Kugler (1980) were the first ones to adapt measures of fiscal capacity" (ARBETMAN-RABINOWITZ & JOHNSON 2007: 3). Steven Rosen had used central government revenue as a rough measure of national strength in the preliminary testing of his quasi-operational power formula (ROSEN 1972: 171; compare MOUL 1989: 118; also footnote #227 in section 13.20). Richard Rosecrance and colleagues used three fiscal measures (total government expenditure, total government revenue, surplus or deficit in government budget) in their calculations of national power (ROSECRANCE et alia 1974; also section 13.19).

agricultural production. The first two factors facilitate taxation as opposed to the third one that impedes taxation (ORGANSKI & KUGLER 1978: 149–150; also SNIDER 1996: 64–72). The subindex is then integrated into the power index along with foreign aid as an external component:

```
National_Power = ( GNP + Foreign_Aid ) × Tax_Effort
```

Tax effort was later on styled as Relative Political Capacity (RPC) (KUGLER & DOMKE 1986). This then augments the measured power of nations like North Vietnam and Israel, especially in regard to times of conflict. They argue that their measure is more applicable to developing countries than developed ones.[238] Some results were pictured in a number of graphs (ORGANSKI & KUGLER 1978: 163–174, also 1980: 91–100). A later article provided some numbers, which the following table presents:

Table 46: National Power in Major Wars 1904–1945 [Organski/Kugler]

Country	1904	1905	1914	1915	1916	1917	1918	1939	1940a	1940b	1941	1942	1943	1944	1945
USA						71.9	247.0							892.1	812.8
Germany			107.0	268.0	233.8	258.5	194.7	121.5	162.1	162.1	153.2	165.5	177.2	220.3	
Japan	28.3	49.8										126.9	175.7	224.3	
Russia / USSR	33.6	38.5	48.9	100.1	69.2	35.2					176.4	148.5	148.2	183.7	182.1
UK			30.6	78.3	128.4	82.7	124.7	10.5	27.4	158.4				176.0	156.1
France			33.2	47.0	71.2	45.4	65.7	42.0	79.6						
Austria-Hungary			33.8	30.0	30.0	30.0	30.0								
Italy				12.7	27.8	26.0	31.8		29.5	19.7	17.6	19.4	16.2	5.0	

Source: KUGLER & DOMKE 1986: 61–62, 64.

Israeli scholar Zeev Maoz notes that Organski and Kugler deem the quantification of power by military capabilities as a reductionist concept. Maoz rejects this view as false when applied to serious interstate disputes (MAOZ 1983: 221–222). James Lee Ray and Ayse Vural interpret RPC as a "will to win" in their discussion of paradoxical conflict outcomes (RAY & VURAL 1986: 324–325). Ted Robert Gurr discusses the importance of political capacity to mobilize and utilize human and material resources. He evaluates the measure by Organski and Kugler as useful but sees a problem for estimating values for states prior to 1950 (GURR 1988: 134–135; compare LAMBORN 1983).[239] Thomas Volgy relates to the measure as similar to his own approach (section 13.34), though he notes that "we are assuming that the concerns raised in the literature regarding societal and political constraints on central government capabilities cannot be captured by a ratio based primarily on predicted tax extraction versus actual tax extraction" (VOLGY & BAILIN 2003: 55).

Operational Modification: Lewis Snider 1986

Lewis Snider finished his PhD at the University of Michigan in 1975, two years after Kugler. It is possible that the two have known each other since that time. Both are now professors at Claremont

[238] Arbetman-Rabinowitz brings an example for this limitation on developed countries: "Establishment of extensive public institutions that deliver educational and health services in Sweden requires a greater degree of tax collection. A lack of similar public institutions in Japan does not indicate a lesser ability to extract resources; instead it reflects a desire by the population to obtain these services by private means" (ARBETMAN-RABINOWITZ & JOHNSON 2007: 6; compare MOUL 1988: 248).
[239] In 1989 William Domke calculated the national power for 18 nations in 1890 using political capacity (DOMKE 1989: 171).

Graduate School. Snider is a Middle East expert. When focusing on the strength of countries that are members of the Gulf Cooperation Council (GCC), he operationalizes a modification to Kugler's formula (SNIDER 1987, 1988). He uses RPC to measure extraction, but for penetration he defines an additional measure:

$$APC = PEN1 \times PEN2 \; / \; APC_{predicted}$$

APC = average penetration capacity; PEN1 = direct taxes / taxes on trade; PEN2 = nontax revenue / taxes on trade; $APC_{predicted}$ = predicted value of each country's APC

The ratio of direct taxes to taxes on trade is meant to measure the extension of government authority throughout society. The ratio of nontax revenue to taxes on trade is meant to measure government sensitivity to external shocks. Predicted values are calculated using regression analysis. The formula in the end becomes:

$$Strategic\_Power = APC \times RPC \times VALMFG$$

APC = average penetration capacity; RPC = relative political capacity; VALMFG = value added in manufacturing

According to Snider, "strategic power refers to the ability of governments to adapt to rapid external system changes through internal adjustments and to influence the global environment through unilateral actions" (SNIDER 1988: 464). The multiplication of APC and RPC represents infrastructural power, which "addresses the functional question of how and how skillfully a state can transform the resources of its society into power" (SNIDER 1988: 464). He takes "value added in manufacturing" rather than GDP because it better reflects on the technological prerequisites of the strategic resource base. The following table presents the complete published results:[240]

Table 47: Strategic Power in 1983 [Snider]

Country	APC	RPC	Value Added in Manufacturing billions of 1980 $	Strategic Power
USA	1.0704	1.030	592,504	653,233.3100
West Germany	1.2035	0.940	310,384	351,147.6100
France	1.1483	0.720	173,370	143,333.9100
Britain	0.9143	0.970	120,228	106,631.4001
Brazil	1.6615	0.671	56,878	63,411.0100
Canada	1.0683	0.937	46,210	46,256.0410
Mexico	1.1751	0.675	41,346	32,793.8620
Israel	0.9489	2.725	*11,512*	29,766.7721
Belgium	0.8409	0.919	30,660	23,694.1310
Spain	1.1372	0.652	*29,581*	21,932.9610
Turkey	1.0726	1.080	14,263	16,506.7100
Egypt	1.1332	1.470	8,950	14,908.3100
South Africa	0.9362	1.221	*12,616*	14,420.9610
India	0.7303	0.698	27,091	*13,808.8300*

[240] One corrected value is in italics, namely, the value for India, which is given at 1380.8830. This must have been a typo, because the value should be exactly ten times higher.

Saudi Arabia	1.0583	1.364	7,230	10,436.4310
Iran	1.1887	0.515	11,596	7,098.6510
Thailand	0.5903	1.527	7,837	7,063.7531
Malaysia	0.7060	1.345	6,080	5,773.5941
Argentina	0.5340	0.503	12,682	3,406.6050
Morocco	0.7723	1.291	3,170	3,160.4131
Peru	0.6526	0.861	4,435	2,491.9591
Oman	1.9208	1.443	760	2,106.5320
Kuwait	1.0962	0.869	1,790	1,705.1390
Syria	1.1961	0.528	2,341	1,478.4141
Tanzania	0.7501	1.449	*687*	746.6946
Qatar	1.1613	1.471	*196*	334.8205
Costa Rica	0.4034	0.865	806	281.2141
Zaire	0.5796	0.973	168	94.7508
Bahrain	0.8976	0.548	*136*	66.8927
United Arab Emirates	0.3409	0.058	2,428	48.0102
Liberia	0.3154	1.614	69	35.1277
Haiti	0.3690	0.398	*52*	7.6359
Uganda	0.0664	0.188	137	1.7092
Total			1,538,193	1,578,184.1654

Source: SNIDER 1987: 329–330, 334–335, 1988: 334–335, 339–340; World Bank 1986: 192–193.

In a later work Snider returns to RPC (styled as RPE for Relative Political Extraction) but not APC (SNIDER 1996: 39–77).

13.26 Farrar 1981 US

Lancelot L. Farrar (born in 1932) is an American historian. When not working as an independent scholar, he has taught at Stanford University, the University of Washington, Trinity College, Boston University, and Brown University. He has written several books and articles on German policy and strategy before and during WWI, one of these being *Arrogance and Anxiety: The Ambivalence of German Power, 1848–1914*, published in 1981 (FARRAR 1981).

The book is concerned with the radical increase in German power in the period preceding WWI. His argument is that if Germany had been weaker, it would have remained anxious, and if it had been stronger, it would have been arrogant, but the way it oscillated between these two extremes merely reinforced both (FARRAR 1981: 194–198). He argues that human power is a function of mobilization and population. He understands mobilization as the number of humans engaged for military and nonagricultural economic purposes. For most of history mobilization was quite low. This changed totally in the 19th and 20th centuries with industrialization, which rapidly increased the quantity of power. Britain, and to a lesser degree France, had an early lead in industrialization, so that in 1848 their industrial power was dominant. Russia and Germany had begun to industrialize by 1870, and material power began shifting towards them (FARRAR 1981: 9–11).

Farrar defines and calculates state power to support his argument for dramatic power shifts in the period preceding WWI. He states:

> If industrial power is equated with manufacturing production and mass power is equated with population, a rough gauge of industrial-mass power is provided as a function of production and population. […] It is assumed that a state's power is relative, a rough gauge of state power can be calculated as a percentage of total industrial-mass power. (FARRAR 1981: 10)

British historian Paul Kennedy interprets this to construct the formula this way (KENNEDY 1987: 571):

```
power = population × manufacturing_production
```

No further details are provided. The results are distributed in a number of footnotes. The following table presents the complete published results. The year 1920 is a projection for how things might have developed if WWI had not happened:

Table 48: State Power 1850–1920 [Farrar]

Country	1850	1870	1880	1890	1900	1905	1910	*1920*
Britain	50.0%	34.7%		29.1%	20.9%		16.9%	*12.9%*
France	30.0%	20.0%		15.2%	11.6%	11.1%	10.6%	*9.6%*
Russia	10.0%	20.3%		19.7%	27.4%	28.1%	28.1%	*28.8%*
Prussia / Germany	10.0%	25.0%	26.7%	32.0%	34.3%	35.8%	37.2%	*40.1%*
Austria-Hungary				4.0%	5.8%		7.2%	*8.6%*
Total	100.0%	100.0%	26.7%	100.0%	100.0%	75.0%	100.0%	*100.0%*

Source: FARRAR 1981: 17–18, 38–39.

Even as Kennedy acknowledges that Austria-Hungary underwent rapid industrialization, he doubts that its power rose by so much so quickly (from 4.0% in 1890 to 7.2% in 1910). He thinks Farrar's measure is too simplistic. In general, he rejects the whole notion of equating military strength with economic strength, because industrial output does not automatically translate into what he calls "Great Power effectiveness". One has to consider other factors as well, such as the internal cohesion of society, the ability to mobilize resources for state purposes, the geopolitical position, and diplomatic capacities (KENNEDY 1987: 198–202).

13.27 Beckman 1984 US

Peter R. Beckman is an American political scientist. He studied international relations at Syracuse University, before doing a master's degree in the subject at the University of Chicago. He did another master degree at the University of Wisconsin, where he also completed a PhD in political science. For thirty years until his retirement he taught as professor of political science at Hobart and William Smith Colleges. He has written several books, one being *World Politics in the Twentieth Century*, published in 1984 (BECKMAN 1984).

The book focuses on international relations from 1900 to 2000, the part after 1984 being based on predictions. For the investigation he uses the historical approach as well as four scientific approaches: the domestic and environmental factor approach, the policy-maker and policy-making

approach, the interaction approach, and the systems approach (BECKMAN 1984: 10–29). He notes the difference in aim between the two types, stating that the historical approach likes to emphasize the unique, whereas scientific approaches look for patterns. The domestic and environmental factor approach is to some degree geopolitics. In discussing this approach he defines power as capability, whereas for power as action he uses the terms "influence" and "force". He divides power into the ability to harm, hinder, or help the interest of other states (BECKMAN 1984: 3–4, 10–14, 53–56).

Before operationalizing his formula, he considers a number of factors, which include military capability, economic factors, access to resources, a skilled and unified population, and a high level of technology. As for preceding measures of power, he mentions Wayne Ferris' index (section 13.17) and the ranking of diplomatic importance by David Singer (section 13.15). He is certainly aware of Wilhelm Fucks' formula (section 13.10). The power formula he constructs for the time period 1900–1910 can be expressed this way (BECKMAN 1984: 54; compare CHANG 2004: 6):[241]

```
power = ( steel + pop × pol_stab ) / 2

steel = percentage of world steel production; pop = percentage of world
population; pol_stab = score for political stability
```

Crude steel production represents economic prowess and technology, population represents the recruitment pool for service in the armed forces, and political stability represents the ability of the government to mobilize its population. He argues that political instability means that governments need to devote more resources and attention to domestic control. As for the assignment of score points, Beckman uses the following criteria (BECKMAN 1984: 54):[242]

0.0	state in civil war, anarchy
0.2	several major uprisings; coups; major deterioration of governmental authority
0.4	major uprising; coup; assorted lesser outbreaks
0.6	general strike; agitation or tension in the political system; government paralysis
0.8	agitation; recurring changes in incumbents
1.0	no real challenges

The power formula for the time period 1920–1939 is modified this way (BECKMAN 1984: 131):

[241] Along with that formula, he also develops a formula that measures the amount of power projected to certain places:

```
projectable_power = power / days_needed_to_deploy_power
```

The variable "days needed to deploy power" refers to the number of days it takes to transport war materials. Beckman calculates values for 1900 focusing on Europe as the center of world politics (BECKMAN 1984: 56–57). It is not unlike the CINC modification by Bruce Bueno de Mesquita (MESQUITA 1981: 103–108; also footnote #206 in section 13.15).

[242] Political stability is the trademark of this particular index, and it appears to be an extremely important indicator that other indexes omit. For example, in a civil war the military power of the government of a given country may dramatically increase, but the net effect in actual power is negative as these forces have to be used against domestic foes. Beckman had to make subjective judgments to quantify this indicator. Nowadays the World Bank provides the Worldwide Governance Indicators (WGI). One of those six indicators measures political stability and the absence of violence "capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism" (KAUFMANN et alia 2009: 6).

```
power = ( steel + pop × pol_stab + engy ) / 3

steel = percentage of world steel production; pop = percentage of world
population; pol_stab = score for political stability; engy = energy production
as percentage of world total
```

Like crude steel production, energy is meant to represent economic prowess and technology. The power formula is again modified for the time period 1947–1975 (BECKMAN 1984: 209):

```
power = ( steel + pop × pol_stab + engy + nuc_weap ) / 4

steel = percentage of world steel production; pop = percentage of world
population; pol_stab = score for political stability; engy = energy production
as percentage of world total; nuc_weap = percentage of deliverable nuclear
weapons
```

Nuclear weapons capability is measured by the number of bombs and strategic bombers. Beckman highlights the unique nature of nuclear weapons. The following table presents the complete published results for the international system:[243]

Table 49: Basic Power Levels 1900–1975 [Beckman]

Country	1900	1910	1920	1930	1935	1939	1947	1955	1965	1975
USA	21	26	39	31	26	27	53	41	33	22
Russia / USSR	8	4	1	6	9	11	9	15	16	24
Germany / West Germany	14	14	8	9	10	13		4	3	2
UK	11	8	11	8	8	8	6	4	3	2
China	4	7	0	0	5	5	0	7	8	7
India								3	5	4
Austria-Hungary	3	4								
France	4	4	3	5	4	4	1	2	2	2
Japan	2	2	2	2	4	4		2	3	5
Belgium	1	2	1	2	2	2				
Poland			2	2	2	1		1	1	1
Czechoslovakia			1	2	1					
Italy	1	1	1	1	2	2			1	
Canada										1
Total	69	72	69	68	73	77	69	79	75	70

Source: BECKMAN 1984: 55, 89, 131, 167–169, 209, 236, 284, 327.

[243] As for regional systems, Beckman calculates the power distribution of countries in the Middle East in 1966. For that in turn he also designs a specific power formula (BECKMAN 1984: 288):

```
power = GNP + mil_exp + ( literate × gov_stab ) / 3

GNP = percentage of regional GNP; mil_exp = percentage of regional military
expenditures; literate = percentage of regional literate population;
gov_stab = government stability
```

It is not clear how government stability is different from political stability. In any case, a complete table of input and output is available for Egypt, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, and Syria.

Richard Lebow uses some of Beckman's numbers in an article to support his argument that the world situation did not become bipolar until the mid-1950s. In his opinion, "Peter Beckman […] carried out the most rigorous attempt to date to measure relative power in this period" (LEBOW 1994: 257).

13.28 Stoll 1989 US

Richard J. Stoll is an American political scientist. He studied political science at the University of Rochester, and in 1979 he got his PhD in the subject from the University of Michigan, where he was also research assistant in the Correlates of War (COW) project (section 13.15). Since 1979 he has taught as professor of political science at Rice University. His specialty is using computer simulation techniques and statistical analysis for issues like defense spending, arms races, and collective security. In 1984 he coedited together with David Singer the book *Quantitative Indicators in World Politics: Timely Assurance and Early Warning*. In 1989 he coedited with Michael Ward the book *Power in World Politics*, in the foreword to which he and Ward state that "despite the impressive progress that has been made, we need to devote more effort to power measurement. This measurement must be based on an underlying theory of what power is and how it affects world politics" (STOLL & WARD 1989: 7). In a chapter of his own he presents what can be considered a power index (STOLL 1989).

This power index shows his concern with power capability and major power status, especially whether power capability is unidimensional or multidimensional regarding the weight of variables at four points in time, that is, 1850, 1900, 1950, and 1980. He defines a major power as a state that can influence other states in other regions of the world. For practical purposes he uses the enumerations of major powers by the COW.[244] He emphasizes that a large number of power capabilities is a necessity for major status. He qualifies this statement by remarking that power capabilities alone are insufficient to determine what constitutes a major power.[245] A feature of his approach is that it operationalizes his assumption that the building blocks of power change over time. Accordingly, the impacts of the different variables have to change for different years.

As variables for measuring power capabilities, he is using the six variables of the CINC for 1850, 1900, and 1950. This in itself presents only a modification of the CINC.[246] For 1980, however, he uses a self-determined list of 22 indicators. The goal is to relate these sets of variables to major power status, which in itself constitutes a dummy variable, and to use factor analysis to arrive at a factor representing power capability as well as the factor loadings, which signify how much of the variance a variable can account for. The factor analysis for 1980 arrives at three factors, which indicates to him that power is indeed multidimensional. It should be remembered that Wayne Ferris had used factor loadings for his quantification of national power (section 13.17). The following table

[244] Diplomatic historians were surveyed in order to determine which countries qualified as major powers at what period in time (SINGER et alia 1972: 22; SINGER 1988: 58; also CORBETTA et alia 2008: 5–6).
[245] Renato Corbetta has also done some quantitative analysis with regard to the problematic issue that power capabilities and major power status do not seem to overlap (CORBETTA 2006; also CORBETTA et alia 2008).
[246] Stoll mentions that in a 1984 conference paper he had already experimented with various weights for the CINC indicators (STOLL 1989: 153).

presents these factor loadings, though some variables were dropped from the factor analyses for 1850 and 1900:

Table 50: Factor Loadings [Stoll]

Variables	1850	1900	1950
Military Expenditures	0.923	0.876	0.976
Energy Consumption		0.920	0.852
Urban Population	0.843		0.868
Iron / Steel Production	0.374	0.889	0.872
Military Personnel		0.623	0.735
Total Population	0.947	0.267	0.535

Variables	1980		
	Factor 1	Factor 2	Factor 3
Total Imports	0.914	0.312	0.188
Health Budget	0.906	0.211	0.284
Amount of Foreign Economic Aid	0.877	0.254	0.148
Education Budget	0.854	0.147	0.430
GNP	0.828	0.166	0.497
Concentration Index of Exports Received	0.808	0.245	0.090
Fuel as a Percentage of all Manufactured Imports	–0.134	–0.124	–0.060
Life Expectancy	0.132	0.973	0.101
Infant Mortality Rate	–0.128	–0.927	–0.091
Literacy Rate	0.108	0.910	0.130
Percentage of Population with Safe Water	0.215	0.823	–0.020
Percentage of Population Living in Urban Areas	0.246	0.781	0.012
Per Capita GNP	0.393	0.605	–0.067
Number of Embassies, High Commissions, Legations Accredited to the State	0.431	0.581	0.180
Number of International Organization HQs and Secretariats Located in State	0.023	–0.442	–0.010
Food as a Percentage of all Manufactured Imports	0.159	0.367	0.008
Armed Forces Personnel	0.160	0.065	0.929
Number of Physicians	0.305	0.112	0.924
Area	0.182	0.046	0.823
Military Expenditures	0.635	0.069	0.728
Number of Strategic Nuclear Delivery Vehicles	0.502	–0.003	0.708
Total Population	0.035	0.014	0.629

Source: STOLL 1989: 145, 147, 150, 152.

As for the three factors for 1980, Stoll interprets the first factor as promoting large, advanced, internationally active nation-states, the second factor as promoting advanced industrial states that are not necessarily large, and the third factor as promoting large nations but not necessarily developed ones. In other words, the first factor represents size multiplied by per capita economic development, the second factor represents per capita economic development, and the third factor represents size. This is similar to the first two dimensions (size and wealth) in the Dimensionality of Nations (DON) project (section 13.16, further sections 16.3, 16.4).

As for the results, he relies on the factor scores.[247] For 1980 he totals the three factor scores. He provides an alternative set of results consisting of the averaged z-scores of the variables used in the factor analysis. In using a modified version of the CINC, Charles Doran and Wes Parsons made the illogical claim that weights do not matter (DORAN & PARSONS 1980: 953–954; also sections 13.15, 13.17). Comparing the factor scores with average z-scores disproves this claim. The following table presents the complete published results, including factor scores and z-scores. Those countries deemed major powers by the COW are in bold:

Table 51: Composite Power Capability of States 1850–1980 [Stoll]

1850				1900			
Country	Factor Score	Country	z-score	Country	Factor Score	Country	z-score
Russia	0.991	**Great Britain**	3.311	**Great Britain**	3.677	**United States**	3.514
France	0.620	**Russia**	1.727	**United States**	3.532	**Great Britain**	3.364
Austria-Hungary	0.410	**France**	1.465	**Germany**	2.051	**Germany**	2.566
Great Britain	0.339	**Austria-Hungary**	0.784	**Russia**	1.220	**Russia**	2.105
United States	0.014	United States	0.407	**France**	1.146	China	1.869
Prussia	−0.082	**Prussia**	−0.020	**Austria-Hungary**	0.400	**France**	1.458
Spain	−0.086	Spain	−0.067	China	0.276	**Austria-Hungary**	0.703
Sardinia	−0.266	Belgium	−0.386	**Italy**	0.016	**Italy**	0.372
Belgium	−0.290	Sardinia	−0.426	**Japan**	−0.042	**Japan**	0.339
Netherlands	−0.295	Netherlands	−0.465	Belgium	−0.081	Turkey	0.092

1950				1980			
Country	Factor Score	Country	z-score	Country	Factor Score	Country	z-score
United States	3.748	**United States**	5.303	**United States**	9.301	**United States**	4.007
Soviet Union	2.452	**Soviet Union**	4.032	**Soviet Union**	7.809	**Soviet Union**	2.871
China	1.853	**China**	2.188	**China**	4.337	West Germany	1.558
India	1.398	**Great Britain**	1.114	Japan	3.812	**France**	1.495
Italy	0.938	**France**	0.496	West Germany	3.663	**China**	1.364
Japan	0.897	India	0.333	**Great Britain**	3.322	Japan	1.224
Argentina	0.419	Japan	0.281	Italy	2.965	**Great Britain**	1.168
Great Britain	0.085	Italy	0.119	Belgium	2.661	Belgium	0.776
Sweden	−0.045	Spain	0.094	Canada	2.283	Canada	0.769
Egypt	−0.056	Brazil	0.048	**France**	2.186	Netherlands	0.765

Source: STOLL 1989: 146, 148, 150, 153.

Stoll is disturbed by the relatively low rank of Great Britain in 1850, also that France is not included in the top ten in 1950, whereas India, Argentina, and Sweden are.[248] He notes as a problem that factor scoring coefficients for a variable can be negative and that colinearity among the variables may produce unreliable factor scores. He concludes that "factor analysis was less satisfactory as a technique for producing the scores representing the composite power capability of the states. […] The equally weighted z-scores produced a composite index whose face validity was at least as high as that of factor scores" (STOLL 1989: 154).

[247] "The set of scoring coefficients for the variables is produced by premultiplying the matrix of factor loadings by the inverse of the matrix of correlations among variables" (STOLL 1989: 149).

[248] The 1980 results are worse still, as Belgium is included in the top ten, apparently more powerful than France. The explanation for this nonsense is that for 1980 he threw into the mixer variables on an aggregate basis, variables on a per capita basis, as well as other ratios and rates, without ensuring dimensional consistency (see section 16.3 for discussion).

13.29 Sullivan 1990 US

Michael P. Sullivan (born in 1942) is an American political scientist. He did a PhD at the University of Oregon. For most of his career he has been professor of political science at the University of Arizona. His research interests are international relations and American foreign policy, as well as quantitative methods related to that. In a 1974 article he measured power by population and energy production (SULLIVAN 1974: 551), a method which can be considered a simplification of the CINC (section 13.15). In 1990 he published the book *Power on Contemporary International Politics*, which includes a chapter on the empirical measurement of power (SULLIVAN 1990: 103–135).

In this chapter he emphasizes that the situational context needs to be clarified before proceeding with the quantification of power. Not all components of power need to be measured and included in a power index, because some components may be related to one another. Different components will show up in other components to varying degrees. Subjective power factors such as morale and will are better indirectly measured by objective factors, because the assessment of them would entail a great deal of bias, which represents an indirect criticism of Ray Cline's formula (section 13.20). He measures power as capabilities, and he sharply separates that from power as influence, though he concedes that more often than not the two go together.

He designs his measure to compare it to the indexes of Clifford German (section 13.5), Ray Cline, and the CINC (section 13.15).[249] His measure is meant to underscore the efficacy of radical simplicity, which he stresses throughout his prior argumentation. The formula can be put this way:

$$summed\_ranks = population_{rank} + defense\_expenditures_{rank} + GNP_{rank}$$

The summed ranks are ranked in turn. The following table presents a truncated list of rankings, ranking the summed ranks for the same nineteen countries that can be found in German's index:[250]

Table 52: Ranked Summed Ranks for 1965 [Sullivan]

Country	Rank	Country	Rank	Country	Rank	Country	Rank
USA	1	India	6	Canada	11	Argentina	16.5
USSR	2	France	7	Brazil	12	Sweden	16.5
China	3	Italy	8	Czechoslovakia	13	South Africa	18
UK	4.5	Poland	9	Australia	14.5	Belgium	19
West Germany	4.5	Japan	10	Egypt	14.5		

Source: SULLIVAN 1990: 111.

The summed ranks have a Spearman correlation coefficient of 0.91 with German's index and 0.64 with Cline's 1975 index. He does not mention if he calculated a Spearman correlation coefficient for the summed ranks and the CINC.

[249] He also mentions Fucks' formula (section 13.10), but he falsely attributes it to Oskar Morgenstern and colleagues, who merely reviewed some of Fucks' work (see SULLIVAN 1990: 116; also HEISS et alia 1973: 27–47). He is aware of the perception-based power index by Norman Alcock and Alan Newcombe (section 13.14) (SULLIVAN 1990: 118).
[250] The rankings were taken from a scatterplot diagram. Though Sullivan did a far larger ranking for many other countries, his other scatterplot diagrams do not feature country designations (SULLIVAN 1990: 112–115, 117).

13.30 Sułek 1990 PL

Mirosław Sułek[251] (born in 1952) is a Polish defense economist. He studied economics, did a master's degree in economics, and completed in 1987 his PhD in economics, all at the Political-Military Academy in Warsaw [Wojskowa Akademia Polityczna], which was a Soviet-style military academy that existed from 1951 to 1990 and trained many political commissars for the army. He did his postdoc habilitation at the University of Łódź. From 1995 to 1998 he was professor at the National Defense University. From 1997 to 2002 he was professor at the University of Podlasie. Since 2002 he has been professor at the Institute of International Relations at the University of Warsaw. His research interests are the political economy of national security and defense planning, and the relationship of forces in the international arena. His special focus is on the economy of power (for which he coined the term *potęgonomia*) along with the metrics of power (for which he coined the term *potęgometria*).

In 1990 Sułek published a rudimentary article on military-economic potential with calculated results for the United States, the Soviet Union, and nine other countries[252] for the year 1986 (SUŁEK 1990: 160–161). His interest in quantification was inspired by the work of Wilhelm Fucks. The formula for military-economic potential is identical to his later formula for coordinative power, which in 2001 was published in the book *The Fundamentals of Powernomics and Powermetrics* [*Podstawy potęgonomii i potęgometrii*] (SUŁEK 2001). This book contains a treatment of diverse power indexes as well as his own formulas. His 2010 work *International Forecasting and Simulations* [*Prognozowanie i symulacje międzynarodowe*] (SUŁEK 2010) provides an update for his numbers and thinking, and was especially designed for one of his courses.[253]

In analyzing various previous approaches to the measurement of power (SUŁEK 2001: 57–85), he makes the important distinction between ideological and operational models of power. Ideological models of power are basically theoretical power formulas that cannot be operationalized either because the functions have not been clearly defined in formulaic terms, which would make them power inventories rather than formulas, or because the proposed variables are immeasurable on account of a lack of available data or the basic impossibility of quantifying such data. Operational models of power are basically operational power formulas that can be directly implemented. Interestingly enough Ray Cline (section 13.20) can be found in both categories. Next to the formula of Cline, other operational, multivariate formulas are those of Wilhelm Fucks (section 13.10), L. L. Farrar (section 13.26), and Jean-Yves Caro (section 13.33). Since 2007 he has also displayed an awareness of Chinese CNP efforts (chapter 14).

As for the selection of variables, "Sułek tried to incorporate only the elements of power that are constant and absolutely essential to completeness of description" (STAŃCZYK 2003: 121). These are territory, population, nominal GDP, military expenditures, with military personnel added later on. In discussing the technicalities of his formulas (SUŁEK 2001: 87–97, also 2003: 93–94, further 2010b:

[251] His name is pronounced 'Su–ek'.
[252] China, West Germany, Japan, Great Britain, France, India, Poland, Italy, and Canada.
[253] UPDATE: His new book *National Power – Models and Applications* is being printed (Potęga państw – modele i zastosowania, Wydawnictwo Rambler, Warszawa 2013, ss. 384).

143–151), he makes three premises for the weighting of elements. The first one is based on a quote of Napoléon, who wrote in a letter to his brother Joseph, whom he wanted to teach how to be an effective king of Spain, that "the moral is to the physical as three is to one" (Napoléon, quoted in SUŁEK 2001: 92). Sułek sees this ratio reconfirmed in Fucks' formula where steel and energy have three times the weight of population, which constitutes the second premise. He applies this to interpret then military expenditures to stand for the moral, whereas population stands for the physical. As for the third premise, he thinks that the importance of territory is somewhere between zero and that of population, so it makes the most sense for him to assign to territory half the importance of population. He uses Euler's constant to adjust exponents. The initial formula:

$$P = P_k = W^{0.652} L^{0.217} p^{0.109}$$

P = power; P_k = coordinative power; W = military expenditures; L = population; p = territory

In this formula the power of the political unit [potêga jednostki politycznej] is equal to coordinative power [potęga koordynacyjna].[254] In 2010 he changed this formula by replacing population with military personnel (SUŁEK 2010: 118):

$$P_{kż} = W^{0.652} Ż^{0.217} p^{0.109}$$

$P_{kż}$ = military power; W = military expenditures; $Ż$ = number of soldiers in active service; p = territory

He has an auxiliary formula for disposable power [potęga dyspozycyjna], which replaces military expenditures by nominal GDP:

$$P_d = D^{0.652} L^{0.217} p^{0.109}$$

P_d = disposable power; D = nominal GDP; L = population; p = territory

Fucks is his inspiration for the formulaic style that uses exponents for weighting. Whereas Fucks gives a bonus to size (sum of exponents = 4 / 3 ≈ 1.33), his formula has a slight malus for size (sum of exponents = 0.978). The following table presents the complete published results from 2001 (updated results can be found in Appendix B):

Table 53: Power of Political Units in 1998 [Sułek]

Country	Disposable Power economy-based	Coordinative Power military-based	Country	Disposable Power economy-based	Coordinative Power military-based
USA	**1,000**	**1,000**	Mexico	92	42
China	274	384	Spain	80	39
Russia	246	246	Netherlands	39	28
India	179	172	Poland	34	26
Japan	353	165	Sweden	32	25
Brazil	156	155	Thailand	36	22
Great Britain	142	133	Greece	19	20

[254] Sułek uses coordinative power and disposable power as cybernetic categories. Coordinative power can also be called "military power" or "real power", whereas disposable power can also be called "total power" or "potential power". See Appendix B for a concise introduction to Sułek's thinking.

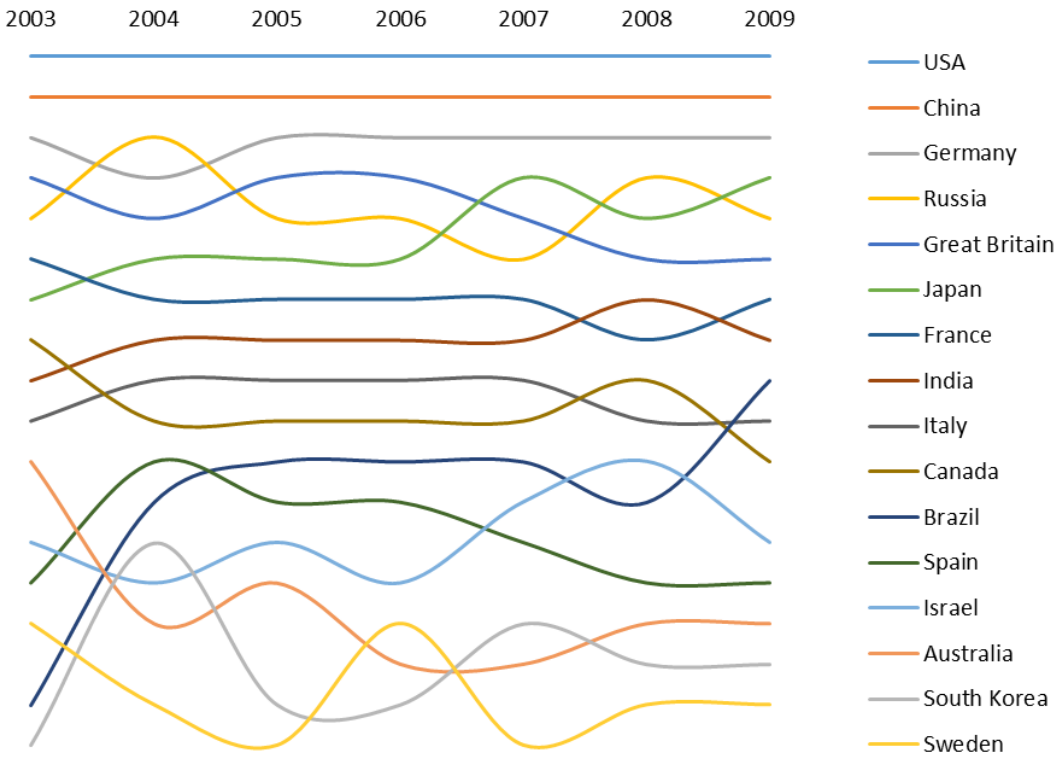
France	163	129	Belgium	26	13
Germany	217	119	Denmark	19	12
Italy	137	83	Austria	25	11
Indonesia	66	59	Finland	19	11
South Korea	59	58	Portugal	17	10
Turkey	47	55	Ireland	11	5
Canada	111	53	Luxembourg	2	1
Australia	74	51	Total	3,739	3,171
Argentina	64	44			

Source: SUŁEK 2001: 134, 137.

Jerzy Stańczyk congratulates Sułek for his courage in presenting an original method. He complains that "insufficient account has been taken of the political and international conditionings of the position of states" (STAŃCZYK 2003: 124).

Besides, Sułek conducted a number of opinion surveys. Some results he published in the article "The Perception of State Power in Selected Expert Groups" ["Postrzeganie potęgi państw przez wybrane grupy eksperckie"] in 2007 (SUŁEK 2007). The original idea to conduct such surveys may have come from Jean-Yves Caro's work (section 13.33). The following diagram depicts the rankings of 17 countries based on the surveys of third-year students at the Institute of International Relations at the University of Warsaw. Among the seven groups surveyed, this was the most uniform expert group with respect to age, interests, and education. Each survey was done on 40 countries, so at least 23 countries are not included in this diagram, though the data is available:

Figure 7: Power Index According to Survey 2003–2009 [Sułek]



Source: SUŁEK 2007: 135–137, 2010a.

Ranks are more stable in the top league, whereas there is a greater dynamic/uncertainty in the ranking the lower one gets. That is partly because the countries in the top league are fewer and farther away from each other. Hence their power and corresponding ranking is more distinct. The closer countries are to the average or normal size, the less the gap between them, and the less distinct they become. Therefore the precise ranking experiences more uncertainty. Another reason for the fluctuations is the number of surveyees. The sample size (n) ranges between 62 and 125 surveyees, which is a bit low for statistical analysis. Caro's sample size was 214, which he himself admitted is modest, though he hoped that this limitation was more than compensated for by the fact that those consulted were experts in the defense industry (CARO 1999: 125). The ideal size should perhaps be between 1,000 to 1,500 surveyees, which was the number used by Bertelsmann in a survey on power carried out by TNS Emnid, one of Germany's leading survey firms (see TNS Emnid 2006: 8). Yet despite the superior financial and logistical means that come from having a professional staff, those surveyed were not experts.[255]

[255] The Chicago Council on Global Affairs has also conducted a number of surveys, again not with experts, concerning the influence of a few countries (Chicago Council on Global Affairs 2002a, 2002b, 2006; also NOYA 2003).

13.31 Barcia 1993 US

Stephen Barcia is an American computer game developer. In 1988 he founded together with Ken Burd a company called Simtex for the development of computer games. By 1992 Barcia had developed a game called *Star Lords*. In early 1993 he submitted the game to MicroProse, a better known company in the field of computer games. The game attracted sufficient interest, and was subsequently improved and polished, to be released as *Master of Orion* in 1993/1994.[256] It became a huge success and is still a classic in the genre of computer strategy games. Previewing the game Alan Emrich coined the term *4X* for "explore, expand, exploit, and exterminate" that now designates this whole subgenre of computer strategy games. Nowadays Barcia is employed at Electronic Arts (EA), an international company developing computer games.

Computer strategy games usually wish to simulate some sort of reality and so they often put the player in charge of some politico-military unit. The player then has to decide how to spend resources and optimize strategies vis-à-vis other human protagonists or computer protagonists (so-called artificial intelligence). The intention is to keep the game simple but challenging. In effect many computer strategy games ought to be considered crude approximate models for the reality of politics and warfare. It could be argued that in many ways designers of computer games are for the modeling of reality better equipped mentally – in terms of imagination, mathematics and problem-solving skills – than their academic counterparts.

Master of Orion presents a future struggle for power over the galaxy between six alien races. For each planet the game simulates (1) ship production, (2) defense production, (3) industry production, (4) ecology production, and (5) technology production. It appears realistic enough if one disregards the science fiction context. It is simple to understand and play without the simulation being too crude or primitive. It is challenging, because simple decisions have great implications on general strategy and imperial power. The game features a composite index for total power, which in terms of relative power determines the amount of respect that computer players display towards the threats of the human player (EMRICH 1994: 240−241). This composite index along with five subindexes can be found in the status screen (racial stats) and consists of the added-up scores of the five equally weighted subindexes.[257] The following table presents the subindexes along with my suggested non-science fiction equivalents:

[256] The games can be downloaded for free at the following websites. Star Lords: http://www.reloaded.org/download/Star-Lords/92/ [16 August 2013]. Master of Orion: http://www.bestoldgames.net/eng/old-games/master-of-orion.php [16 August 2013]. In order to play these games, emulator software is necessary: http://www.dosbox.com/ [16 August 2013].

[257] The predecessor *Star Lords* features the five subindexes plus a diplomatic relations matrix but no index for total power. The sequel *Master of Orion II* features a history graph instead of a total power index. The history graph is based on (1) population, (2) number of buildings, (3) fleet strength, and (4) progress in technology. Each of the four variables can be switched on or off, which in turn allows for 15 different perspectives.

Table 54: Subindexes of Total Power in Status Screen (Racial Stats) [Barcia]

Subindex	Explanation	*Suggested Equivalent*
Fleet Strength	number of space ships regardless of technology level but taking account of different ship sizes; uses a modified logarithmic scale	*Military Personnel*
Population	total population	*Population*
Technology	averages technology in six categories	*Patent Applications*
Planets	number of colonies regardless of size	*Territory*
Production	measures annual gross income; uses a modified logarithmic scale	*Nominal GDP*
Total Power	adds the five subindexes and standardizes scores to 100 for strongest race	*National Power*

Source: BARCIA 1993: 20; EMRICH 1994: 316–319; author's own suggestions.

As can be expected for every power index, some people consider some subindexes more important than others. Douglas Zimmerman states in the context of the game: "In general, high tech is critical. Ignore the 'fleet size' and 'total power' status lines; just keep production near the best, and tech higher if you can" (CHALLOUX 1996).

To prove the viability for the real world of this (in the computer game) operational index from a fictional computer game, I constructed a real-world power index based on the suggested equivalents for the subindexes. Values were taken as percentages of the world total, and for total power the simple arithmetic mean was taken. The following table presents the six most powerful countries:

Table 55: Index of Total Power for 2007 [Barcia]

Country	Armed Forces Personnel	Population	Patent Applications	Surface Area	Nominal GDP	Total Power
United States	5.5%	4.6%	26.2%	7.2%	27.0%	14.1%
China	13.3%	20.0%	12.9%	7.2%	5.5%	11.8%
Japan	0.9%	2.0%	25.1%	0.3%	8.8%	7.4%
India	9.6%	17.0%	1.8%	2.5%	1.9%	6.5%
Russia	5.3%	2.2%	2.3%	12.8%	2.0%	4.9%
Brazil	2.8%	2.9%	1.5%	6.4%	2.2%	3.1%

Source: http://databank.worldbank.org/ddp/home.do [10 June 2010]; author's own calculations.

The values point to the dormant potential for power analysis that exists in looking at some of the power indexes used in computer games. Gaming and international relations modeling are compatible, as war games have been used for millennia as a training device in the military. Harold Guetzkow had used international simulation games to understand better the psychological aspect of international relations (section 13.6). Nor are computer games necessarily situated in fictional contexts, as the WWII strategic war game *Making History* demonstrates (section 13.43).

13.32 Chaczaturov 1997 RU

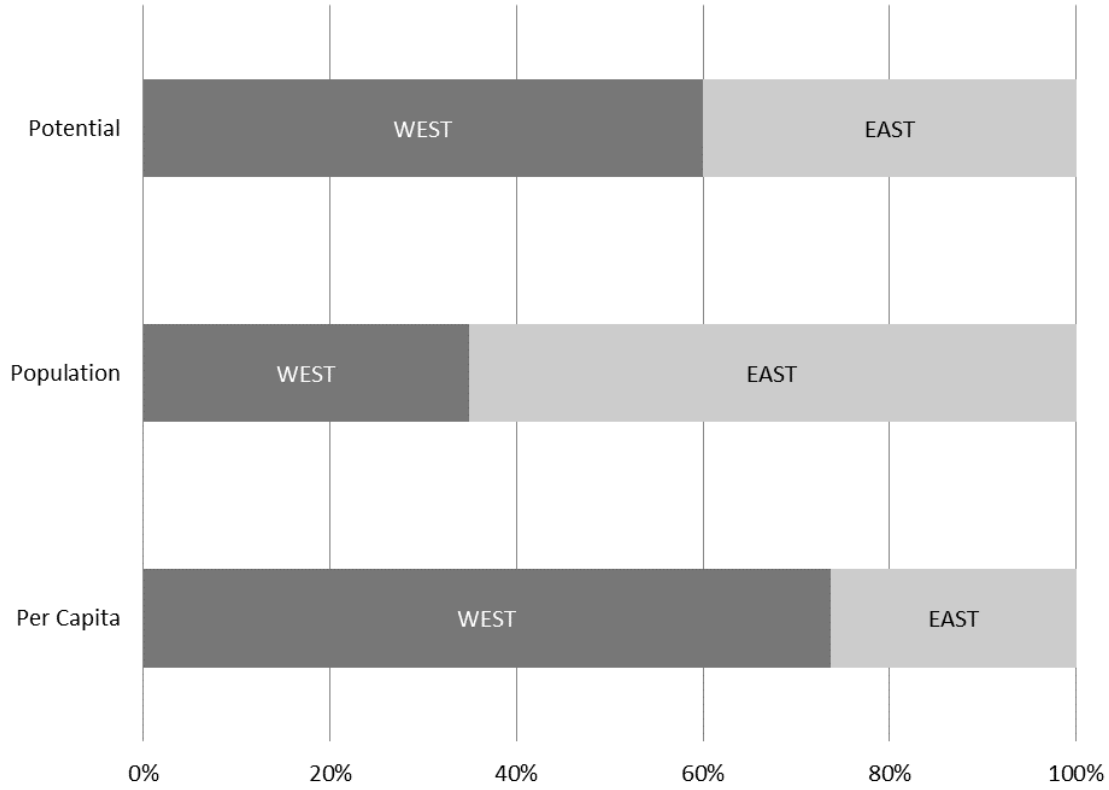
Vladimir Rubenovich Chaczaturov is professor of mathematics and physics in Russia, though his research interests and activities are much broader. He is working at the Dorodnicyn Computing Centre

of the Russian Academy of Sciences (RAS), where he heads the Department of Design Practices in Developing Systems [методов проектирования развивающихся систем]. There his attention is on the development of new information technologies, some of which is applicable to use in the energy development (e.g. gas exploration) in Russia. This in turn connects him to the larger issues of geopolitical stability and sustainable development. He is the author of more than 120 papers. In 1997 he published the article "Russia and the geopolitical stability of the world" ["Россия и геополитическая стабильность мира"] (CHACZATUROV 1997). The aim of the article was to compare the potentials of different blocks of countries, defined as civilizations, in order to reach conclusions about the number of polarity, global connectedness, and geopolitical stability.

He considers the following variables as indicators of potential: population, territorial size, total consumption of fuel and electricity, GDP, national income. In the end he settles on four indicators, which are (A) area, (B) population, (C) annual consumption of primary energy resources, and the (D) annual consumption of electricity in the residential and service sectors (household electricity). These four indicators provide for 15 possible sets of indicators: A, B, C, D, $(A\ B)^{0.5}$, $(A\ C)^{0.5}$, $(A\ D)^{0.5}$, $(B\ C)^{0.5}$, $(B\ D)^{0.5}$, $(C\ D)^{0.5}$, $(A\ B\ C)^{1/3}$, $(A\ B\ D)^{1/3}$, $(A\ C\ D)^{1/3}$, $(B\ C\ D)^{1/3}$, $(A\ B\ C\ D)^{0.25}$. The actual formulas are not given as such. The few numbers provided prove that it must be the geometric mean. Four sets can be considered single-indicator approaches, eleven are multivariate approaches. As for the results, they are not published in the article. Chaczaturov states that 12 out of 15 sets show a unipolar world order dominated by countries with a Western-type culture. There are some numbers in the text that allow a reconstruction of $(A\ B\ C\ D)^{0.25}$ potential for East and West:[258]

[258] According to Chaczaturov, the West consists of most of Europe (excluding Turkey and part of the former Yugoslavia), the United States, Canada, Australia, New Zealand, Latin America, Africa (excluding Islamic countries), and half of the former USSR (50% of the population and 50% of the area), whereas the East in turn consists of the Middle East, the remainder of Europe (Turkey and part of the former Yugoslavia), Japan, China, India, Asia (rest), Africa (Islamic countries), and the other half of the former USSR (50% of the population and 50% of the area).

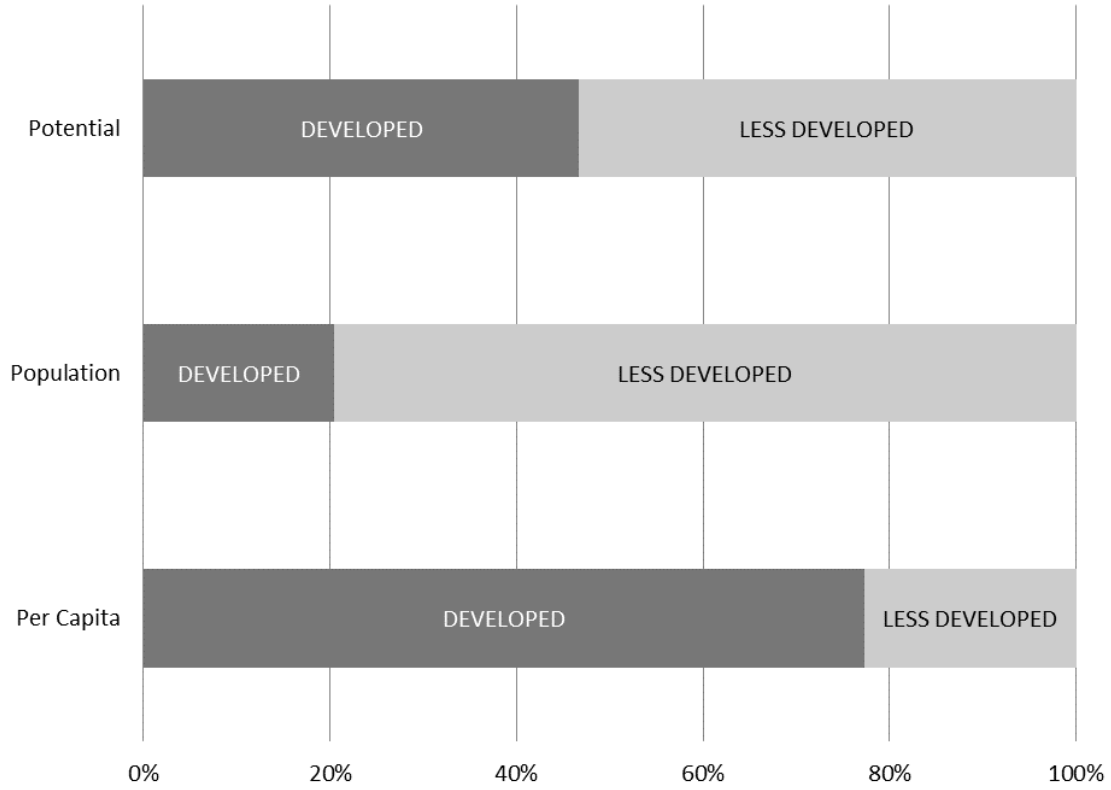
Figure 8: Potential of East and West [Chaczaturov]



Source: CHACZATUROV 1997; author's own calculations.

There are also some numbers to allow a reconstruction of $(A\ B\ C\ D)^{0.25}$ potential for developed countries and less developed countries. Developed countries are those with above-average life expectancy relative to global life expectancy, whereas the less developed are those below-average:

Figure 9: Potential of Developed and Less Developed Countries [Chaczaturov]



Source: CHACZATUROV 1997; author's own calculations.

Even though the $(A\ B\ C\ D)^{0.25}$ potential of less developed countries is greater in total, it must be realized that, in terms of population, the developed countries represent only the "golden billion" of the world population. The 1:2 population ratio of West to East is less unbalanced in comparison to the 1:4 population ratio of developed countries to less-developed countries.

13.33 Caro 1998 FR

Jean-Yves Caro (born in 1944) is a French economist. He got his PhD in economics at the Dauphine Paris IX University in 1982. Part of his dissertation was published as *The Distinguished Economists: Social Logic of a Scientific Field* [*Les économistes distingués. Logique sociale d'un champ scientifique*] a year later. He is professor of economics at Panthéon-Assas Paris II University. His special interests have been monetary macroeconomics, decision theory, defense economics, and the strategy of France. He has written a number of articles on defense economics. In 1998 he conducted a survey on power perceptions, on the basis of which he published four articles in 1999/2000 (CARO 1999, 2000a, 2000b, 2000c).

Caro is looking at national power as a research question pertaining to the issue of defense budgets. He thinks that most literature in international relations reveals an essentialist and doctrinal approach regarding national power, an approach which he contrasts to the more operational analysis

he adopts. Before presenting his survey and the resulting formulas, he composes a simple power index based on the ranks of ten countries in four variables. Those ranks are added and then ranked again. The following table presents the complete published results of this simple approach:

Table 56: Simple Power Index for 1997 [Caro]

Country	Population rank	GNP-PPP rank	International Trade rank	Defense Budget PPP rank	Summed Ranks rank
United States	3	1	1	1	1
China	1	2	7	2	2
Germany	7	4	2	7	3
Japan	6	3	3	8	3
India	2	5	10	5	5
France	8	6	5	4	6
United Kingdom	9	7	4	6	7
Russia	5	10	8	3	7
Brazil	4	8	9	9	9
Canada	10	9	6	10	10

Source: CARO 1999: 125, 2000a: 22.

The index serves merely as orientation, for he proceeds to introduce a more sophisticated analysis based on a survey he conducted. The survey was conducted in the first semester of 1998 at the Institute of Higher Studies for National Defense [Institut des hautes études de défense nationale – IHEDN]. The IHEDN is a French public institution with the purpose of training military and civilian public servants in defense matters. 214 students agreed to participate in the survey, 36 of whom were in the military, 39 were economists, and 40 were diverse civilian auditors. The average age of the surveyees was 38.5. Caro concedes that the number of surveyees is quite small. He hopes that their superior knowledge on defense matters compensates for this shortcoming (compare section 13.30).

In the survey the surveyees were asked to assign scores ranging 1–15 for the estimated power of 40 selected countries. The scores are then averaged into an interval scale. He subsequently uses multiple regression analysis (or something similar) on these power perception scores to determine the weights for a varying number of selected factors. This way he produces three formulas as the best approximations of power in correlation to the surveyed power perception scores. There are two versions for the three formulas: the version of the three formulas with the higher Pearson correlation coefficients is presented below (CARO 2000a: 28), the other is not (for that see CARO 2000c: 98–99, 101). The formula using only socio-economic factors is:

$$\text{exponent}\ (\ \text{Power}_i\ ) = \text{GNPatPPP}_i^{1.15} \times \text{IT}_i^{0.39}$$

GNPatPPP = GNP at PPP; IT = international trade; i = respective country

The Pearson correlation coefficient for the results of this formula and the power perception scores is 0.94. The formula using only military factors is this:

$$\text{exponent}\ (\ \text{Power}_i\ ) = \text{NC}_i^{0.41} \times \text{AFP}_i^{0.58} \times \text{DEPCatPPP}_i^{1.20}$$

NC = nuclear capacity; AFP = armed forces personnel; DEPCatPPP = defense expenditures per capita at PPP; i = respective country

The Pearson correlation coefficient for the results of this formula and the power perception scores is 0.89 – not as good as the civilian formula. The factor for nuclear capacity is not entirely clear. He takes account of the nuclear arsenals, the capabilities of countries to develop and produce nuclear weapons rapidly, as well as the aspirations of countries to obtain them. He seems to have initially assigned scores ranging 1–7 to countries based on his evaluation (CARO 1999: 127, 2000c: 97). He then seems to have changed his mind by preferring a simple measure composed of two variables, namely (1) whether a country possesses nuclear weapons (dummy variable) and (2) the number of warheads (CARO 2000a: 26).[259] The formula capturing both socio-economic and military factors is:

$$\text{exponent}\ (\ \text{Power}_i\ ) = \text{T}_i^{0.42} \times \text{GNPatPPP}_i^{0.72} \times \text{NC}_i^{0.20} \times \text{DEatPPP}_i^{0.53}$$

T = technology; GNPatPPP = GNP at PPP; NC = nuclear capacity; DEatPPP = defense expenditures at PPP; i = respective country

The Pearson correlation coefficient for the results of this comprehensive formula and the power perception scores is 0.98. The coefficient has to be better than the previous two by logical necessity (the formula being more inclusive). The factor for technology is quantified by adding telephone lines per capita, whether fixed or portable, and the number of computers per capita.

The following table presents the complete published results as for perceived power and calculated power, using the third formula that includes both socio-economic and military factors:[260]

Table 57: Index of Calculated Power for 1998 [Caro]

Country	Perceived Power	Calculated Power	Country	Perceived Power	Calculated Power
United States	14.38	14.8	Mexico	7.10	8.3
China	12.11	11.9	Indonesia	7.12	7.8
France	11.61	11.5	Pakistan	7.38	
Japan	12.00	10.9	Argentina	7.18	
United Kingdom	11.34	11.4	Iraq	7.09	
Russia	11.32	11.3	Singapore	6.93	
Germany	11.82	10.5	Ukraine	6.87	
India	10.24	9.7	Egypt	6.81	
Italy		9.8	Syria	6.75	
South Korea		9.5	Chile	6.23	
Canada	9.76	9.2	Poland	5.86	
Israel	9.92	8.7	Malaysia	5.78	
Brazil	8.41	9.0	Morocco	5.76	
Australia	8.65	8.7	Nigeria	5.47	
Spain	8.44	8.9	Libya	5.37	

[259] Estimates on nuclear arsenals are notoriously unreliable especially with regard to Israel, India, Pakistan, and North Korea. Normally estimates are on the number of warheads, disregarding that different warheads may have different explosive yields as measured in megatonnage. One of the treasures of the internet is a website by Robert Johnston who provides estimates on nuclear arsenals, including megatonnage: http://www.johnstonsarchive.net/nuclear/ [16 August 2013].
[260] Results also exist for the other versions of the formulas (see CARO 2000c: 104).

Netherlands		8.4	Algeria	5.27
South Africa	8.25		Colombia	4.76
Turkey	7.80	8.5	Uruguay	4.43
Saudi Arabia	8.12		Lebanon	4.30
Thailand		7.9	Sudan	3.32
Iran	7.80		Yemen	3.29
Sweden	7.69	7.8	Zambia	2.50

Source: CARO 2000a: 32, 2000b: 103–104.

In what could be called a postmodernist analysis Francis Rousseaux compared Jean-Yves Caro to other authors on power. He remarks that in comparison to the other authors Caro is concerned with the order of powers. The problematic issue is a random disorder taunting the qualitative. For Rousseaux this approach is a measurement of concordance and has nothing to do with science. The central question remains as how to reconstruct opinion (ROUSSEAUX 2001: 8–10). Guy Teissier is deputy to the French National Assembly and chairman of the National Assembly Committee on National Defense and Armed Forces [Commission de la Defense Nationale et des Forces Armées]. He reflects in a 2006 article on this power analysis of Caro that, among other things, he feels reassured by the fact that it can be demonstrated that nuclear weapons are an advantageous factor for French military power (TEISSIER 2006: 91–92). In this regard, Caro's survey also shows that French defense experts evaluated nuclear weapons as the most important determinant of power among 20 possible determinants (CARO 2000b: 113).[261] French Frigate Captain Delorme appreciates the essential importance of military capacity as demonstrated by Caro (DELORME 2006: 4). Caro's approach most likely inspired Polish defense economist Mirosław Sułek to conduct regular surveys as well (section 13.30).

Having Shinn (section 13.13) as well as Alcock and Newcombe (section 13.14) as predecessors in terms of method, Caro used perhaps the best approach available for the quantification of power. He used a perception survey as the basis for multiple regression analysis (or something similar), rather than an arbitrary assignment of weights. Shimbori and colleagues (section 13.8) as well as Saaty and Khouja (section 13.23) used perception surveys to determine the importance of variables. Though Caro surveyed on the relative importance of variables, he did not base the weights on this perceived importance of input variables. He based the weights of variables on the perceived output approximated by power perception. The calculation of the weights via multivariate regression analysis keeps the focus on optimizing output results. This approach can be considered empirical despite limitations (section 16.7). There are minor technical issues providing room for improvement, for example in the way he quantified technology or nuclear capacity. It could further be debated whether it is better to use a linear or nonlinear model. The use of an interval scale rather than a ratio scale is a drawback, because it is not terribly interesting to know that the United States is more powerful than China – no formulaic sophistication is needed to figure that one out – but

[261] The determinants were (score in parenthesis, the score range being 1–15): nuclear weapons (12.54), technology (12.19), international trade (11.50), GNP (11.46), armed forces (11.39), economic independence (11.39), diplomacy (10.81), currency (10.59), social cohesion (10.55), military alliance (10.25), wealth per capita (10.25), population (10.09), education system (10.06), natural resources (9.77), institutions (9.50), situation (9.14), language and culture (8.81), territory (8.72), history (8.67), and regional organization (8.16).

it is imperative to know how much more powerful the United States is than China. Nevertheless these problems can be solved. The basic method is sound and workable.

13.34 Volgy / Bailin 2003 US

Thomas J. Volgy (born in 1947) is an American political scientist. He studied political science and history at Oakland University. He did his master's degree and PhD in political science at the University of Minnesota. Since 1971 he has been professor of political science at the University of Arizona. His interests are international politics, democratic processes, and domestic public policy. From 1987 to 1991 he was mayor of Tucson. In 2003 he published together with Alison Bailin, one of his graduate students, *International Politics & State Strength* (VOLGY & BAILIN 2003).

Much of the inspiration for this work comes from the political economist Susan Strange, with the consequence that they discuss the architecture of the new world order under the assumption that state strength has been declining.[262] For this purpose three indexes are developed for the quantification of state strength (VOLGY & BAILIN 2003: 35–77). Volgy and Bailin reject the idea that power is unidimensional and favor a multidimensional approach. From Strange they take the ideas of relational strength, which represents the relative capabilities of states, and structural strength, which refers to the capability of the state to shape rules, norms, and modes of operation in the international system. Structural power thus depends on the desire, will, and competence of a country to engage in international affairs,[263] something Volgy and Bailin do not take for granted. One of their examples is the pre-WWI United States, which had immense capabilities but not much interest in participating in international politics. They add a third dimension of domestic strength, which indicates the long-term base a state has for developing its structural power.

In general, countries should have sufficient strength in all three dimensions to play their part in the architectural structure of the international order. Relational power is a power index in the most conventional sense. The formula is:

```
RS = ( GDP / GroupGDP + MilSpend / GroupMilSpend ) / 2

RS = relative strength; MilSpend = military spending; Group = aggregate scores
for designated group powers
```

This formula for relational power appears like the simplest multivariate formula conceivable for calculating capabilities. For structural power the formula is:

[262] Susan Strange has argued that the power of states has diminished relative to the power of markets as borders have lost much of their meaning. Intervention by government bureaucracies in the daily life of citizens appears to be growing, but Strange deems these sectors of state intervention to be of a trivial nature (STRANGE 1996: 3–9).
[263] Susan Strange explicates that structural power can be found in four interacting structures. These are the production structure, security structure, finance structure, and knowledge structure. The structural power lies with those who control these sectors (STRANGE 1998:24–32).

$$SS = (EC - RIA) - \nabla Size$$

SS = structural strength; EC = external capabilities = all resources spent on foreign activity; RIA = relative internal autonomy = trade / GDP; ∇Size = system size = change (in percent) of states in the system

External capabilities refer to all resources a government spends annually for external purposes, including military spending, spending for foreign affairs infrastructure, and spending on foreign assistance.[264] For domestic strength the formula is:

$$DS = (DR - OR +/- PS - Social) / Pop$$

DS = domestic strength; DR = central government revenue; OR = overreach = budget deficit and money spent on debt service; PS = political strength = support for the head of government in national legislature and public opinion; Social = index of social stress = average percentage of inflation and unemployment plus crime dimension; Pop = population

In both the formulas for structural strength and domestic strength percentage values are added/subtracted to absolute values. It is not clear how this is done. Calculations were limited to six major powers: Japan, Germany, France, United Kingdom, United States, and China. Results for these three measures are published via diagrams (VOLGY & BAILIN 2003: 60–63, 66–67, 69–70, 108).

Independent Variation: H. Sönmez Ateşoğlu 2008

With regard to relative strength, Volgy is not alone in adding up GDP and military expenditures. Turkish scholar H. Sönmez Ateşoğlu stated independently that "national power in [his] study is measured as the sum of economic and military power" (ATESOGLU 2008: 43). In his study economic power is measured by GDP at PPP, and military power is measured by military expenditures at OER. The difference is that Volgy gives GDP and military expenditures equal weight by adding relative percentages. Ateşoğlu adds direct monetary values, so GDP has a much higher weight than military expenditures. His results are available as bar charts (ATESOGLU 2008: 38, 43).

13.35 *Newsweek* 2003 US

Based in New York but sold internationally, *Newsweek* is an American magazine that has been published since 1933. It is one of the big three American weekly news magazines next to *TIME* and

[264] A challenge was to compile the data. Volgy described the situation to me in an email (13 October 2009): "The real complication is to create the structural index measure, since it requires in the numerator all spending on foreign affairs. There is no good data base for those numbers, and several issues arise, including missing data on intelligence spending, and also on how much states spend on foreign policy infrastructure. For the US the latter was relatively easy, as it was for Germany. For France, we relied on a colleague who had her graduate students pore through parliamentary debates across the years to assess this for France. Likewise, we had to go to a colleague in Japan to estimate for Japanese foreign policy infrastructure, and the same for the British, despite notions of transparency in democracies. The data for Russia came from research colleagues at MGIMO in Moscow, and our worst estimates are for China where there was virtually no relationship between official estimates and estimates by outside observers. One of the lessons we learned is that while we expected problems uncovering data about non-democracies, the level of financial transparency in stable, mature democracies is unbelievably low."

U.S. News & World Report. Its headquarters is in New York. In 2003 *Newsweek* published two pages titled "The Power Game" as part of a special section (SPARKS & GATES 2003) that purported to show the ten most powerful countries in the world. The article itself has the appearance of a board game. The limited text was written by John D. Sparks, with tables and graphics designed by Guilbert Gates.

They rank the top ten nations in 22 categories, grouped into seven sections. The following table shows the categories and sections:

Table 58: 22 Categories of Power [*Newsweek*]

Military Power	Economic Power	Resource Power	Technology Power	Diplomatic Power	Movie Power	Social Power
Military Spending	Exports	Oil Reserves	Nobel prizes in Science	Donors of Foreign Aid	Feature-Film Production	University Students
Nuclear Warheads	Competitiveness (WEF Index)	Freshwater Supplies	Patents Granted	U.N. Security Council	Film Investment	Quality of Life (U.N. Index)
Weapons Exports	Total GDP	Agricultural Exports	Internet Users	Environmental Treaties	Movie Tickets Sold Per Year	Housing: People Per Room
			Personal Computers			

Source: SPARKS & GATES 2003: E16–E17.

As can be seen, soft power is represented by the latter three sections. Thirteen categories can be considered hard power and nine soft power. They use inverse ranks to assign points to the top ten nations in each category (that is, ten points for the first place, and one point for the tenth place). They add these points (summed ranks) to determine the ten most powerful countries. The total scores are not given. I recalculated them from the points in each of the 22 categories. The following table presents the complete results:

Table 59: The World's Most Powerful Countries in 2003 [*Newsweek*]

Country	Score	Country	Score	Country	Score	Country	Score
United States	169	Spain	27	Cyprus	9	Venezuela	4
Germany	97	Iceland	24	Gabon	9	Bulgaria	3
France	94	Australia	23	*Hong Kong*	8	Congo	3
United Kingdom	88	New Zealand	22	Indonesia	8	Bolivia	2
Japan	72	South Korea	22	Iran	8	Brazil	2
Canada	69	Switzerland	22	Iraq	8	Ireland	2
Sweden	65	Belgium	18	Luxembourg	8	Libya	2
China	50	Finland	18	Papua New Guinea	8	Mexico	2
Norway	48	Saudi Arabia	14	United Arab Emirates	7	North Korea	2
Netherlands	46	*Bermuda*	13	Kuwait	6	Philippines	2
Russia	39	Pakistan	12	Israel	5	Ukraine	2
India	34	San Marino	10	Liberia	5	Czech Republic	1
Denmark	29	Angola	9	Austria	4	Nigeria	1
Italy	29	Chile	9	Singapore	4	Peru	1

Source: SPARKS & GATES 2003: E16–E17; author's own calculations.

Though not independent, Bermuda and Hong Kong score higher than Brazil, for instance. The reason is that only 14 categories are national sum totals (e.g. total GDP), whereas eight categories are per capita rates (e.g. university students per 100,000 adults). This distorts the scores in favor of small but

highly developed entities (see section 16.3 for discussion). The index was never designed to look beyond the top ten, though even here Sweden ranks higher than China. In fairness to *Newsweek*, this article was not intended as serious academic work but rather as interesting entertainment.

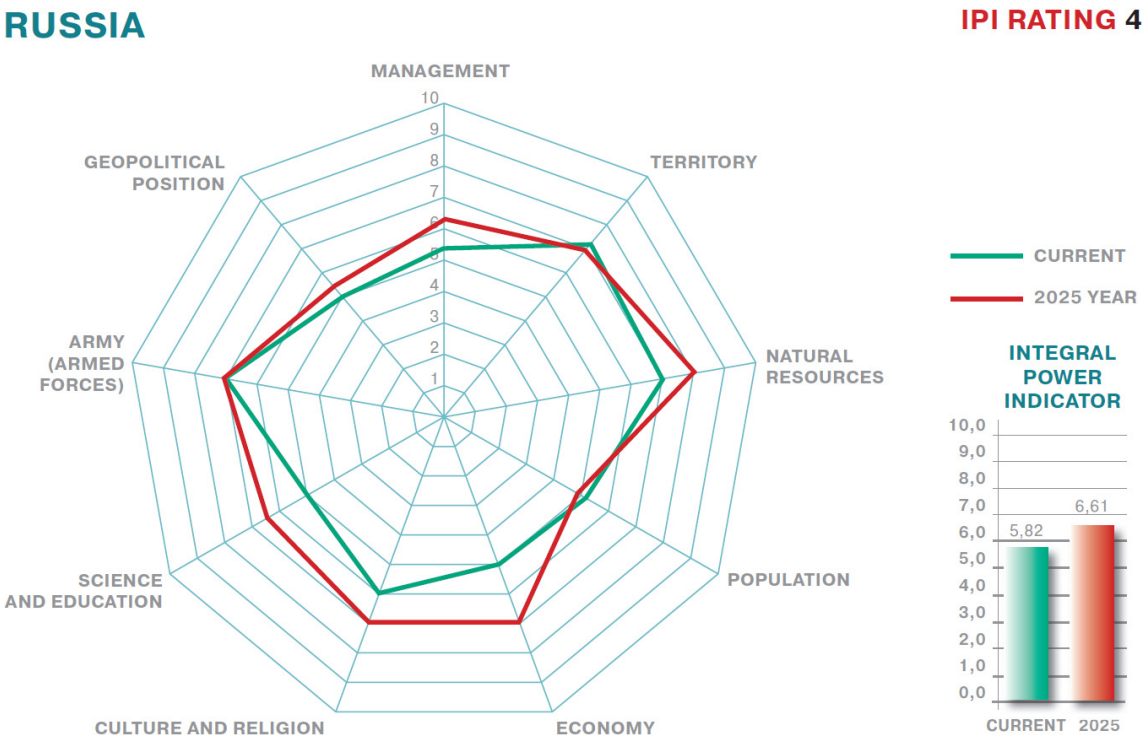
13.36 Ageev 2004 RU

Alexander Ivanovich Ageev (born in 1962) is a Russian economist and futurologist. He studied at Lomonosov Moscow State University and at the Institute of World Economy and International Relations. He was awarded a Doctor of Science degree in economics. He has been instrumental in setting up several associations, leagues, academies, and institutes, all of which have appointed him president. One of these institutes is the Institute for Economic Strategies (INES) [Институт экономических стратегий (ИНЭС)]. In 2004 he published with four coauthors a book titled *Russia in Space and Time* [*Россия в пространстве и времени*] (KUZYK et alia 2004). In the book he traces the history of Russia for the last 2000 years with the help of a strategic matrix. He determines the geopolitical weight of Russia based on Russia's total strength (KUZYK et alia 2004: 74–98; also SUŁEK 2010b: 136–139). In 2007 he published with two (this time different) coauthors the *Global Rating of Integral Power of 50 World's Leading Countries* [*Глобальный рейтинг интегральной мощи 50 ведущих стран мира*] and in 2008 the *Global Rating of Integral Power of 100 World's Leading Countries* [*Глобальный рейтинг интегральной мощи 100 стран*]. The latter appeared in English translation in 2009 (AGEEV et alia 2007, 2008, 2009).

The basic ideas for the 2007 work on the integral power of 50 countries (and the subsequently updated and extended 2008 work on 100 countries) are already in place in the 2004 work that focuses on Russia. In both works Ageev uses a "strategic matrix" consisting of nine base factors, applying concepts designed for strategic management. The concept of the strategic matrix was developed to suit companies, with the word "strategic" referring "to continuous self-improvement, growth of competitive ability, capitalization in the context of orientation towards [sic] consumer, ensuring the leadership, etc" (AGEEV et alia 2009: 5). Robin Matthews is a British professor at universities in London and Moscow and a featured participant in Ageev's network. He developed a nine-factor model to assess management regarding "target-setting system, resource base, technologies for the implementation of managerial decisions" (AGEEV et alia 2009: 5).

The nine base factors for the quantification of integral power are (1) management, (2) territory, (3) natural resources, (4) population, (5) economy, (6) culture and religion, (7) science and education, (8) army (armed forces), and (9) foreign policy (geopolitical environment). For the graphical display of these base factors Ageev uses aesthetically appealing enneagrams, which are nine-pointed geometric figures:

Figure 10: Strategic Matrix Enneagram for Russia in 2008 & 2025 [Ageev]



Source: AGEEV et alia 2009: 82.

No systematic theoretical justification is given for the nine base factors in the 2009 work. Ageev points out that a harmonious development of all base factors is desirable for achieving a viable state corresponding to stability in the international system. This indicates that Ageev is preoccupied with a strong notion of sustainability, possibly based in particular on the experience of the unfavorable outcome of the unbalanced development in the former Soviet Union.[265]

The nine base factors summarize 48 basic parameters. For each base factor, experts were surveyed to determine arbitrary thresholds to assign points using scales of 1–10, with the parameters in place for adjustment. The range 8–10 represents what one would want to expect from a superpower, 5–7 from a great power, 2–4 from a regional power, and 1 from a small state. Ageev points out that these country "categories applied in such scale have fairly definite values today in the political lexicon" (AGEEV et alia 2009: 7). In fact, the problem of developing objective standards for classifying nations has been anything but solved (see LEVY 1983: 11–19; also CORBETTA 2006: 3; CORBETTA et alia 2008: 2). The following table presents the nine base factors in the 2009 work along with the number of parameters for each:

[265] With the Soviet implosion in mind, the concept of sustainability has a much wider and more serious connotation to Russian strategic thinkers than in the West, where sustainability is more associated with environmentalism and related aims (compare KUZNETSOV et alia 2000; further PUDENKO 2006a).

Table 60: Basic Factors of the Strategic Matrix [Ageev]

Base Factors	Parameters
Management	5
Territory	5
Natural Resources	7
Population	4
Economy	8
Culture & Religion	5
Science & Education	7
Army (Armed Forces)	4
Foreign Policy (Geopolitical Environment)	3
Integral Power Indicator	48

Source: AGEEV et alia 2009: 9.

These 48 parameters are not used for processing the raw data through a formula. They are only consulted for the purpose of declared expert assessment. Once scores are assigned for all base factors, a formula is used to average these into the integral power indicator (IPI):

```
IPI = ( M + T + NR + P + 1.5 E + C&R + S&E + A + FP ) / 9.5

IPI = integral power indicator; M = management; T = territory; NR = natural
resources; P = population; E = economy; C&R = culture & religion; S&E = science
& education; A = army (armed forces); FP = foreign policy (geopolitical
environment)
```

Ageev produced results for 100 countries for 2008 as well as forecasting results for 2025. He assumes a scenario where the Euro-Atlantic community will continue to preserve its leading positions in the international system. The following table presents the top 29 out of 100 countries (includes European Union) in the 2008 report. Scores for the Russian/Soviet IPI as well as total geopolitical potential [совокупный геополитический потенциал] for selected years ranging from 1956 to 2000 are available in the 2004 work (KUZYK et alia 2004: 89); the 2007 report has IPI scores on 50 countries (AGEEV et alia 2007: 40–89):

Table 61: Integral Power Indicator Rating for 2008 & 2025 [Ageev]

Country	2008	2025	Country	2008	2025	Country	2008	2025
United States	8.33	8.26	Italy	4.04	4.13	Saudi Arabia	3.40	3.41
European Union	7.54	7.64	Iran	3.80	4.17	South Africa	3.48	3.32
China	6.96	7.29	Canada	3.84	3.87	South Korea	3.25	3.36
Russia	5.82	6.61	Australia	3.59	3.70	Israel	3.12	3.30
Germany	5.51	5.70	Mexico	3.50	3.64	Sweden	3.28	3.13
India	5.33	5.82	Pakistan	3.52	3.56	Ukraine	3.01	3.06
UK	5.34	5.41	Spain	3.51	3.54	Switzerland	2.98	2.95
France	5.44	5.20	Indonesia	3.40	3.58	Poland	2.91	2.88
Brazil	4.64	5.41	Turkey	3.41	3.50	Nigeria	2.80	2.87
Japan	4.67	4.81	Egypt	3.40	3.41			

Source: AGEEV et alia 2008: 48–147, or 2009: 46–145.

Russia gains the most in these projections. The projection for Brazil is almost as positive as that for Russia, while India and Iran gain more than China. France is the major loser in the list, while Germany gains about the same. This is unexpected as French demographics are better than those of Germany.

13.37 Virmani 2004 IN

Arvind Virmani (born in 1949) is an Indian economist. He received his PhD in economics from Harvard University in 1975. From 1980 to 1987 he held positions at the World Bank. He was involved in drafting India's liberal economic reforms program from 1991 to 1993 as an advisor to fellow economist and finance minister Manmohan Singh (now prime minister), which fueled the explosion in Indian economic growth that continues to this day. He served as director of the Indian Council for Research on International Economic Relations (ICRIER), an influential New Delhi think tank. From 2007 to 2009 he headed as Chief Adviser the Indian Economic Service (IES) division within the Ministry of Finance. Since 2009 he has been India's representative in the International Monetary Fund (IMF). From December 2004 to November 2005 Virmani, then still director of the ICRIER, wrote five papers (one a lecture) on his idea of how to measure power potential (VIRMANI 2004, 2005b, 2005d, 2005e, 2005g, see also 2005f), four of them directly published in 2006 as chapters in his two-volume *Propelling India: From Socialist Stagnation to Global Power*.

First and foremost an economist, he has been seeking to "ground geopolitical interaction in economic reality" (VIRMANI 2004: i). The inspiration to advance his views in a power formula most likely came from a published lecture given by George Perkovich on 23 April 2003, titled "The Measure of India: What Makes Greatness?" The lecture is primarily concerned with indicators of national power in relation to India's aspiration to major power status (PERKOVICH 2003). A modified version was published as an article in 2004 (PERKOVICH 2004). In the lecture itself he states:

> Power cannot be measured satisfactorily through quantitative indices alone. Measures of raw capability must be balanced with subjective evaluations of a state's effectiveness. (PERKOVICH 2003: 8)[266]

His lecture refers to three approaches to the measurement of power: the CINC (section 13.15), the National Security Index (NSI) (chapter 15),[267] and the Tellis approach to measuring national power (TELLIS et alia 2000a, 2000b; also footnote #129 in section 11.2; compare section 15.4).[268]

[266] The one does not exclude the other. The Worldwide Governance Indicators (WGI) by the World Bank are combined measures consisting of surveys, with government effectiveness being one of those indicators (see KAUFMANN et alia 2009). Perkovich makes governmental efficacy further dependent upon "social factors such as national cohesion and cultural unity" (PERKOVICH 2003: 8).

[267] Actually Perkovich mentions only the Population Index, which is no more than one subindex among five equally weighted subindexes in the NSI 2000. The Population Index multiplied a country's population by its Human Development Index (HDI) coefficient (see section 15.10).

[268] RAND published the two works on the Tellis approach in 2000. Ashley Tellis and colleagues wanted to measure national power, which was divided into three realms: national resources, national performance, and military capability. Each realm consists of numerous variables. The appendix of the more detailed work lists 41 suggested indicators in total (TELLIS et alia 2000a: 179–182). Since then they have produced neither a working formula nor any results. The Tellis approach has a geoeconomic focus by looking for industrial-technological supremacy. Perkovich comments that "while interesting and realistically detailed, this model is explicitly geared toward assessing the capacity of a state to achieve and sustain global hegemony. Assessing the emergence of potential major powers does not seem to require a model as detailed as that proffered by the RAND group" (PERKOVICH 2003: 22).

Virmani pays most attention to the Tellis approach. He considers it unnecessarily complex. He bases the legitimacy of his simple power formula on Occam's razor "to define technological capability in the simplest possible way" (VIRMANI 2005e: 3, or 2005g: 5), which is to measure technological capability by the square root of per capita GDP-PPP. It can be criticized that tourism and natural resources boost per capita values without being related to technology (HÖHN 2008a: 14). The measurement of technology is an unresolved issue. His approach looks convenient enough as a working hypothesis. He estimates "that differences in per capita GDP capture at least 90% of the difference in technological capability" (VIRMANI 2005g: 7).

In the formula he multiplies economic size by technological capability. Economic size is represented by total GDP-PPP. He frequently insists that GDP-PPP is the better measure. Though he states in an article unrelated to his formula that "we measure the incremental impact of an economy on the rest of the World through trade and financial flow, by change in GDP at current exchange rate" (VIRMANI 2005a). As he intends to measure power in terms of international impact rather than comparable living standards, GDP-OER should have been the more logical choice. Instead he condemns as "fallacious" a CIA assessment of India's current and future power on the basis of GDP-OER (VIRMANI 2006).[269] The formula for the Virmani Index of Potential Power (VIP^2) is:

$$VIP^2 = Y \times y^{0.5}$$

or

$$VIP^2 = L \times y^{1.5}$$

VIP^2 = Virmani Index of Potential Power; Y = GDP-PPP; L = population; y = per capita GDP-PPP

Essentially his argument is that if one raises per capita GDP-PPP to the exponent 1.38 (rounded to 1.4 in the first paper, and 1.5 in all the following),[270] then one will arrive at per capita GDP-OER discounting currency fluctuations and other local factors involved in the error term. Recognizing that the balance of power is based on military power, he proposes a supplemental "natural balance of power" based on economic power potential. Countries modify their actual power by military spending, though ultimately economic power constitutes the power base. He assumes that economic and military power have a tendency to converge in the long run. The "natural balance of power" represents what he considers a reasonable equilibrium (compare section 13.10).

In his first paper he advocates the VIP^2 to be used in the United Nations Security Council and General Assembly as a basis for determining voting shares. In all papers he uses projections to predict that the world will become bipolar by 2025 due to the emergence of China, and tripolar by 2050

[269] The general debate remains inconclusive as to whether economic size is best measured by GDP-OER or GDP-PPP. It can be observed that GDP-PPP is the preferred measure in the United States. In Germany it remains GDP-OER.
[270] As for the upper limit the exponent may possibly have, he sets 1.4 as upper limit in the first paper, 1.6 in the second paper, and finally extends it to 2 in the fourth and fifth paper. The lower limit is always 1, which would make the VIP^2 equal GDP-PPP. The upper bound of 2 indicates that he may have actually preferred this value for no other reason than elegant simplicity. Because this would have placed Russia, Brazil, and South Korea above India, he rejected it (see VIRMANI 2005b: 7). When the exponent is set to 2, the VIP^2 becomes identical to the formula by the economist and former CIA analyst Evan Hillebrand (HUGHES & HILLEBRAND 2006: 184). Hillebrand's formula itself is part of the CIA Index (section 13.38).

due to the emergence of India. One of the reasons for his optimism is the underlying assumption of "the existence of a large under-utilised pool (20 mi. to 100 mi.) of free thinking, autonomous working, high IQ people" (VIRMANI 2005b: 25). In contrast, for the population as a whole, IQ tests conducted in India have delivered consistent results of an average IQ ranging from 78 to 82:

Table 62: Adjusted IQ Scores from Tests in India 1959–1992 [Lynn/Vanhanen]

Year	Sample Size	Adjusted IQ British IQ = 100	Age	Regions
1959	5,607	81	9–15	Ahmedabad, Trivandrum, Patna, Allahabad, Uttar Pradesh, Cuttack, Tiru
1968	1,050	80	5–10	Andra Pradesh
1986	748	78	9–12	
1992	569	82	11–15	Delhi

Source: LYNN & VANHANEN 2002: 207–208; for an extended list see LYNN & VANHANEN 2006: 301.

In this context it is suitable to quote Indian Major General Dipankar Banerjee:

> *Let there be no mistake, comprehensive national strength will be determined in future not by the percentage of GDP spent on defence, but the money spent on education at all levels.* (BANERJEE 2005: 3)

In the fourth and fifth paper Virmani develops the Virmani Index of Actual Power (VIP), for which no results were ever calculated.[271] The theoretical formula is:

$$VIP = (VIP^2)^{1-\sigma} \times (K^S)^{\sigma}$$

VIP = Virmani Index of Actual Power; VIP^2 = Virmani Index of Potential Power; K^S = strategic assets

For determining strategic assets, Virmani put forward this formula:

$$K^S_t = \epsilon_t \, E_t \, / \, p_t - \delta \, K^S_{t-1}$$

K^S = strategic assets; ϵ = capability & efficiency; E = expenditure on this technology; p = price; δ = rate of depreciation; t = time

Essentially, this formula posits the hypothetical value of a good minus depreciation. The formula emphasizes that strategic assets are unlike commercially tradable goods. The actual cost of a strategic asset may differ drastically from its hypothetical value, which is the price if it were commercially tradable. The lower the cost is compared to the produced value, the higher the efficiency. In effect this means that one cannot simply take military expenditures to measure strategic assets, since efficiencies are different.[272] Economic assets in the form of the VIP^2 are included in the military oriented VIP formula to account for "complementarities/synergy between economic and military/strategic elements (e.g. investment in strategic technology that has positive spin-off on the civilian economy and vice versa) or substitutability" (VIRMANI 2005g: 8). The following table presents

[271] Virmani uses 0.5 and 0.3 as exponents for sigma (σ) in two examples (VIRMANI 2005g: 9), which may hint at the range he thinks reasonable. Correspondingly the VIP^2 has a weight of 50–70% in these examples.
[272] Variations in efficiencies can be further implied by the fact "that a carrier might cost twenty times as much as a destroyer does not mean that twenty destroyers equal one carrier, in the operational sense" (JONES 1953: 425).

the complete published results, including projections of the VIP^2 in his second paper. Slightly differing results for the VIP^2 are also published in the other papers (VIRMANI 2004: 11, 30, 2005d: 34, 2005e: 17–19, 2005f: 24, 2005g: 30–32):

Table 63: VIP^2 Results and Forecasts 1980–2050 [Virmani]

Country	1980	2000	*2010*	*2020*	*2030*	*2040*	*2050*
United States	**1.00**	**1.00**	***1.00***	***1.00***	***1.00***	***1.00***	***1.00***
China	0.03	0.16	*0.34*	*0.58*	*0.89*	*1.21*	*1.45*
India	0.03	0.06	*0.10*	*0.18*	*0.33*	*0.54*	*0.79*
Japan	0.31	0.29	*0.26*	*0.23*	*0.21*	*0.19*	*0.18*
Germany	0.25	0.19	*0.16*	*0.14*	*0.13*	*0.13*	*0.12*
United Kingdom	0.14	0.13	*0.12*	*0.12*	*0.12*	*0.12*	*0.12*
France	0.17	0.13	*0.13*	*0.12*	*0.11*	*0.11*	*0.11*
South Korea	0.01	0.05	*0.07*	*0.09*	*0.11*	*0.12*	*0.11*
Russia	0.15	0.05	*0.07*	*0.09*	*0.11*	*0.12*	*0.13*
Canada	0.09	0.08	*0.09*	*0.09*	*0.09*	*0.09*	*0.09*
Italy	0.17	0.13	*0.11*	*0.09*	*0.08*	*0.07*	*0.06*
Spain	0.07	0.06	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Australia	0.05	0.05	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Mexico	0.06	0.05	*0.04*	*0.04*	*0.04*	*0.04*	*0.05*
Brazil	0.08	0.06	*0.05*	*0.05*	*0.04*	*0.04*	*0.04*
Indonesia	0.01	0.02	*0.02*	*0.03*	*0.04*	*0.04*	*0.05*
Total	2.62	2.51	*2.68*	*2.97*	*3.42*	*3.94*	*4.42*

Source: VIRMANI 2005b: 34.

Kaushik Basu criticizes the VIP^2 for several reasons (BASU 2008). He states that power is complex and hence the VIP^2 too simplistic. This is a common criticism thrown at single indicator power formulas (compare introduction to chapter 12). He misses the social dimension and suggests looking at the per capita income of the poorest 20%, which could be used in the measurement of national power.[273] Basu puts forward the argument that growing income inequality could decrease political stability. This is a point that Virmani also puts forward regarding China (VIRMANI 2005b: 21). However, China has a higher political stability rating at –0.32 than India at –0.99 in 2008 (KAUFMANN et alia 2009: 84) despite higher income inequality. At a more fundamental level Basu criticizes that "it is not all clear why this close variant of GDP is a measure of power" (BASU 2008: 402).[274]

Harsher still is the critique by Swaminathan Ayar (AYAR 2006), a former India correspondent of *The Economist*. He rejects the whole notion of global powers and regional powers as a leftover from 19th century politics. He focuses on India's inability to attain its regional aims as proof of the inutility of military and economic power nowadays. Ayar goes so far as declaring that being a big country is a disadvantage, because other countries are more likely to resent it. He calls attention to India's inability

[273] This offers interesting perspectives. For example China has a per capita GDP-PPP of $6,757 compared to India's at $3,452. However, if the per capita GDP-PPP of the poorest 20% is compared, China stands at $243 and India at $280. This means India is superior in the social dimension. Data is taken from the *Human Development Report 2007/2008* (UNDP 2007).

[274] The VIP^2-Hillebrand formula seems most useful for applying it to the data set of historical GDP-PPP values ranging from 1 AD to 2008 compiled by Angus Maddison (MADDISON 2010). Because no exchange rate rates exist here, those values indeed appear to neglect the technological dimension.

to cope with the Naxalite-Maoist insurgency.[275] His cynicism culminates in this verdict: "India is an utterly hollow power. This hollowness cannot be disguised by an outer shell of rising GDP, technological prowess and nukes. […] Virmani's measures of power are irrelevant" (AYAR 2006). This critique helps to call attention to the fact that an increase in wealth and international power may not necessarily compensate for a decrease in domestic security (compare JAIN 2007).[276]

13.38 CIA / IFs [2005] US

In 2005 Gregory Treverton and Seth Jones from RAND Corporation published a report on a two-day workshop under the title "Measuring National Power" (TREVERTON & JONES 2005a, or 2005b). Participants in the workshop were mostly from RAND and the CIA's Strategic Assessment Group (SAG), plus Barry B. Hughes. Born in 1945, Hughes did his undergraduate degree in mathematics at Stanford University before taking his master's degree and PhD in political science at the University of Minnesota. He is currently professor of international relations at the University of Denver and director of the Pardee Center for International Futures. He has developed the huge International Futures (IFs) database[277] and uses a large scale integrated global modeling system to explore different scenarios for the future of 182 countries and the international system until the year 2100. Though not mentioned in the report, the nexus between the CIA and the IFs is the former CIA employee and today's geoeconomics professor Evan Hillebrand. Born in 1947, Hillebrand studied economics at the University of California. He did his master's degree in economics at the University of Wisconsin and later got a PhD in economics from George Washington University. From 1972 to 2004 he worked as staff economist for the CIA. From 1998 to 2003 he was chief economist in the SAG. Since 2004 he has been professor of geoeconomic studies at the University of Kentucky.

The report contains information on the discussion that took place within the workshop and the conclusions that were reached. It has only one paragraph on the CIA-SAG assessment of power:

> The main categories of capabilities in the Strategic Assessments Group assessment of power are gross domestic product (GDP), population, defense spending, and a less precise factor capturing innovation in technology. In the SAG estimate, the United States is first but hardly the only power. The United States holds about 20 percent of total global power, and the European Union (EU) (considered as a unified actor) and China about 14 percent each. India holds about 9 percent; Brazil, South Korea, and Russia hold about 2 percent each. Moving toward 2015, the United States will first

[275] It has been estimated that the Naxalite-Maoist insurgency numbers 10,000 to 20,000 insurgents affecting 40% of India's geographical area (*Al Jazeera* 2009; THAPALIYA 2007).
[276] A number of indexes exist on the issues of violence and insecurity (see BANDURA 2008). Virmani is not as blind to the intangible domestic factors as Ayar suggests. However, he sees the greatest challenge and danger for India in the widespread corruption and the parallel deterioration in the quality and capacity of governance. With regard to corruption, he estimates that "80% of 'public servants' [maximize] their own personal interests" (VIRMANI 2002). Still worse for a democracy is the corruption of the legislators in national and state parliaments, because that makes serious reform almost impossible (VIRMANI 2005c). Given this state of uninspiring governance, it is quite understandable that Virmani is a champion of small government. Edward Luttwak, whose geoeconomics promotes industrial policy and thereby government intervention in the economy (section 7.3), would still have no problem with Virmani's view: "Just as there is no successful warfare without effective armed forces, there can be no successful geo-economic action without effective and honest bureaucrats" (LUTTWAK 1993: 313).
[277] The IFs website: http://www.ifs.du.edu/ [16 August 2013].

> gain power, then decline somewhat, ending up at about where it is now. The EU, however, will lose power, as will all non-U.S. members of the G-8. The gainers will be China and India. (TREVERTON & JONES 2005a: 55, or 2005b: ix)

Three of the four variables are more or less straightforward,[278] but "a less precise factor capturing innovation in technology" is the murky one.

Anybody can download the IFs model for free, its easy to use, and its easy to play with the power definition and see the resulting power projections. Because of the general uncertainty over the issue of how to calculate power, the IFs database allows the user to do his own power calculations by giving different weights to nine variables, which are (1) population, (2) GDP at purchasing power, (3) GDP at market prices, (4) economic-technological capability using GDP per capita at purchasing power, (5) economic-technological capability using GDP per capita at exchange rates, (6) government size, (7) military spending, (8) conventional military power, and (9) and nuclear power. As for variables 4 and 5, it is stated that "Evan Hillebrand suggested that economic-technological capability, as indicated by the product of GDP and GDP per capita, should be a core component of capabilities" (HUGHES 2009: [Policy Equations Power]).[279] Hillebrand's formula can be put this way:

$$\text{TechPower} = \text{GDP} \times \text{GDPPC}$$

or

$$\text{TechPower} = \text{population} \times \text{GDPPC}^2$$

TechPower = economic-technological capability; GDPPC = GDP per capita

The basic question behind the formula can be summed up this way: Does a country have the capacity to build and operate the high tech systems that are necessary for modern warfare and a modern economy? If one just looks at GDP and population, one does not get a fair idea of the power balance between Egypt and Israel, say, or the United States and China. If one just looks at GDP per capita, Luxembourg seems like a very powerful state. The measure is not perfect, but it gets at the concept of technological "capacity" with easily available data.[280]

The pieces of the puzzle seem to come together when one looks at one of the "packaged displays" in the IFs program. These packaged displays have already predesignated sets of data, and in the category "power" one finds nine such packaged displays. Choosing the packaged display "power component weightings" in table format, one receives these weightings:

[278] Though it is not spelled out whether GDP is used at purchasing power parity or at official exchange rate (OER), the common American preference seems to be that for PPP. The *CIA Factbook* had only PPP until 2005. These days they have both GDP-PPP and GDP-OER.

[279] In 2006 Hughes and Hillebrand published together *Exploring and Shaping International Futures* on the IFs. The book contains two sentences to the same effect: "Finally, the contemporary environment is one in which technological capability, including that outside of the military sector, is more important than ever. IFs uses a proxy for technological capability based on GDP per capita times GDP (originally suggested by Evan Hillebrand, with base-weightings in collaboration with Paul Herman)" (HUGHES & HILLEBRAND 2006: 184).

[280] Another line of argument supporting the formula is that of the disposable surplus. It refers to the idea that a basic amount of income is needed for subsistence, and only the amount in surplus above subsistence can actually be used by the state for whatever purpose (KAHN & WIENER 1967: 131–132; further KNORR 1956: 231–232, 1970: 47–48). Hillebrand's squaring GDP per capita may put more weight on this disposable surplus by favoring high GDP per capita farther away from mere subsistence.

Table 64: Power Component Weightings [IFs]

Component	Weight	Percentage
Population	0.8	26%
GDP-PPP	1.1	35%
GDP-PPP × GDP-PPP per capita	0.3	10%
Military Spending	0.9	29%
Hard Power Capabilities	3.1	100%

Source: HUGHES 2009: [Power Component Weightings].

Exactly the same three straightforward variables of the CIA index can be found here, and for "a less precise factor capturing innovation in technology" Hillebrand's measure of "economic-technological capability" is the perfect fit.[281] Given that he spent thirty years at the CIA and is close enough to Hughes to a write a book with him on the IFs, it is not too far-fetched to conjecture that the packaged displays on "power" are related to the CIA index mentioned in the paper by Treverton and Jones. The following table compares the results in the paper by Treverton and Jones with those that can be found in one of the packaged displays in Hughes' IFs:

Table 65: Comparison of Information Sources [CIA/IFs]

Country	Treverton/Jones	Hughes values for 2005
United States	20%	22.960%
European Union	14%	20.400%
China	14%	10.990%
India	9%	7.381%
Russia	2%	3.114%
Brazil	2%	2.320%
South Korea	2%	1.563%

Source: TREVERTON & JONES 2005a: 55, 2005b: ix; HUGHES 2009: [Power of States Over One Percent Power].

These results have a coefficient of determination (r^2) of 0.886. Given that the data is constantly revised, that weightings may have been changing, that no information exists when and for what year the rough values reported by Treverton and Jones were calculated, that the CIA calculations were probably based on past/present data, whereas the 2005 values in the IFs calculation already represent a forecast, some divergence could be expected. Those two indexes are simple variations of the same index possibly applying different weights for different years. Their similarities are not incidental. Neither were the conclusions of the two-day workshop:

> The presentations, breakout group sessions, and discussions led to several possible next steps for RAND, the Strategic Assessments Group, and the International Futures model:
>
> • Strengthen the International Futures data set by adding relevant variables.

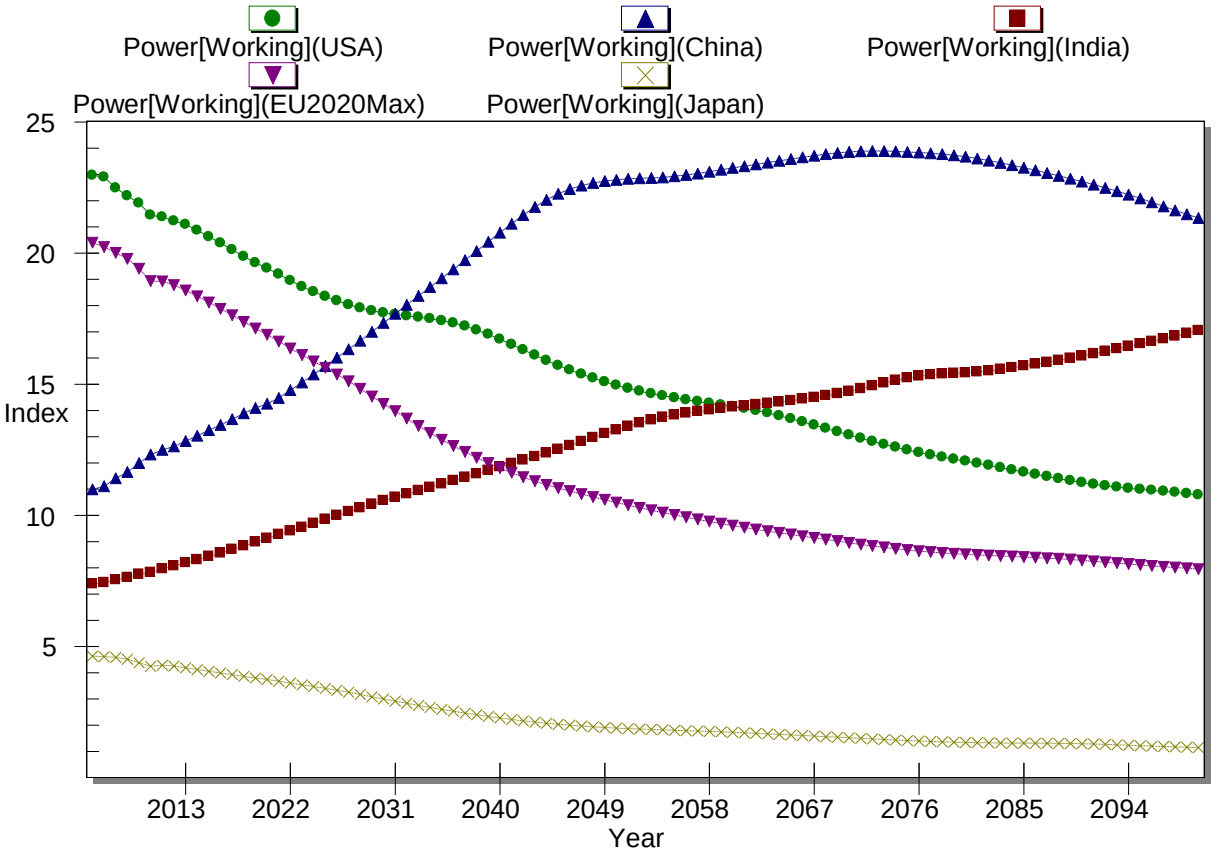
[281] Hillebrand himself revealed his momentary preferences in a 2008 conference paper, for which he applied the following weights for the IFs' calculation of power: 0.25 for GDP in 1995 purchasing power parity dollars, 0.25 for GDP in nominal dollars, 0.125 for population, 0.25 for military spending in constant dollars, 0.062 for nuclear weapons, and 0.062 for technological sophistication (HILLEBRAND 2008: 23). He does not indicate whether technological sophistication is measured via PPP or OER. Note that he gives "economic-technological capability" (the last one) a rather low weight.

- Improve the formulation for forecasting power.
- Enhance the model foundations for forecasting power.
- Develop scenarios.

(TREVERTON & JONES 2005b: 19)

The following chart depicts the IFs forecast on the power of the leading actors. More results can be found in the packaged displays in the IFs software providing forecasts for 24 countries covering the time period 2005−2100:

Figure 11: Power of Leading Actors 2005−2100 [IFs Projection]



Source: HUGHES 2009: [Power of Leading Actors].

The model puts a lot of faith in the sustainability of Indian growth (compare sections 13.37, 13.42).[282] On the other hand, it must be admitted that India excels in governance, that is, its governance is much better than could be predicted by its level of economic development.[283]

[282] As for sustained growth in general, a note of caution: "Over a decade ago four economists published a paper that shocked development optimists. They found that a high average growth in one decade was no guarantee that a country would grow at a relatively high rate in the next decade. Inter decadal growth was almost uncorrelated (0.15)! The average country had episodes of high growth and then reverted back towards the mean" (VIRMANI 2007). The mentioned paper was an article published in 1993. The conclusive remark of the article is: "Just as a baseball star is dubbed a clutch hitter after a lucky hit, some so-called economic miracles are likely due to random variation" (EASTERLY et alia 1993: 481).

[283] For this one can take the GDP per capita data (http://databank.worldbank.org/ddp/home.do [16 August 2013]) for economic development and convert it into z-scores. For governance one can use the Worldwide Governance Indicators (WGI) (http://info.worldbank.org/governance/wgi/pdf/wgidataset.xlsx [16 August 2013]). The WGI are already given as z-scores.

13.39 Gonçalves 2005 BR

Reinaldo Gonçalves is professor of international economics at the Institute of Economics of the Federal University of Rio de Janeiro. In 2005 he published *International Political Economy: Theoretical Foundations and International Relations of Brazil* [*Economia Política Internacional: Fundamentos Teóricos e as Relações Internacionais do Brasil*] (GONÇALVES 2005a). The same year he published the article "Poder potencial, vulnerabilidade externa e hiato de poder do Brasil" based on chapter 5 of the book (GONÇALVES 2005b). A more detailed profile description of the formulas in his work has already been provided by Nathalie Serrão (SERRÃO 2010: 36–38). No detailed one is provided here. Gonçalves developed four formulas:

```
IVE = ( IVCO + IVPT + IVMF ) / 3

IPP = ( IDT + IDP + IDVP ) / 3

IPE = 100 - IVE

IHP = 100 × IPP / IPE - 100

IVE = External Vulnerability Index; IPP = Power Potential Index;
IPE = Effective Power Index; IHP = Power Gap Index; IVCO = Commercial
Vulnerability Index; IVPT = Productive-Technological Vulnerability Index;
IVMF = Monetary-Financial Vulnerability Index; IDT = Territorial Size
Performance Index; IDP = Population Performance Index; IDVP = Production Value
Performance Index
```

The first formula calculates a vulnerability index. The second formula calculates a power index. The third formula calculates a power index via a vulnerability index. The fourth one calculates the gap between power and vulnerability. The following table presents the top ten countries in terms of calculated power gap. In both the article and the book, scores are available for 113 countries:

Table 66: Top Ten in Power Gap Index in 2005 [Gonçalves]

Country	Power Potential Index	External Vulnerability Index	Effective Power Index	Power Gap Index
Brazil	80.8	49.1	50.9	58.7
Zambia	40.9	69.7	30.3	34.8
Argentina	65.3	49.1	50.9	28.3
China	95.9	24.4	75.6	26.8
Russia	81.9	31.1	68.4	19.8
Sudan	57.6	51.4	48.6	18.5
Turkey	64.5	45.0	55.0	17.3
United States	91.1	22.0	78.0	16.8
Pakistan	66.4	42.8	57.2	16.1
Indonesia	74.1	34.5	65.5	13.2

Source: GONÇALVES 2005b: 125–126.

Brazil has great power potential but also great external vulnerability. Gonçalves suggests reducing the external vulnerability (GONÇALVES 2005b: 114–115). This suggestion appears at least in part to be somewhat in the tradition of Marxist dependencia theory (see footnote #190 in section 13.11).

13.40 GlobalFirePower.com 2005 US

The domain GLOBALFIREPOWER.COM was established 28 June 2005 and is registered to a post office box in Vancouver, Washington. The site generates a lot of traffic, receiving well over 100,000 visits per month, which may generate a modest amount of ads revenue. The website is not often updated. The website features the World Military Strength Ranking, which "is based on an in-house formula used to generate an average of all applicable statistics found on this website" (GlobalFirePower.com 2010). As far as can be traced from the Internet Archive,[284] the index has been revised at least seven times, the first six times in 2006 and then once in 2009.

Though purportedly a military index, its composition enables one to consider it a power index in the broader sense because many nonmilitary variables are included. As for the original index from November 2005, the following elaboration was added in February 2006 regarding its composition:

> Key factors that are used to rank the countries on this list include, but are not limited to: Present and proven nuclear capabilities, present global alliances, overall military manpower, available military technology, active space programs, modernization, overseas maintenance, economic indicators, historical assessments, military build up, localized insurgencies, recent combat action, natural resources, manufacturing capabilities and current border disputes. (GlobalFirePower.com 2006a)

From April to September 2006 at least six revisions took place. In the end it was stated that "nuclear weapons, past and current military experience, unit training and equipment quality are not taken into account" (GlobalFirePower.com 2006b). 25 variables were grouped into five categories by the end of 2006. Those were extended to 33 variables in six categories in 2009, which the following table presents. Nonmilitary variables are emphasized by italics:

Table 67: Major Categories of World Military Strength in 2009 [globalfirepower.org]

Personnel	Systems	Logistics	Oil	Geographic	Finance
Total Populations	Airborne Systems	*Airports*	*Oil Production*	*Coastline*	Defense Spending
Military Manpower	Helicopters	*Merchant Marine*	*Oil Consumption*	*Waterways*	*Purchasing Power*
Active Military	Land Systems	*Ports / Terminals*	*Proven Oil Reserves*	*Sq. Land Area*	*Reserves*
Active Reserve	Towed Artillery	*Roadways*			
Fit for Service	Navy Ships	*Railways*			
Military Age	Aircraft Carriers				
Paramilitary	Submarines				

[284] Website: http://web.archive.org [16 August 2013].

Labor Forces	Destroyers			
	Frigates			
	Mine Warfare			
	Patrol Craft			

Source: GlobalFirePower.com 2010.

It is not revealed how these variables are combined, nor what theoretical assumptions go into the index. The following table presents the complete published results from four of the seven available rankings:

Table 68: World Military Strength Rankings 2005–2009 [globalfirepower.org]

Country	November 2005	April 2006	September 2006	May 2009	Country	November 2005	April 2006	September 2006	May 2009
United States	1	1	1	1	Saudi Arabia	15	15	22	24
China	2	2	3	2	Australia	21	24	21	26
Russia	3	3	2	2	Greece	11	18	27	22
India	5	5	4	4	Sweden			25	21
Germany	9	7	5	7	Taiwan	21	25	28	16
France	11	6	6	6	Thailand			23	28
Great Britain	5	10	10	5	Syria	17	21	29	34
Turkey	17	4	8	10	Argentina		28	24	33
Japan	17	9	7	9	Denmark				29
Italy	11	11	11	13	Poland			31	30
South Korea	11	8	12	12	Ukraine			32	25
Brazil	25	16	9	8	Philippines		31	30	31
Iran	7	17	16	18	Iraq		26	34	37
Indonesia	24	23	13	14	South Africa				32
North Korea	8	13	18	20	Venezuela		30	36	38
Canada	17	22	15	23	Norway			33	35
Pakistan	4	19	20	15	Libya		29	35	39
Egypt	21	14	17	17	Afghanistan		32	39	40
Spain	15	20	19	27	Georgia				36
Israel	9	12	26	11	Nepal		33	38	41
Mexico		27	14	19	Lebanon			37	42

Source: GlobalFirePower.com 2005, 2006a, 2006b, 2010.

Some huge fluctuations can be observed for a number of countries, notably Brazil, Israel, Pakistan, Greece, Turkey, North Korea, Iran, and Japan. North Korea and Israel are special cases, so major fluctuations can be expected whenever variables and weights are changed. The rest are not that special, so doubts on the quality of the assessment are appropriate. In particular the first assessment attracted much criticism in various internet forums for the unrealistically high ranking of Pakistan. The subsequent revisions should be seen as attempts to deliver more credible numbers, though in the brief website description the claim for accuracy has now been explicitly abandoned. The rankings are presented as being "still entertaining to consider" (GlobalFirePower.com 2010).

13.41 Zarghani / [Hafeznia] 2006 IR

Sayed Hadi Zarghani is an Iranian political geographer. In 2007 he got his PhD in political geography at Tarbiat Modares University in Tehran.[285] The English translation of the title of his dissertation is *The Evaluation of the Variables Effective on National Power and the Designing of a Model for the Measurement of the National Power of Countries*. His PhD supervisor was Mohammad Reza Hafeznia (born in 1955), who is Iran's leading political geographer and the founder of the Iranian Association of Geopolitics [رانی‌ک ای‌تی‌انجمن ژئوپل]. Zarghani is now assistant professor of political geography at Ferdowsi University.

In 2008 Zarghani, Hafeznia, together with Zahra Ahmadipor and Abdelreza Roknoddin Eftekhari, who also work at Tarbiat Modares University, published an article in English called "Presentation [sic] a New Model to Measure National Power of the Countries" (HAFEZNIA et alia 2008) that appears to have been based in parts on the 2006 article "Model Assessment of National Power" ["طراحي مدل سنجش قدرت ملي كشورها"] (HAFEZNIA et alia 2006). Zarghani and colleagues have also written other articles on national power in Farsi. In 2010 Zarghani published *An Introduction to National Power: Principles, Functions, Calculation and Measurement* [ی؛ مبانی‌بر قدرت مل یامقدمه، کارکردها، محاسبه و سنجش]. The same year he also published *Measurement of National Power: Definitions, Functions, Measurement* as the English translation of his book (ZARGHANI 2010).

The 2008 article starts by asserting that the "new model […] is much better than previous models" (HAFEZNIA et alia 2008: 230). Zarghani has studied a number of power formulas, including those of Clifford German (section 13.5), Norman Alcock and Alan Newcombe (section 13.14), the CINC (section 13.15), and Wayne Ferris (section 13.17). He writes that he analyzed 28 different theories on the elements of national power, most of these theories being power inventories (lists of elements of power) or suggestions at single-indicator approaches (just as ubiquitous). In looking at past formulas and power inventories, he summarizes his criticisms as follows:

- Limited number of variables used in the models
- Lack of stability in the model based on variable variety and emphasizing on one certain power aspect
- Lack of proportion in the used variables with the strategically conformed variables in the current time
- The effect of opinions and personal viewpoints of the designer on the model (emphasis of economists on economical variables, military Strategists on military variables, geographers on natural variables)
- Using some qualitative variables without presenting methods to use them quantitatively

[285] In 1987 Tarbiat Modares University started accepting the first PhD students for political geography. This program became the focal point for the now growing community of geopolitical scholars in Iran. A concise history of geopolitics in Iran can be found in Farsi on *Wikipedia*: http://fa.wikipedia.org/wiki/یاسی‌س ای‌ای‌جغراف [16 August 2013].

• Emphasis in using variables with positive role in power and not paying attention to variables with a negative role

• Lack of global data about all variables and states

(HAFEZNIA et alia 2006: 231–232)

He writes that he collected data on 280 variables for 140 countries (which makes for 39,200 data points). The most work usually goes into filling the numerous gaps in such a large body of diverse data. For that reason 130 out of 280 variables were then excluded, with 150 variables remaining (still 21,000 data points).

In his 2006 work *Principles and Concepts of Geopolitics* [کـیـتـیـم ژئوپـــلـیـاصـول و مفـاه], Hafeznia had already done the basic theoretical work of identifying nine factors that make up national power: (1) economical, (2) territorial, (3) political, (4) scientific and technological, (5) social, (6) cultural, (7) military, (8) astro-space, and (9) transnational (HAFEZNIA 2006: 161). Experts for each of these nine factors were asked to rate the importance of variables. Based on these evaluations and some sort of factor analysis, 64 variables were excluded as being of minor significance, with 86 variables remaining.[286] Four methods are used to standardize scores: (a) The method of proportional percentage simply divides the value of one country by the world total; (b) The Morris' index method, which is used in the Human Development Index (HDI), is that:

```
dimension_index = ( actual_value – minimum_value )
                                / (maximum_value – minimum_value)
```

(c) The intentional method, where the value of one country is set as the base, and the values of other countries are divided by that; (d) Using the indexes' own numbers as scores, which means that the values of a variable, which is some index, are directly taken without further standardization.[287]

The weights of the selected variables in each factor are of equal magnitude. Nine variables are given a negative weight (for example "under-five mortality rate per 1000 population"), which means that the higher a country scores on such a variable, the worse it stands in the final averaging of scores, as these scores are subtracted rather than added. The results for each factor subindex are standardized again giving 100 to the country with the highest score (Delphi method). In the end all nine factors are given equal weight when averaged for the final index. The following table lists the nine factors and the number of variables used to calculate each:

[286] In the 2008 article Zarghani writes that he sorted out 63 variables, with 87 variables remaining. If one counts the number of variables presented in the 2008 article, one arrives at 86. Zarghani writes that "the Astro-space factor has 4 variables" yet lists only three (see HAFEZNIA et alia 2008: 237).
[287] For examples of the four methods, see HAFEZNIA et alia 2006: 234.

Table 69: Factors to Measure National Power [Zarghani]

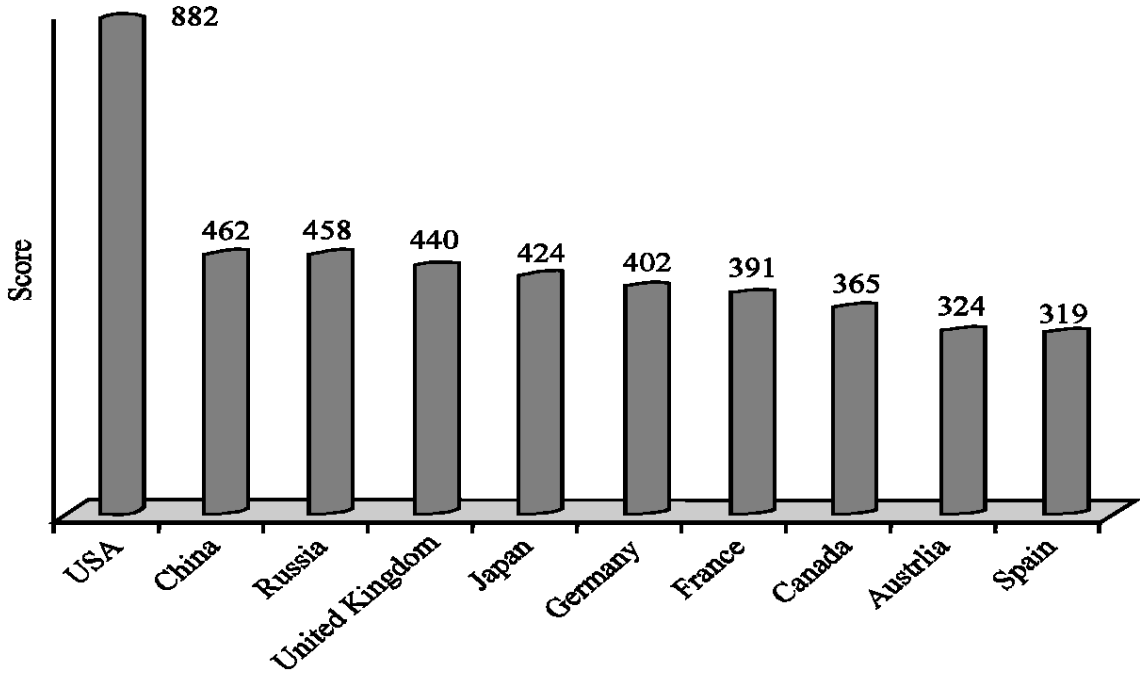
Factors	Variables
Scientific & Technological	12
Economical	11
Social	11
Territorial	11
Cultural	10
Political	10
Transnational	10
Astro-Space	3
Military	8
National Power	86

Source: HAFEZNIA et alia 2008: 235–238.

The calculations then were an addition of variables on an aggregate basis, per capita basis, and other ratios and rates with no attention paid to ensuring dimensional consistency (see section 16.3 for discussion). The end results are not on a ratio scale. It could be argued that the use of four different standardization methods in a way defies the very idea of standardization. Ideally one wants to make values comparable based on applying one and the same standard for all. The method is unique for determining which variables to use and which to abandon. Nevertheless, a general survey on power perception with multiple regression analysis may have delivered more accurate weights to apply to variables (and by extension categories) (compare sections 13.33, 16.7). The following diagram presents the top ten results of the index. The maximum possible score is 1000. Results were calculated for at least 32 other countries as well, though for these countries only score ranges are given in the 2008 article:[288]

[288] The following score ranges list the following countries: 500–1000: USA; 400–500: China, Russia, United Kingdom, Japan, Germany, France; 200–400: Canada, Spain, Italy, Sweden, Norway, Switzerland, India, Iran, Brazil, South Korea; 100–200: Thailand, Ukraine, Malaysia, Romania, South Africa, Egypt, Kazakhstan, Saudi Arabia, Morocco; 0–100: Syria, Libya, Iraq, Yemen, Qatar, Turkmenistan, Niger, Chad, Mali, Central African Republic, Lesotho, Liberia, Mauritania, Sierra Leone, Eritrea (HAFEZNIA et alia 2008: 239, also 2006: 71). Note that France is given a score of 391 but listed in the 400–500 score range. Australia is not mentioned at all in these score ranges (though included in the diagram).

Figure 12: Top Ten Powers in 2005 [Zarghani]



Source: HAFEZNIA et alia 2008: 238

Mirosław Sułek notes that neither India nor Brazil are included in the top ten. He finds the idea of Canada, Australia, and Spain being placed above India rather unconvincing and sees in these results the limitations of the method employed (SUŁEK 2010b: 141).

13.42 Höhn 2006 DE

I initially developed my power index in 2006. During that time I was active as a human rights activist for the Tajik NGO Social Institute "Youth & Civilization" and conducted a socio-cultural survey for German Agro Action [Welthungerhilfe] in Tajikistan, where I observed a high level of corruption as well as a relatively good infrastructure for such a poor country, the latter being a remnant from the days of the Soviet Union. These observations flowed into the index in integrating variables like integrity (defined as the reciprocal of corruption) and life expectancy that are of greatest importance to developing countries. Ashley Tellis commented on power formulas that "the similarity of findings is greatest for the developed world and least for the developing world—an outcome generally attributed to analysts' greater interest in and familiarity with the great powers as opposed to the underdeveloped countries" (TELLIS et alia 2000b: 3; compare TABER 1989; also section 1.3). I would argue that a third world perspective is most helpful for creating a holistic paradigm.

There were three challenges in developing the formula. First, there was the challenge of weighing the selected variables. Some preliminary experimenting was done on this issue but did not reach a satisfactory stage (HÖHN 2008a: 21). In the end the weighting was arbitrary. The following variables with their respective weights were used in the 2006 and 2008 indexes:

Table 70: Variables and Weights [Höhn]

Variables	Weights	
	2006	2008
Socio-Economic Body	33.33%	25.00%
Nominal GDP	8.33%	6.25%
Life Expectancy	8.33%	6.25%
Education/Intelligence	8.33%	6.25%
Integrity	8.33%	6.25%
Energy Production	16.67%	25.00%
Military Variables	33.33%	25.00%
Military Expenditures	16.67%	12.50%
Arms Production	16.67%	12.50%
Nuclear Weapons Capability	16.67%	25.00%
Total	100.00%	100.00%

Source: HÖHN 2006: 1, 2008a: 13.

Military expenditures and arms production are taken as ratios of GDP and then multiplied by all socio-economic variables, so that in effect the socio-economic body is the base for 66.67% of the 2006 index and 50% of the 2008 index.

Second, there was the challenge of converting index values from an interval scale like that of corruption into ratio scale values useful for aggregation into country totals. This applies even to real world values like life expectancy, which to a certain extent display a quasi-logarithmic quality.[289] The pleasant feature of the 2008 index is that the worldwide arithmetic averages of per capita nominal GDP and the transformed variables are equal whether they are viewed on an absolute or logarithmic scale. The following table shows what converted values for some countries looked like:

Table 71: Standardized Per Capita Values of Socio-Economic Body [Höhn]

Country	Nominal GDP	Life Expectancy	Education Intelligence	Integrity
Japan	38,318	53,054	17,245	35,568
United Kingdom	38,618	23,011	11,525	72,194
France	33,608	36,100	8,768	29,652
Germany	34,890	24,494	7,730	45,172
United States	43,667	19,318	8,574	27,352
China	2,052	5,381	22,509	1,776
Brazil	5,089	4,523	1,040	1,844
Russia	5,189	910	7,730	719
India	713	1,805	696	1,788

Source: HÖHN 2008a: 19.

[289] This problem was initially solved by transforming values to have the same standard deviation of their logarithms as that of per capita nominal GDP, with the impact of nations on the calculation weighted according to the number of individuals. In other words, the z-scores based on individuals rather than nations were used to make to make these index and quasi-index values equivalent to per capita nominal GDP. This way each nation had a weight corresponding to its population size. In 2008 the method changed. The average converted absolute values remained equal to the average absolute values of per capita nominal GDP, but the index and quasi-index values were transformed in such a way that the average logarithm of converted values is equal to the average logarithm of per capita GDP. Again each nation had a weight corresponding to its population size, calculating averages per person. The idea for 2008 was to preserve the geometric relations of per capita nominal GDP to which other index and quasi-index values were standardized.

The values are based on the equal sum totals for each variable for the world. As one can see, values have been made comparable on a per capita nominal GDP basis.[290]

Third, there was the challenge of finding a formulaic way to integrate the variables. The principal theory was that a country is stronger when its resources are balanced across many sectors rather than concentrated in a few sectors. The underlying theoretical assumption for my formula was that power should be treated as a holistic phenomenon. Gerhard Groessing writes:

> In general, holistic phenomena cannot be described by linear, monocausal reasoning. Rather, whichever element on some particular level is chosen for investigation, it must be considered in its context involving other levels, with circularly causal relations between them. (GROESSING 2000: 2).

There are usually two basic ways of integrating variables, one is addition, the other is multiplication. Addition is rather insensitive to small values in various sectors, thus lopsided countries benefit from that. Multiplication is overly sensitive to the small values in various sectors, thus if a country scores zero in one sector, it will score zero in total. A great deal of mental effort had been put into coming up with something in between addition and multiplication. The solution has been the Laakso-Taagepera effective number of components, which is the reciprocal to what is known as the Herfindahl-Hirschman concentration index (TAAGEPERA 2002: 4–5). The formula for the Laakso-Taagepera effective number of components is this:

$$N = (\Sigma S)^2 / \Sigma (S_i^2) = 1 / \Sigma (s_i^2)$$

N = number of effective components; S = total size; S_i = size of the i-th component, $s_i = S_i / S$

For my formula the percentage values of world totals across various variables were added together according to their respective weights and then divided by the comprehensive concentration value that is also based on the same weights. For the 2006 index values had simply been added according to the weights of variables. For the 2008 index this formula was then used:

$$\begin{aligned}ISP = {} & (0.0625\ \$GDP + 0.0625\ LE + 0.0625\ INT + 0.0625\ EDU + 0.25\ EP + 0.03125\ ME\% \times \$GDP + 0.03125\ ME\% \times LE + 0.03125\ ME\% \times INT \\ & + 0.03125\ ME\% \times EDU + 0.03125\ AP\% \times \$GDP + 0.03125\ AP\% \times LE + 0.03125\ AP\% \times INT + 0.03125\ AP\% \times EDU + 0.125\ NWC + 0.125\ NW\#) \\ & / (0.0625\ \$GDP_i^2 + 0.0625\ LE_i^2 + 0.0625\ INT_i^2 + 0.0625\ EDU_i^2 + 0.25\ EP_i^2 + 0.03125\ (ME\% \times \$GDP)_i^2 + 0.03125\ (ME\% \times LE)_i^2 + \\ & 0.03125\ (ME\% \times INT)_i^2 + 0.03125\ (ME\% \times EDU)_i^2 + 0.03125\ (AP\% \times\end{aligned}$$

[290] For example, if in one country like Japan people live on average 82.02 years and in another like India 68.59 years, it follows that the development in the former country is much higher than of the latter and that not merely by a factor of 1.2 as the direct numbers relate to. Therefore life expectancy has to be recalculated. 82.02 years of average life expectancy can be quantified to resemble a per capita nominal GDP of $53,054, and 68.59 years of average life expectancy resemble a per capita nominal GDP of $1,805, with the result being a factor of 29. In comparison, the real nominal GDP for Japan is $38,318 and India $713 with a factor of 54 (HÖHN 2008a: 16).

$GDP)_i^2 + 0.03125 (AP% \times LE)_i^2 + 0.03125 (AP% \times INT)_i^2 + 0.03125 (AP% \times EDU)_i^2 + 0.125 NWC_i^2 + 0.125 NW\#_i^2)$

ISP = integrated state power; $GDP = nominal GDP; LE = life expectancy equivalent; INT = integrity equivalent; EDU = education equivalent; EP = energy production; ME% = military expenditures as percentage of GDP; AP% = arms production as percentage of GDP; NWC = nuclear weapons capability (dummy variable); NW# = number of nuclear warheads; $_i$ = percentile

The formula increases the power of well-balanced countries over lopsided countries.

Given that different weights and calculation methods formulas are used for the 2006 index and 2008 index, values are not comparable as to time. Rather the 2008 index was intended as an updated improvement of the 2006 index. The following table presents results for 25 countries. Results are available for 194 countries in 2006 and 197 in 2008 (HÖHN 2006: 2–5, 2008a: 23–27):

Table 72: Index of Integrated State Power for 2006 & 2008 [Höhn]

Country	2006	2008
United States	12,286,044,111,368	15,560,391,352,857
China	6,530,741,806,142	7,274,136,279,455
Russia	3,357,639,438,583	3,705,139,438,227
United Kingdom	2,160,990,706,281	2,644,074,492,416
France	1,816,690,920,600	2,267,323,575,136
India	1,067,193,599,226	1,624,570,464,134
Japan	1,664,017,921,541	1,191,697,578,762
Canada	817,502,227,863	1,090,645,086,689
Germany	1,294,564,950,081	894,295,443,562
Australia	613,604,812,472	678,992,572,822
Saudi Arabia	541,690,935,012	544,039,081,355
Brazil	370,078,141,967	477,393,399,548
South Korea	418,516,480,674	382,058,307,230
Indonesia	403,267,363,247	380,207,527,433
Mexico	394,670,246,055	371,458,319,734
Israel	554,171,028,630	340,992,265,172
North Korea	545,535,737,208	331,277,804,664
Norway	297,160,257,576	329,806,347,252
Italy	457,938,513,551	313,236,028,852
Pakistan	379,874,207,489	276,728,333,157
Iran	293,621,121,019	270,309,795,500
Netherlands	326,640,430,334	270,210,944,799
Poland	196,869,453,643	264,299,819,568
Spain	365,615,003,722	259,818,200,597
Sweden	295,275,475,418	207,454,377,541

Source: HÖHN 2006: 2–5, 2008a: 18.

The power of Israel and North Korea is extremely lopsided towards their military sectors. Accordingly, their values have been sharply reduced as a result of the modification of the calculation method.

In discussing a number of methods for forecasting, Mirosław Sułek finds the approach for the construction of my formula, which was an analogy between human and state (HÖHN 2008a: 11),[291] "worthy of [interesting] discussion," though he is skeptical concerning integrity as a variable because of the difference between image and reality. He has doubts on education/intelligence as a variable too (SUŁEK 2010b: 56). Greek economist Panagiotis Petrakis has developed an interest both in my power index and in the subindex of concentration that is part of the formula. He notes that the power of the United States is more balanced than that of China, and, further, that Greece and the Scandinavian countries exhibit a low degree of balance (PETRAKIS 2010: 44–50; see HÖHN 2008a: 23–27).

13.43 McCool / Gerth / Ferguson 2007 US / UK

Making History: The Calm & The Storm is a computer game released in March 2007 by Muzzy Lane, a company founded in 2002 that develops computer games. Their principal product is the *Making History* series. Dave McCool has been the producer and Ralph Gerth the principal designer of the game series. The initial *Making History: The Calm & The Storm* is a WWII grand strategy computer game covering the time period 1936–1945. One can choose to start with different scenarios: 1936, 1939, 1941, and 1944. A special edition for teachers with special features for classroom use also included a scenario for 1938. The game has been used in the world history curriculum of at least 150 schools. The *Gold Edition* scenario was released in July 2008 and integrated the teacher's edition with its 1938 scenario as well as adding a new scenario for 1933. In June 2010 Muzzy Lane released *Making History II: The War of the World*.

For the entire series the designers from Muzzy Lane consulted Niall Ferguson, a British historian (born in 1964) who specializes in financial and economic history. He is also a champion of counterfactual history, which explores alternative historical developments that might have happened in the absence or presence of certain historical key events.[292] Given that a strategy game puts the player in charge of events, one can understand what interest Ferguson may have in the game.[293] Though games are made for the enjoyment of the computer player, they can nevertheless serve as simulation models for counterfactual history as well. Moreover, Ferguson has expressed an interest in what

[291] The 2 × 2 dimensional paradigm for humans:

human	qualitative	quantitative
mental	*character*	*intelligence*
physical	*health*	*wealth*

The analogous 2 × 2 dimensional paradigm for the state:

state	qualitative	quantitative
mental	*integrity = lack of corruption*	*educational level*
physical	*life expectancy*	*economic level*

[292] Ferguson's positions are not uncontroversial. He thinks that it might have been better for the United Kingdom to have stayed out of WWI and let Germany win. His thought-provoking ideas on WWI he published in *The Pity of War: Explaining World War One* in 1998. In the book he also portrays a counterfactual scenario about what might have happened if Germany had won.
[293] Geographical proximity has also helped. Muzzy Lane is located in Massachusetts, and Ferguson is a professor at Harvard University, which makes regular meetings possible.

constitutes national power, publishing in 2003 the short article "What is Power?" (FERGUSON 2003), which has been widely cited.

In his 2001 book *The Cash Nexus: Money and Power in the Modern World, 1700–2000* he takes on economic determinism in the form of three common hypotheses, the third one being that "economic growth is the key to international power (but too much power can lead to economic decline)" (FERGUSON 2001: 10). This theory, known as *overstretch*, was advocated by British historian Paul Kennedy in his 1987 work *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000* (KENNEDY 1987).[294] Ferguson admits that "the causal connections between the economic and political world do exist; but they are so complex and so numerous that any attempt to reduce them to a model with reliable predictive power seems doomed to failure" (FERGUSON 2001: 20). This statement is not just important in response to Kennedy. It also indicates that even as he may support speculative modeling such as found in *Making History*, he is not convinced that these models can in any way predict what might have been. That is, counterfactuals are at best suggestions providing food for thought in exploring historical processes.

Ferguson notes in his book that whereas power in physics is measured in watts, power in history can be measured in many different units. He recalls the German historian Leopold von Ranke (1795–1886) in stating that every epoch has to be understood on its own terms. He emphasizes that a country's superiority in the organizational quality of the military and government may more than compensate for the economic superiority of its enemy, and that *understretch* may be just as dangerous as overstretch. To summarize, even as he recounts the history of finance with its important connections to power, he firmly rejects a purely materialist interpretation of power. In his 2003 article he unequivocally states that the psychological is the final dimension of power.

Nevertheless the power formula used in *Making History* is materialist.[295] With finance being one component, the formula for the world power scores of countries is:

```
world_power_score = MPU + IPU + resources +/- financial

MPU = manpower = number of workers; IPU = industrial production;
resources = production of coal, metals, oil; financial = debt/excess as a
result of budget deficits/surpluses
```

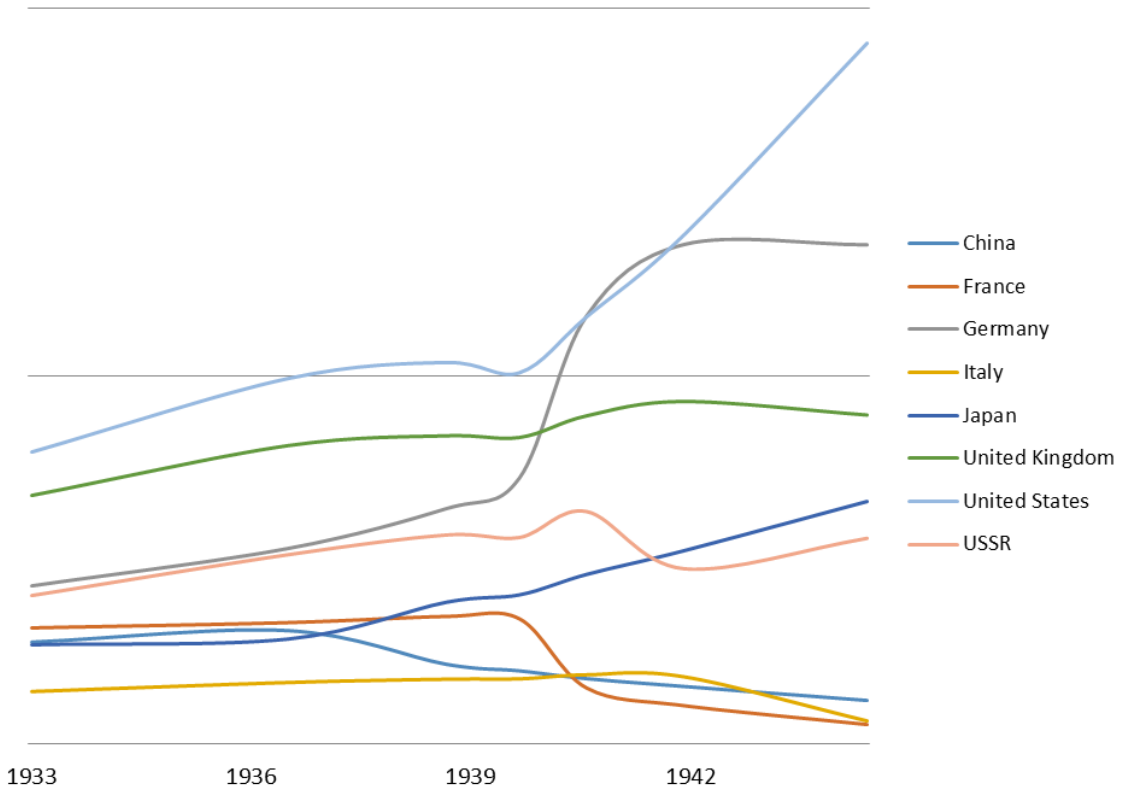
Finance tends to have a negligible impact on world power scores, whereas the effective weight for manpower is about 42%, for industry about 50%, and for resources about 8%. This is one more indicator of how the financial model of the game may seem underdeveloped. As most similar computer strategy games can live without a financial model (which, of course, does not imply the absence of an

[294] Paul Kennedy writes that "Great Powers in relative decline instinctively respond by spending more on 'security,' and thereby divert potential resources from 'investment' and compound their long-term dilemmas" (KENNEDY 1987: xxiii).
[295] Many computer strategy games seem to feature three basic dimensions of power. These are (1) military forces available for engagement in battles, (2) economic production to deliver resources to create and maintain military forces, and (3) the strategic situation that depends on the moves and locations of friendly forces and enemy forces. The decisive dimension albeit external is (4) the psychological, being the player itself, the player's attitude and ability.

economic model), there is no reason why *Making History* should need one, but this feature indirectly acknowledges the work of Ferguson and the inspiration derived from it.

The following diagram depicts the world power scores of countries that the game has designated as the major players. World power scores are also available for minor players:

Figure 13: World Power Scores of Major Players 1933–1944 [McCool et alia]

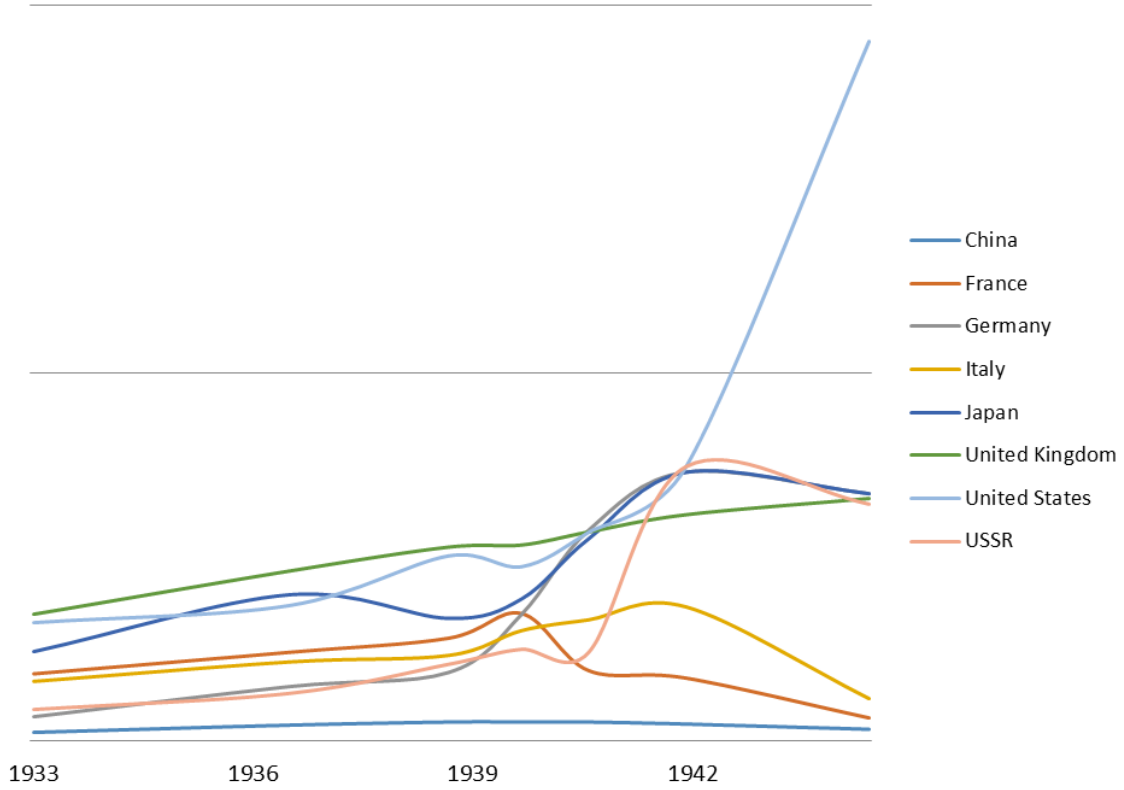


Source: Muzzy Lane 2008.

World Power Scores are used to determine the winner of the game (whether a nation, coalition, or ideology). The game has a separate index for military power, which appears to be based on a country's number of military units multiplied by their respective unit costs. The following diagram depicts the military power of countries that the game has designated as the major players. This reconstructed graph is approximate, as the game supplies this information in graphs rather than numbers. Graphic information on the military power of minor players is also available:[296]

[296] World power scores and the graphic information on military power in the 2008 *Gold Edition* are slightly different from those in the original 2007 edition of *Making History*.

Figure 14: Military Power of Major Players 1933–1944 [McCool et alia]



Source: Muzzy Lane 2008.

The two charts can be useful in seeing the difference between demographic-economic potential and actual military power. The United States had the greatest potential all along, though it is through WWII that it realized this potential. Mirosław Sułek also uses two measures on national power, one economy-based and the other military-based (section 13.30; compare section 13.6).

Making History II still calculates scores to determine world power rankings, but the scores themselves are not as such available. The formula has been modified, so national research has been added to the formula, while natural resources were dropped:

```
world_power_points = IPU + MPU + Tech + Wealth

IPU = industrial production units; MPU = available manpower; Tech = national
research; Wealth = money
```

Military power has been divided into offensive attack power and defensive attack power, scores being available for those two (see Muzzy Lane 2010).

13.44 MGIMO 2007 RU

Andrei Melville (born in 1955) is a Russian political scientist. He studied philosophy at Lomonosov Moscow State University and in 1977 finished his PhD in social philosophy at the Institute of

Philosophy of the Russian Academy of Science. In 1987 he completed his postdoc habilitation in social philosophy at Lomonosov Moscow State University. From 1989 to 2009 he was professor of political science at the Moscow State Institute of International Relations (MGIMO). Since 2009 he has been professor of political science at the Faculty of Applied Political Science of the Higher School of Economics.

In 2005 MGIMO and the Institute of Social Design launched the Political Atlas of the World project, with Melville and more than 45 other experts and analysts participating.[297] In 2007 Melville published the preliminary results in the *Political Atlas of the Modern World: An Experiment in Multidimensional Statistical Analysis of the Political Systems of Modern States* [*Политический атлас современности: Опыт многомерного статистического анализа политических систем современных государств*] (MELVILLE 2007). In 2010 Melville and colleagues published their results for a wider English-speaking audience in their work *Political Atlas of the Modern World* (MELVILLE et alia 2010).

Given that the project was intended as an open experiment, the approach has been more empirical than theoretical. However, two theoretical assumptions did exist:

> One is recognition of the fact that the structural diversity of the modern world has set political development on different paths, or vectors. […] Another assumption is that no universal political models exist in the modern world to fit each and every country or nation, however whoever might wish they could. (MELVILLE 2008: 56)

As for the statistical analysis, they write that they have put together a database of about 70 variables for 192 countries, which makes for about 13,440 data points, by relying on a variety of sources.

They determined five major factors impinging on the global standing of individual countries. These set the basis for five indexes, and the variables are distributed in such way as the designers agreed upon. The five indexes are the (1) State Capacity Index, (2) External and Internal Threats Index, (3) Potential for International Influence Index, (4) Quality of Life Index, and (5) Index of Institutional Basis of Democracy. All these indexes are related to varying degrees. For the purpose of this study, only the Potential for International Influence Index is considered a power index, for the simple reason that it contains two basic military variables. Discriminant analysis was used to weigh the eight variables.[298] The following table presents the eight variables and their weights:

[297] Russian website: http://www.worldpolities.org/ [16 August 2013].

[298] Discriminant analysis, which is related to principal component analysis and factor analysis, is yet another statistical method for achieving dimensionality reduction. In particular it is useful for the prediction of group membership. As I have been told, principal component analysis was briefly considered but rejected for creating a lot of statistical noise. "Strictly defined, statistical noise is a term that refers to the unexplained variation or randomness that is found within a given data sample or formula. There are two primary forms of statistical noise: errors and residuals. A statistical error is simply the portion of the final amount that differs from the expected value that was assumed to be the correct answer. A residual is the result of a more casual estimate of the anticipated outcome. The general notion behind statistical noise is that a particular set of data is not necessarily precise and might not be able to be duplicated if the same information was collected or calculated again" (http://www.wisegeek.com/what-is-statistical-noise.htm [16 August 2013]).

Table 73: Variables and Weights for Potential for International Influence [MGIMO]

Variables	Weight
Military expenditures	0.85
IMF member's voting power	0.83
Share of world goods and services exports	0.80
Share of world GDP	0.77
Factors of influence	0.66
Permanent membership in the UN Security Council	0.11
Membership in the Paris club	0.11
Nuclear weapons	0.11
Advanced military systems	0.11
Nobel prize winners	0.11
Military deployments abroad	0.11
Contribution to the UN regular budget	0.61
Armed forces personnel	0.55
Share of world population	0.48

Source: MELVILLE 2008: 70.

The subvariables for "factors of influence" are dummy variables. As for the Pearson correlation coefficients of the Potential for International Influence Index in relation to other indexes, it is 0.581 in relation to the State Capacity Index, 0.321 in relation to the Quality of Life Index, 0.156 in relation to the Index of the Institutional Basis of Democracy, and −0.166 in relation to the External and Internal Threat Index. Overall these correlations are not so strong, which is good, because the aim of having different indexes is to measure different things.

When using principal components analysis for depicting information in diagrams, they arrive at a fourth component consisting of power projection. They use cluster analysis to arrive at ten clusters or groups of countries. One group consists of China, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States, all of them having in common a high potential for international influence. When the number of clusters is increased to 13, this group splits into two groups, with China, Russia, and the United States together in one group, and France, Germany, Italy, Japan, and the United Kingdom in the other. When the number of clusters is increased to 33, China splits to form a group consisting of itself alone. This implies that Russia is still the country that most resembles the United States in terms of international standing. It demonstrates that statistical analysis can be useful in grouping countries together based on lines of similarities in the input data (compare section 13.16).

The following table represents results for the five indexes. Scores are standardized from 0–10. The table presents the published results in a 2008 discussion paper, in which Melville selected 16 countries as examples (the results for the other 176 countries were not included):

Table 74: Indexes for the Global Standing of Political Units [MGIMO]

Country	Index of State Consistency	Index of Capacity for International Influence	Index of National Threats	Index of Institutional Basis of Democracy	Quality of Life Index
USA	10.00	10.00	3.06	7.30	6.53
China	8.24	3.93	4.48	0.69	2.35
Japan	9.34	3.25	4.03	6.46	6.05
Germany	8.93	3.24	0.77	6.60	5.55
Russia	7.50	2.60	4.34	5.24	2.68
India	5.42	2.28	5.99	7.35	1.60
Italy	8.06	1.95	1.05	7.02	5.72
Saudi Arabia	6.99	1.69	3.63	0.64	3.21
North Korea	5.01	1.25	4.89	0.68	1.46
South Korea	8.53	1.02	4.28	6.62	4.66
Iran	6.97	0.83	5.34	1.76	2.49
Ukraine	4.35	0.59	2.27	6.46	2.20
South Africa	7.35	0.49	2.37	5.23	2.00
Hungary	6.88	0.29	1.02	6.94	3.80
Ethiopia	2.66	0.22	10.00	4.03	0.33
Central African Republic	0.81	0.02	7.57	3.20	0.00

Source: MELVILLE 2008: 71–73.

The power index is one of five diverse indexes. It is not unlike the work of Liu Ben-Chieh (section 13.24). The major difference is that Melville and colleagues did not combine these indexes into a composite index. They thought about it, but found it hard to conceptualize.

One critical voice has been that of Yuri Gromyko from the Russian Academy of Natural Sciences and director of its Institute for Advanced Studies. He stated in an interview:

> The analysis developed by Professor Melvil of MGIMO has been presented as if it were designed merely as a joystick for always maneuvering Russia into the center of world processes, which is inaccurate, and, like any less-than-objective evaluation, dangerous. The MGIMO analysis is far inferior, if contrasted with the ideas of the late Pobisk Kuznetsov, and his methodology for analyzing the power of nations on the basis of physically measurable magnitudes. […] Another weakness of the Political Atlas is that it ignores the condition of the world financial system […]. (GROMYKO & KRUPNOV 2007: 25)

Pobisk Kuznetsov measured national power via energy consumption (section 12.4), though Gromyko may also have other measurements in mind.

13.45 Orłowski 2007 PL

Witold Maciej Orłowski (born in 1962) is a Polish economist who studied economics at the University of Łódź, where he also got his PhD in economics in 1992. He got his postdoc habilitation degree at the University of Warsaw in 1997. He has been active in a number of positions: from 2002 to 2005 he served as principal economic adviser to Aleksander Kwaśniewski, who was president of Poland

between 1995 and 2005. In 2007 he received the title of professor of economics. His special interests are macroeconomics and econometrics. He has written six books, one of which is the *Centenary of Chaos: Alternate History of the XXth Century* [*Stulecie chaosu. Alternatywne dzieje XX wieku*] published in 2007 (ORŁOWSKI 2007). In this book he discusses a number of alternative historical scenarios – an unusual interest that he shares with Niall Ferguson (section 13.43).

In his book he features three indexes, the methodology of which is discussed briefly at the end of the book (ORŁOWSKI 2007: 535–537). There is one summary index for the total strength of a given country [indeks łącznej siły kraju], consisting of one subindex for scientific-technological potential [indeks potencjału naukowo-technicznego] and another subindex for military potential [indeks potencjału militarnego]. The one summary formula for all years 1900–2000 is:

```
TSC = 0.5 GNP + 0.225 STP + 0.225 MP + 0.05 ( P + A )

TSC = total strength of country; STP = scientific-technological potential;
MP = military potential; P = population; A = area
```

Early GNP data is partially based on the data set created by Angus Maddison (MADDISON 2010). The subindexes for scientific-technological potential and military potential change with time. This is reminiscent of Peter Beckman's changing formula for the 20th century (section 13.27). The formula for the scientific-technological potential for 1900, 1939, and 1950 is:

```
STP = 0.6 NPS + 0.4 US

STP = scientific-technological potential; NPS = Nobel prizes in sciences
(1900-1925, 1920-1945, 1940-1965 respectively); US = number of university
students
```

For the year 2000 it changes to this:

```
STP = 0.25 NPS + 0.25 SPJ + 0.25 IU + 0.25 RW

STP = scientific-technological potential; NPS = Nobel prizes in sciences
(1975-2000); SPJ = scientific publications in journals; IU = number of internet
users; RW = number of research workers
```

For the military potential subindex the formula changes three times. For 1900:

```
MP = 0.5 LAND + 0.25 SEA + 0.25 STEEL

MP = military potential; LAND = army strength; SEA = naval strength;
STEEL = steel production
```

Steel dropped subsequently in importance, while air power became a new factor. For 1939:

```
MP = 1/3 LAND + 1/3 SEA + 1/3 AIR

MP = military potential; LAND = army strength; SEA = naval strength; AIR = air
force strength
```

Subsequently after WWII nuclear weapons had to be added. For 1950 and 2000:

```
MP = 0.25 LAND + 0.25 SEA + 0.25 AIR + 0.25 NUCLEAR

MP = military potential; LAND = army strength; SEA = naval strength; AIR = air
force strength; NUCLEAR = nuclear strength
```

The values for army, naval, air force, and nuclear strength are once more the product of formulas. He provides only the input for the naval strength in the year 2000 as an example. This is based to 40% on the number of nuclear-powered submarines, to another 40% on the number of aircraft carriers, and to 20% on the remaining number of ships. As for results, his book has a great number of graphical representations. He also calculated scores for his alternative historical scenarios, though the following table presents solely the available numerical values for actual history:

Table 75: The Most Important Countries in the World in 1900 & 2000 [Orłowski]

Country	1900	2000	Country	1900	2000	Country	1900	2000
United States	19.0	27	France	10.0	4	Brazil		3
Germany	18.0	4	Austria-Hungary	6.0		Turkey	2.0	
Great Britain	18.0	4	India		6	Poland	1.4	1
Russia	10.0	8	Japan	2.0	7	Rest	6.6	21
China	4.0	12	Italy	3.0	3	Total	100.0	100

Source: ORŁOWSKI 2007: 64, 528.

As for Orłowski's approach in general, it is interesting to observe how he changes dramatically the indicators for military potential over the course of merely a century, though all these decisions are, of course, rather arbitrary.

13.46 Lach / Skrzyp / Łaszczuk 2008 PL

Zbigniew Lach, Julian Skrzyp, and Andrzej Łaszczuk are professors of the Geostrategy and Geography Department at the National Defence University of Warsaw [Akademia Obrony Narodowej – AON]. The AON is the most important military university in Poland. In 2008 they published "Resistance of the Polish space to external interference – spatial and territorial circumstances of defense and national security" ["Odporność układu polskiej przestrzeni na zakłócenia zewnętrzne – przestrzenne i terytorialne uwarunkowania obronności i bezpieczeństwa państwa"] (LACH et alia 2008).[299]

The purpose of their power index is to focus on strategic infrastructure essential for the security of the state with regard to asymmetric threats and unconventional forms of struggle (LACH et alia 2008: 657–658). The eight indicators used for the calculation of the index correspond roughly to the systems (and their constituent, functionally interrelated objects) that play the key role in ensuring the smooth functioning of the country (compare section 7.1). As military spending is only one indicator, it follows that the critical infrastructure is not the responsibility of the defense ministry alone.

[299] One can also refer to Z. Lach, J. Skrzyp, *Geopolityka i geostrategia*, National Defence University, Warsaw 2007, 186–190 (The matrix for the assessment of the power of African states).

The power index itself was quantified thanks to multidimensional comparative analysis, specifically the method of ranks and weights (ŁASZCZUK 2010: 73–75). Multidimensional comparative analysis (including method of ranks and weights) belongs to the category of taxonomic methods. There is also numerical taxonomy (in American literature called cluster analysis).[300] The following table presents the complete results, with standardized inputs and corresponding weights:

Table 76: State Power in Central Europe and of Russia in 2008 [Lach et alia]

Weights	2.5	1.0	1.0	1.5	2.0	1.0	0.5	0.5	10.0
Country	GDP	Self-sufficiency in Oil (resources / annual consumption)	Self-sufficiency in Natural Gas (resources / annual consumption)	Total Electricity Production	Total Exports	Military Spending	Paved Airport Runway > 1524m	Paved Road Density km / km²	Power
Russia	0.73	**1.00**	**1.00**	**1.00**	0.27	**1.00**	**1.00**	0.02	0.74
Germany	**1.00**	0.01	0.01	0.58	**1.00**	0.53	0.33	**1.00**	0.66
Poland	0.22	0.01	0.04	0.15	0.10	0.13	0.19	0.51	0.15
Denmark	0.07	0.38	0.06	0.04	0.08	0.04	0.03	0.90	0.13
Austria	0.11	0.01	0.01	0.06	0.12	0.04	0.02	0.86	0.11
Czech Republic	0.09	0.00	0.00	0.08	0.08	0.05	0.07	0.87	0.10
Ukraine	0.11	0.07	0.05	0.19	0.03	0.06	0.25	0.15	0.10
Romania	0.09	0.20	0.02	0.06	0.03	0.06	0.06	0.14	0.07
Hungary	0.07	0.03	0.01	0.03	0.06	0.04	0.04	0.41	0.07
Slovakia	0.04	0.01	0.01	0.03	0.04	0.03	0.02	0.41	0.05
Lithuania	0.02	0.01	0.00	0.01	0.01	0.01	0.03	0.58	0.04
Belarus	0.04	0.06	0.00	0.03	0.02	0.02	0.07	0.21	0.04
Latvia	0.01	0.00	0.00	0.01	0.01	0.01	0.03	0.58	0.04
Estonia	0.01	0.00	0.00	0.01	0.01	0.01	0.02	0.16	0.02
Moldova	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.17	0.01
Total	2.61	1.79	1.21	2.28	1.86	2.03	2.17	6.97	2.33

Source: LACH et alia 2008: 674–675, or ŁASZCZUK 2010: 78–79.

The standardization method assigns 1.00 to the highest value for each indicator, adjusting the other values proportionately. Resulting values are on a ratio scale. According to this index, Germany is 4.4 times more powerful than Poland.

13.47 Jaishankar 2009 IN

Dhruva Jaishankar is an Indian expert in international affairs living in Washington DC. He studied history and classics (archaeology) at Macalester College in St. Paul from 2001 to 2005. From 2007 to 2009 he was a research assistant at the Brookings Institution, a nonprofit public policy organization. Since 2009 he has been researching US foreign policy towards South Asia for the German Marshall Fund, an American public policy institution dedicated to promoting better understanding and cooperation between North America and Europe. He has been working on a master's degree in

[300] A Polish representative of numerical taxonomy is Jan Czekanowski (1882–1965). It is possible to look him up at this web address: http://www.antropologia.uw.edu.pl/AS/as-023.pdf [16 August 2013] (Czekanowski's diagram). He published in various languages, including German – for example, see Czekanowski J. (1909); "Zur Differentialdiagnose der Neandertalgruppe", *Korrespondenz-Blatt der Deutschen Gesellschaft für Anthropologie*. In Poland there is a strong school of taxonomy, primarily in the hub of Wrocław (Breslau).

international security at Georgetown University since 2009. He is also a fellow for geopolitics at the Takshashila Institution, an Indian, networked think-tank focused on India's strategic affairs. He is the writer of *Polaris*, a Takshashila Institution blog, where on 27 April 2009 he posted the "The Frank Zappa Scale of Comprehensive National Power" (JAISHANKAR 2009).

Frank Vincent Zappa (1940–1993) was an American composer and rock musician who received two Grammy Awards posthumously. He also wrote texts on current events, in which he regularly displayed a satirical attitude. One of his statements, which inspired Jaishankar to construct his power index, is that:

> You can't be a real country unless you have a beer and an airline. It helps if you have some kind of a football team, or some nuclear weapons, but at the very least you need a beer. (Zappa, quoted in JAISHANKAR 2009)

The statement is obviously satirical, and Jaishankar's use of it indicates that he himself is inclined towards the satirical. As the title of his blog posting indicates, Jaishankar created the index as a satire on Sino-Japanese CNP. The index of Hu Angang and Men Honghua (section 14.10) is mentioned explicitly. It is worthwhile here to bear in mind the original purpose of satire as elucidated in the *Penguin Dictionary of Literary Terms and Literary Theory*:

> In his *Dictionary* Johnson defined *satire* as a poem 'in which wickedness or folly is censured'. This, clearly, is limiting. Dryden claimed that the true end of satire was 'the amendment of vices'; and Defoe thought that it was 'reformation'. One of the most famous definitions is Swift's. 'Satire', he wrote, 'is a sort of glass wherein beholders do generally discover everybody's face but their own, which is the chief reason for that kind of reception it meets in the world, and that so very few are offended with it.' […] The satirist is thus a kind of self-appointed guardian of standards, ideals and truths […]. (CUDDON & PRESTON 1998: 780)

Given his expertise in geopolitical issues, Jaishankar's satire has an underlying corrective, which is that as long as no clear method and theory on the quantification of national power is developed, even combining provocatively ridiculous variables like beer, football teams, and airlines may provide a ranking not necessarily less significant than what serious formulas have provided.

As for the quantification of the four variables, all of them are treated as dummy variables. That is, either a country has it or not, and correspondingly receives one point or no point for this particular variable. For the beer, Jaishankar relies on his own drinking experience to know which countries have a major brand of beer. For airlines, he is uses external information, but counts only major international airlines that are less than 50% government owned. For football teams, he gives one point to countries that participated in at least one of the last four FIFA World Cups. It is not clear what source he may have used for nuclear weapons, but given that this is a dummy variable, it does not really matter. In any case, the formula is:

```
CNP = Beer + Airline + Football_Team + Nuclear_Weapons
```

The score range for power of individual countries is thus 0–4. The following table presents the complete results:

Table 77: The Frank Zappa Scale of CNP for 2009 [Jaishankar]

Country	Beer	Airline	Football Team	Nuclear Weapons	CNP
United States	1	1	1	1	4
China	1	1	1	1	4
United Kingdom	1	1	1	1	4
France		1	1	1	3
Russia	1		1	1	3
Germany	1	1	1		3
Japan	1	1	1		3
India	1	1		1	3
Ireland	1	1	1		3
Netherlands	1	1	1		3
Mexico	1	1	1		3
Italy	1	1	1		3
Australia	1	1	1		3
Belgium	1	1	1		3
South Africa	1		1		2
Canada	1	1			2
Austria		1	1		2
Brazil		1	1		2
Spain		1	1		2
Turkey	1		1		2
Argentina	1		1		2
South Korea		1	1		2
Jamaica	1		1		2
Israel				1	1
Pakistan				1	1
Total	18	18	21	8	65

Source: JAISHANKAR 2009.

Jaishankar admits that the scale is biased in favor of European countries, and that in a next step the variables could be fine-tuned (rather than using dummy variables). In the end he affirms "how this simple index manages to factor in military, economic *and* soft/cultural power" (JAISHANKAR 2009). If one disregards the satirical presentation of the index for a moment, the index may be useful as an intuition-based prototype for a soft power index. It is through beer and airlines as well as football teams that some people connect to countries.

13.48 Davutoğlu / Aslanli 2009 TR / AZ

Kenan Aslanli is an Azerbaijani economist. He studied at the State Economic University in Baku and at the Central European University in Budapest. Currently he is head of the Projects and Research Division of the Azerbaijan-Turkey Business Association and teaches human resource management

and public administration at the Azerbaijan Academy of Public Administration. In 2009 he published the article "Geopolitical power and human factor" (ASLANLI 2009). In the article he operationalizes a theoretical power formula designed by Ahmet Davutoğlu (born in 1959), a Turkish politician, who has been Turkey's Minister of Foreign Affairs since May 2009. Davutoğlu studied at Boğaziçi University, where he also did his master's degree in public administration as well as his PhD in international relations. He speaks English, German, and Arabic fluently, and is considered the strongest proponent of a multidimensional foreign policy, putting more emphasis on the historical and religio-cultural characteristics of Turkey in relation to its geopolitical region. In 2001 he published *Strategic Depth: Turkey's International Position* [*Stratejik Derinlik: Türkiye'nin Uluslararası Konumu*] (DAVUTOĞLU 2001). The book contains the theoretical power formula that Aslanli is using.

Davutoğlu presents his theoretical formula in the section "Equation and the Elements of Power" ["Güç Denklemi ve Unsurları"] (DAVUTOĞLU 2001: 17–34). Essentially the formula serves him as a basis upon which to discuss the various elements of power. The formula:

$$G = (SV + PV) \times SZ \times SP \times Sİ$$

$$SV = t + c + n + k$$

$$PV = e_k + t_k + a_k$$

G = resulting coefficient of geopolitical and geoeconomic power; SV = constant factors; PV = changing factors; SZ = strategic thought; SP = strategic planning; Sİ = political will; t = history; c = geography; n = population; k = culture; e_k = economic power; t_k = technological power; a_k = military power

For his short analysis of geopolitical and geoeconomic processes in Caucasus region, Aslanli chooses to use the formula and his personal evaluations as input (assigning 1–3 points to each variable). The following table presents the complete results and inputs; corrected values are in italics:

Table 78: Geopolitical and Geoeconomic Power in 2009 [Aslanli]

Country	constant				changing			SZ	SP	Sİ	[G]
	t	c	n	k	e_k	t_k	a_k				
Turkey	3	3	2	3	2	3	3	3	2	2	26
Russia	2	3	2	2	2	3	3	3	3	3	26
Iran	3	3	2	3	2	3	3	3	2	2	26
Kazakhstan	2	3	2	2	2	2	2	2	2	2	21
Azerbaijan	2	3	2	2	2	1	2	1	1	2	18
Georgia	2	3	2	1	1	1	1	1	1	2	15
Armenia	2	2	2	1	1	1	1	2	1	2	15
Turkmenistan	2	2	2	2	1	1	1	1	1	2	15
Region	18	22	*16*	*16*	13	*15*	16	16	13	17	162

Source: ASLANLI 2009.

Aslanli freely acknowledges that this method has a "totally subjective character" and that this "should be considered mostly as an example, not as the result" (ASLANLI 2009).

13.49 Zahreddine / Gomide 2009 BR

Danny Zahreddine is a Brazilian geopolitical analyst. He studied geopolitics at Pontifical Catholic University of Minas Gerais, where he also received his PhD. Since 2003 he has been professor of international relations at the same university. Nathália Ribeiro Gomide was apparently a graduate student in international relations at the same university. In 2009 they together presented a conference paper titled "International Relations and the Development of an Index of Power: An Analysis of the Projection of Power in East Asia" ["As Relações Internacionais e a Elaboração de um Índice de Poder: Uma Análise da Projeção de Poder do Leste Asiático"] (ZAHREDDINE & GOMIDE 2009). A more detailed profile description of the formula in their work has already been given by Nathalie Serrão (SERRÃO 2010: 35–36). No detailed one is given here. Zahreddine and Gomide use 25 variables in four categories: (1) seven variables for military power, (2) ten variables for economic power, (3) seven variables for material resources, and (4) one variable for sharing of values. They subsequently use principal component analysis to determine the first principal component, which then represents the power of countries. The following table presents the complete results for 24 countries:

Table 79: Power Index for East Asia in 2005 [Zahreddine/Gomide]

Country	First Principal Component		Country	First Principal Component	
	nonstandardized	standardized		nonstandardized	standardized
China	3.83496	1.00000	Philippines	–0.38368	0.04430
Russia	1.31443	0.42900	Bangladesh	–0.38533	0.04400
India	1.23809	0.41170	Myanmar	–0.41704	0.03680
Japan	1.17127	0.39660	North Korea	–0.42460	0.03510
South Korea	0.20261	0.17710	Cambodia	–0.52226	0.01290
Indonesia	0.04195	0.14080	Sri Lanka	–0.52715	0.01180
Pakistan	–0.23422	0.07820	Mongolia	–0.53322	0.01050
Thailand	–0.27157	0.06970	Nepal	–0.54098	0.00870
Vietnam	–0.30337	0.06250	Laos	–0.55177	0.00630
Singapore	–0.30929	0.06120	Brunei	–0.57105	0.00190
Taiwan	–0.32755	0.05710	Bhutan	–0.57545	0.00090
Malaysia	–0.34540	0.05300	Timor Leste	–0.57939	0.00000

Source: ZAHREDDINE & GOMIDE 2009: 25.

Given the method and the exclusion of Brazil from the list of countries analyzed, no bias can be inferred. The selection of variables remains arbitrary. The resulting scores are on an interval scale and not a ratio scale. The numbers are useful in assigning ranks, but they cannot be used, for example, to deduce how much more powerful China is vis-à-vis Japan.

13.50 Milewicz / Nothdurft 2009 PL / DE

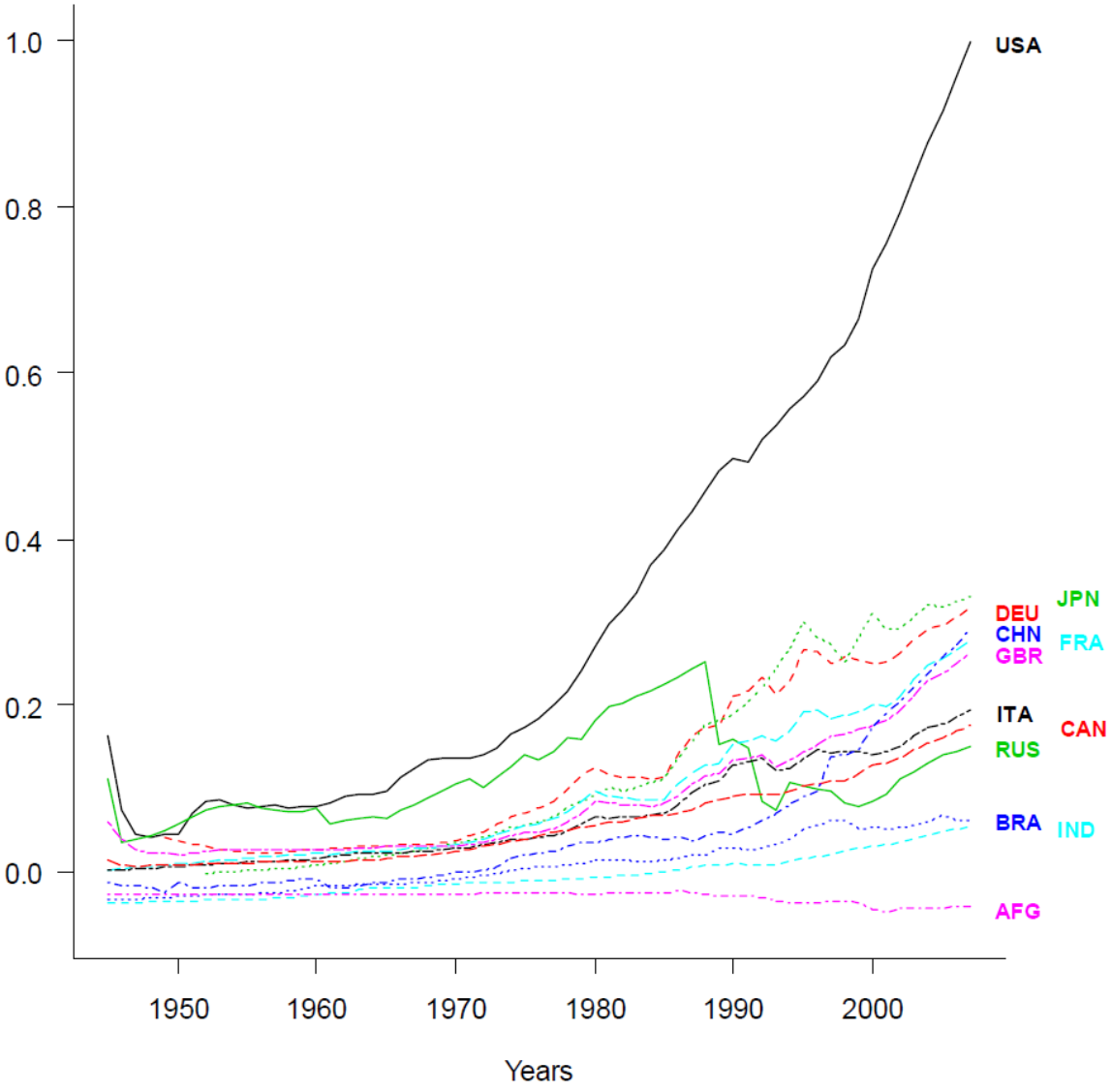
Karolina Milewicz (born in 1978) is a Polish trade analyst. She has a PhD in political science from the University of Berne, where in 2009 she submitted her dissertation, titled *Premises and Promises of International Law*. Currently she is a postdoctoral fellow at the World Trade Institute (WTI) in Berne. Arne Nothdurft has a PhD in forestry from the University of Göttingen, where in 2007 he submitted his

dissertation, titled *A non-linear hierarchical mixed model for tree height growth of Norway spruce (Picea abies (L.) Karst.) in Baden-Württemberg* [*Ein nichtlineares, hierarchisches und gemischtes Modell für das Baum-Höhenwachstum der Fichte (Picea abies (L.) Karst.) in Baden-Württemberg*]. It indicates competence in modeling. He works at the Forest Research Institute Baden-Württemberg. They had planned to present together a paper titled "Measuring Power: An Extended Indicator of National Material Capabilities" at the Midwest Political Science Association 67th Annual National Conference in 2009, but had to cancel at the last moment. I emailed Karolina Milewicz to ask her to summarize her index, which she kindly did for me in her email of 15 June 2010. As her description is concise and not amenable to paraphrasing, here the content of her reply:

> To measure power, we focus on the material capabilities of states. We have constructed a power indicator (POWER) with three dimensions containing demographic, economic and military resources. The indicator is made up of 10 variables: MILITARY EXPENDITURE (in thousands of current year US$), MILITARY PERSONNEL (in thousands), ENERGY CONSUMPTION (in thousands of coal-ton equivalents), TOTAL TRADE (in millions of current year US$), GDP PER CAPITA (log), GOVERNMENT EXPENDITURE (in current US$), LITERACY RATE (as percentage of adult population), number of PHYSICIANS (per 1,000 people), TOTAL POPULATION (log), and POPULATION AGES 15–64 (as percentage of total population).
>
> To handle missing observations, we used several data sources and applied statistical imputation techniques. As a rule, we employed generalized additive model (GAM) fitting for extrapolation and interpolation of the data. After careful graphical examination of all variables for all states, we applied linear fits to individual cases. The POWER indicator was computed on the basis of a factor analysis for time series. Separate time-series factor models were estimated for all variables and for each state. The factor loadings obtained were then averaged for each variable over all states. Based on the linear combinations of the mean factor loadings and the standardized observations, we calculated a singular factor quantifying material state capabilities. The POWER indicator covers 164 states from 1945 to 2007.
>
> (MILEWICZ 2010: 1)

The following diagram then illustrates the development of state material capabilities for 12 states:

Figure 15: Development of State Material Capabilities 1945–2007 [Milewicz/Nothdurft]



Source: MILEWICZ 2010: 1.

Notes: The US displays by far the highest degree of material capabilities, compared to other powerful states (the G8 states, Brazil, China and India). RUS refers to the Soviet Union until 1990 and Russia afterwards, DEU to West Germany until 1990 and Germany afterwards. (MILEWICZ 2010: 1)

To complete the list of abbreviations: USA = United States, JPN = Japan, CHN = China, GBR = Great Britain, ITA = Italy, CAN = Canada, BRA = Brazil, IND = India, AFG = Afghanistan.

13.51 Serrão / [Pirró e Longo] 2009 BR

Nathalie Torreão Serrão did a master's degree in strategic studies on defense and security at the Fluminense Federal University in Niterói, Brazil. She submitted her master's thesis in 2009, titled

National Power: An Exploratory Comparative Research Enlightening the Influence of Science and Technology [*Poder Nacional: Um Estudo Exploratório de Avaliação Comparativa, Destacando a Influência do Fator C&T*] (SERRÃO 2009). Her supervisor was Waldimir Pirró e Longo, professor of political science, who attained his PhD in materials science and engineering at the University of Florida. In 2003 he had himself written about "potential power, effective power, scientific-technological capacities" ["poder potencial, poder efetivo, capacidade científico-tecnológica"] (PENNA 2010: 6). In 2010 Serrão and Longo presented a conference paper together titled "Exploratory Study of the Relevance of Scientific and Technological Capabilities on National Power" based on Serrão's master's thesis (SERRÃO & LONGO 2011). In her thesis she presents a huge number of formulas, most of them taken (with proper citation) from a 2008 conference paper of mine (HÖHN 2008a). She adds profile descriptions for two Brazilian formulas, notably that of Gonçalves (section 13.39) and Zahreddine and Gomide (section 13.49). As in the case of Gonçalves and Zahreddine/Gomide, no detailed profile description is given here on Serrão's formula. Instead I refer directly to her thesis for obtaining detailed information on her approach (SERRÃO 2009; also SERRÃO & LONGO 2011).[301]

For the purpose of avoiding bias through arbitrary selection and weighting of variables, Serrão uses principal components analysis (PCA) and clustering analysis on a set of 186 diverse variables for 112 countries.[302] The idea of using PCA may have come from the paper by Danny Zahreddine and Nathália Ribeiro Gomide (section 13.49). The following table only presents the results for the eleven top countries as given in the 2011 paper; the results for all 112 countries can be found in Serrão's master's thesis (SERRÃO 2009: 128−130):

Table 80: Country Performance in the First Component 2006−2008 [Serrão]

Country	First Component	Country	First Component
United States	36.156	France	11.498
Japan	16.458	Denmark	11.420
Germany	15.109	Switzerland	11.302
UK	14.374	South Korea	11.013
Canada	12.172	Netherlands	10.842
Sweden	11.667		

Source: SERRÃO & LONGO 2011: 8; also SERRÃO 2009: 128.

The first component has a cumulative variance of 0.295. This means 29.5% representativeness, not 100%. Serrão and Pirró e Longo claim that "we reached a result consistent with common sense of the usual hierarchy of countries" (SERRÃO & LONGO 2011: 10). The accuracy or inaccuracy of this claim can be assessed in the following way: Mirosław Sułek has conducted regular surveys since 2003 on power perceptions, surveying mostly students of international relations at the University of Warsaw. Taking four surveys from 2007/2008 (SUŁEK 2010a), one can determine the Spearman correlation

[301] A number of spreadsheets with data and calculations in support of her thesis can be downloaded from this site: http://sites.google.com/site/dissertacaouffnathalieserrao/ [16 August 2013].

[302] "As for the methodology, traditionally PCA is applied to reduce dimensionality of data while maintaining as much information as possible about the original dataset. […] The PCA results constituted the input for the Clustering Analysis, which is an unsupervised machine-learning method that organizes data without prior classification into groups with common properties" (SERRÃO & LONGO 2011: 6).

coefficient (r_s) of the four surveys and Serrão's ranking. Sułek's surveys and Serrão's study have 37 countries in common. The r_s ranges from −0.25 to −0.22. Thus the claim by Serrão and Pirró e Longo is inaccurate. If anything, they reached a result that contradicts what they call the "common sense of the usual hierarchy of countries." Denmark is calculated as being in the top ten with rank eight, allegedly more powerful than Russia, which has rank 32 – one rank below Malta. If anything, this proves that multiple variables and a sophisticated method are no guarantee for the avoidance of nonsensical results. The underlying problem is that dimensional consistency in adding up variables is missing. As a result variables representing different dimensions (size, per capita development, and other ratios and rates) are added together via PCA (see section 16.3 for discussion). This problem could be addressed and solved by transforming all values, as far as possible, into national sum totals (total size or gross size) *prior* to using PCA. Such prior transformation and adjustment of input data might in turn produce somewhat credible results.

14. Sino-Japanese Comprehensive National Power (CNP)

Two different versions seem to exist with regard to the origin of the CNP concept: one claiming it to be originally a Japanese concept and imported into China, and the other version seeing it originate in China. As for the former, apparently in 1980 the Policy Research Council of the Japanese cabinet under prime minister Masayoshi Ōhira proposed a **comprehensive security strategy** with a focus on national strength, looking at the integrated use of political strength, military strength, diplomatic strength, economic strength, cultural strength, and all other aspects of strength (ZHANG 1993: 22). In 1987 Japan's Economic Planning Agency (EPA) published the results of a study on national power in a book titled *Japan's Comprehensive National Power: Japan's Rising National Power and Expected International Roles* [*日本の総合国力: 高まる日本の国力と求められる国際的役割*] (EPA 1987; also section 14.1). According to Zhang Boli, "since then the term 'Comprehensive National Power' has swept the world in the field of international politics" (ZHANG 1993: 22).[303]

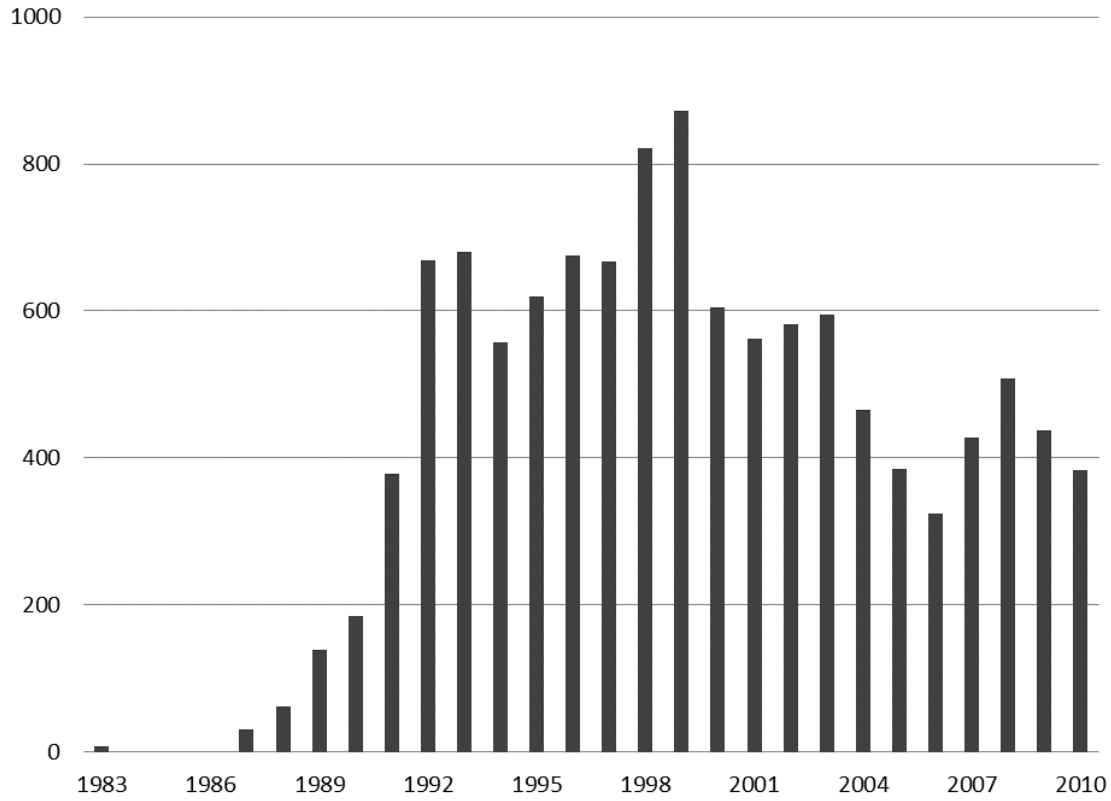
It is perfectly plausible that the CNP concept was imported from Japan as "Chinese authors do not lack knowledge of Japan; they cite Japanese language sources and interviews in Japan" (PILLSBURY 2000: 113). In 2001 Michael Pillsbury testified in a hearing of the United States-China Economic and Security Review Commission (USCC) about "a Chinese concept of comprehensive national power, which they, in turn, borrowed from the Japanese" (USCC 2001: 415). Retired US colonel Larry Wortzel, who has collaborated with Pillsbury in the past, has also repeated on at least one occasion that "[Chinese strategic thinkers] take this [concept of comprehensive national power] from a Japanese political scientist who developed the concept" (WORTZEL & CHENG 2006: 24).

In his book published a year earlier, Pillsbury cites Huang Shuofeng (section 14.3) to the effect that Deng Xiaoping had directed Chinese scholars to analyze the future security environment. In accordance with this task Huang Shuofeng claims to have constructed the concept of comprehensive national power (CNP) in 1984 (PILLSBURY 2000: 211–212, 225, 256). According to Pillsbury, Huan Xiang, Deng Xiaoping's national security adviser, proclaimed in an interview at the beginning of 1986 the following: "The focal point of the competition has been raised from the past emphasis, which was solely on the struggle for military superiority… to a contest of entire economic, scientific and technological, military and political comprehensive strength. Thus for the next several years… strengthening Comprehensive National Power will be the main task" (Huan, quoted in PILLSBURY 2000: 11). The timing of this quote (1986) lends support to Huang's claim. It is also possible that this is a case of parallel, independent development, as has happened before in the history of science.

The following table shows how many articles per million have been dealing with CNP as looked up in the CNKI database for Chinese articles:

[303] Chinese text: "自此，'综合国力'一词在国际政治领域风靡全球。"

Figure 16: Articles on CNP per million [CNKI]



Source: http://www.cnki.net/ [29 March 2011].

One can find two articles in 1983 that contain CNP as its subject, then none until 1987, when one can find twelve articles. Since then the number of articles mentioning CNP has exploded. This provides empirical support to the thesis that the concept of CNP has been an import. Given that "the Chinese do unabashedly hark back to World War II with a firm dislike and distrust for Japan" (McVADON 1999: 33), this possibly explains why some Chinese appear reluctant to credit their source of inspiration.

In 2000 Michael Pillsbury published the main work in English on Chinese CNP [综合国力] within the context of how China perceives its future security environment. According to his brief definition, "CNP (*zonghe guoli*) refers to the combined overall conditions and strengths of a country in a number of areas" (PILLSBURY 2000: 203). He quotes Deng Xiaoping stating in 1990 that "in measuring a country's national power, one must look at it comprehensively and from all sides" (Deng, quoted in PILLSBURY 2000: 204). The concept of CNP enjoys much more prestige in Chinese political thought than any quantification of national power in Western political discourse. Pillsbury emphasizes this point: "*Consistent with the texts of ancient statecraft, China's analysts believe in geopolitics*. They try to calculate mathematically the hierarchy of the world's future major powers" (PILLSBURY 2000: xxiv). Zhou Yongming considers CNP as one of three key concepts "of a new paradigm by which the Chinese have come to perceive their position in the world since the late 1980s" (ZHOU 2002: 23).[304]

[304] The other two key concepts are *national interest* and *rules of the game*. As for the latter: "The concept gained popularity in China's long negotiation process to join the World Trade Organization (WTO), which sets rules governing international trade. Gaining WTO membership requires China to conduct international trade according to these rules, while simultaneously

According to Colleen Holmes, CNP serves as the basis of a calculative grand strategy in order for China to achieve a balance of power with stronger states (United States) through "*constrained maximization*" (HOLMES 2000: 8). CNP was first mentioned officially in the Report of the Fourteenth Party Congress of the Chinese Communist Party in 1992, proposing a strategy called "comprehensive national power competition (*zhonghe guoli jinzheng*)" (ZHENG 1999: 115). According to Huang Shuofeng, one strategic goal of this CNP competition is "to maintain and raise China's international status and prestige" (Huang, quoted in ZHENG 1999: 115).

In 2002 the United States-China Economic and Security Review Commission reporting to the US Congress emphasized as one of its key findings among other things that "Chinese strategic thinking and military planning differ markedly from our own, underscoring the need to study such differences more carefully" (USCC 2002: [chapter 1]).[305] One difference is that the "Chinese place heavy emphasis on strategy and stratagems whereas the West relies more on overwhelming force and advanced capability" (LAI 2004: 3). Chinese analysts refer to comparisons of such matters as the quantity and quality of weapons, the training level and fighting will of personnel, the logistics support capabilities, and combat operational concepts as the *balance of static forces*. However, they consider the *balance of dynamic forces*, which refers to how static forces are used, as a much more useful measure of effectiveness (PILLSBURY 2000: 79–80).

This relates to a deeply ingrained Chinese view that the weaker side can defeat the stronger side if superior in strategy (USCC 2002: [chapter 1]). However, the difference between East and West is more often than not one of emphases than one of different truths. Western analysts focus more often on the *what* question, whereas Eastern analysts focus more on the *how* question. Nevertheless, Western analysts like John Mearsheimer also recognize "that power calculations alone do not determine which side wins a war. Clever strategies, for example, sometimes allow less powerful states to defeat more powerful foes" (MEARSHEIMER 2001: 34). Equally he accentuates that "although material resources alone do not decide the outcome of war, there is no question, that the odds of success are substantially affected by the balance of forces" (MEARSHEIMER 2001: 58). Likewise Chinese "also understand that without solid and credible capability, the play of strategy is empty" (LAI 2004: 6). Chinese look at both strategy and capability as unified within a holistic paradigm.

Chinese CNP as a paradigm has basically three sources of inspiration. Those are (1) China's ancient statecraft especially during the Warring States era (475–221 BC), (2) Marxism-Leninism with the addition of Mao Zedong Thought and Deng Xiaoping Theory, and (3) Western approaches to power – but only indirectly – by looking at Western power formulas. Western academic IR approaches

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benefiting from the rights to which it is entitled. […] By conceiving political, economic, and strategic interactions among different world players as game playing, the concept of the 'rules of the game' has symbolized the total de-ideologization by the Chinese in their perception of world affairs. While Westerners have emphasized 'rules' in dealing with Chinese, Chinese have focused on the aspect of 'game playing, ' with the prize of national interest as the ultimate goal" (ZHOU 2002: 24).

[305] The complete text of this key finding: "Chinese strategic thinking and military planning differ markedly from our own, underscoring the need to study such differences more carefully. Such Chinese thinking draws heavily on ancient Chinese military lore and history, as well as Chinese Communist revolutionary history, and emphasizes nontraditional and asymmetrical techniques designed to enable an inferior power to defeat a superior one. Such techniques include deception, preemption, use of 'assassin's mace' or trump card weaponry, as well as information and cyber warfare. The possibilities of miscalculation, miscommunications, and misunderstandings are high, given the substantial differences in each country's thinking and planning, and require far more attention from U.S. policymakers and the Congress."

have been denounced as "bourgeois theories of international relations" (PILLSBURY 2000: xxxi). Pillsbury provides a number of examples that

> China's ancient statecraft demanded efforts to calculate the future. [Herbert Goldhamer] points out that ancient China's first Minister was called "The Universal Calculator"; that the philosopher Han Feizi demanded that strategy be based on cost-benefit calculations; and that the philosopher Mozi persuaded an enemy general to surrender by showing he could calculate through a "seminar game" what the outcome of the battle would be. (PILLSBURY 2000: xxxvii)

There are more examples mentioning Sun Zi as well (PILLSBURY 2000: xxxviii, 208). Marxism is still emphasized. Accordingly, the conflict of economic interests is considered a major reason for war (PILLSBURY 2000: 46). Lenin has been cited in support of CNP by stating that "war is a test of every nation's complete economic and organizational power" (Lenin, quoted in PILLSBURY 2000: 212). Mao Zedong is cited to the effect "that the dialectical aspect of Chinese military science requires assessment of weakness as well as strength" (PILLSBURY 2000: 72). Mao emphasized the importance of spiritual components such as leadership and popular will (PILLSBURY 2000: 212–215).[306] According to Deng Xiaoping, economic power and military power are complementary. This view places more emphasis on economic development as a factor of national strength (PILLSBURY 2000: 211).

Chinese thinkers have a tendency towards a broader conception of national power and national security, especially with regard to intangibles like strategy, culture, and various other aspects of what may be nowadays called *soft power* in the West (section 9.2; compare section 14.7).[307] Former Chinese diplomat David Lai emphasizes that "there is nothing softer and weaker than water, yet nothing is more penetrating and capable of attacking the hard and strong" (LAI 2004: 4). Pillsbury supports this point by stating that "much like current times, Chinese ancient strategists also attempted to help their country achieve dominance through nonwarfare methods" (PILLSBURY 2000: xxxvii).

Pillsbury cites Wu Chunqiu in this regard: "China's wise ancient strategists […] never advocated relying only on military power to conquer the enemy, but emphasized combining military power with the nonmilitary power related to war in order to get the upper hand" (Wu, quoted in PILLSBURY 2000: 207–208). From statement like these it can be inferred that in Chinese strategic thinking peace is the continuation of war by nonmilitary means, as, for example, expressed by Deng Xiaoping when he stated: "Combine Peace and War" (Deng, quoted in MOSHER 2006: 9). Wu Chunqiu brings the thought of Chinese ancient strategists up to date when stating:

> Victory without war does not mean that there is not any war at all. The wars one must fight are political wars, economic wars, science and technology wars, diplomatic wars,

[306] Zhang Boli wrote a whole article on the relation of CNP to Mao Zedong Thought (ZHANG 1993).
[307] A problem that may arise from the broader concept of power is whether power becomes altogether synonymous with country performance and development. One has to wonder at what point may an excessive degree of comprehensiveness make the concept of power become meaningless if not counterproductive. This issue is not treated further in this study except in relation to the weighting problem (section 16.6).

> etc. To sum up in a word, it is a war of Comprehensive National Power. (Wu, quoted in PILLSBURY 1999: 109, or 2000: 209)[308]

Alarmed and critical voices have appeared warning of the Chinese CNP concept. Retired US Lieutenant Colonel Larry Wortzel says:

> Like good scientific Marxists, they have actually worked out the algorithm to compute every country's *zonghe guoli* (综合国力), or comprehensive national power. What bothers me about their formula is when you get enough comprehensive national power, in the view of these Chinese strategists, the end of that algorithm equals *qiang zhi li* (强制力), the power or strength to compel other countries. (WORTZEL 2007: 7; also see WORTZEL & CHENG 2006: 24)

Nor are the Russians exactly at ease despite their collaboration with the Chinese in the Shanghai Cooperation Organisation (SCO):

> According to General-Major V. Slipchenko, the ultimate goal of Chinese military reform consists in the creation of a military establishment that guarantees "living space" within "strategic borders." These "strategic borders" must shift according to the expansion of China's "Integrated State Power," the primary components of which are economic and military might. The Russians warn that a Chinese "Monroe Doctrine" is quietly at work: "All of Asia belongs to the Chinese—and not only Asia...." (Hudson Institute 2005: 85)

The term "Integrated State Power" ["комплексной мощи государства"] is the English translation of the Russian translation of CNP.

As a limitation it ought to be mentioned that this chapter on Sino-Japanese CNP formulas suffers because of the language barrier, which makes complicated issues and formulas much more difficult to understand. I have tackled this issue through the extensive use of internet translation, by comparing terms in original materials with available translations thereof, and at times with the kind help of native speakers. Another serious complication are the poor citation habits of Chinese scholars, which make it exceedingly difficult to track the work of others.[309]

There are hints for at least three more formulas that are not included here. Pillsbury mentions a confidential report about CNP circulating among the Chinese leadership, which leaked to the press in 1994 (PILLSBURY 2000: xxi, 255–256). Two others are contained in a list of 33 power inventories and power formulas published in an article in 2009 (WANG 2009: A3). One is by Li Tianran in 1990 (#16)

[308] A lot of statements on Chinese CNP emphasize the role of science and technology. Fan Ying stated in 1998: "First, we should strengthen our comprehensive national power and competitive capacity so as to improve the national economic quality. Competition in comprehensive national power means competition in science and technology development" (Fan, quoted in WANG 2001: 31). Likewise Chinese premier Wen Jiabao emphasized in a formal speech in 2005 that "science and technology are the decisive factors in the competition of comprehensive national strength" (Wen, quoted in PILLSBURY 2005: 5).

[309] Pillsbury describes this unhappy situation: "Chinese analysts do not observe international scholarly standards by footnoting each other or providing bibliographical information. Most authors write as if they were the sole Chinese to ever deal with an issue, in sharp contrast to Western scholarly books and articles, where the author is expected to make clear his debt to earlier work and narrowly and modestly to describe his new contribution" (PILLSBURY 2000: 9).

and the other by Wu Chunqiu in 1998 (#21), though it is not clear whether these two approaches are formulas or inventories, the latter merely listing elements of national power.

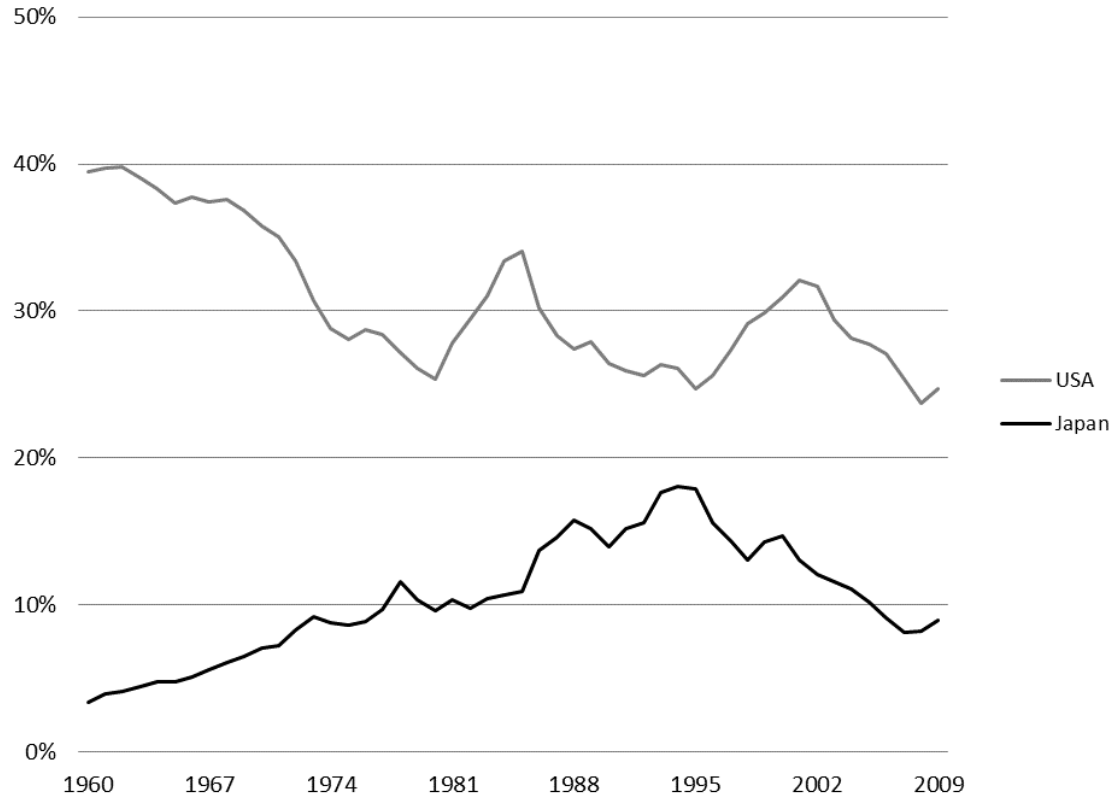
14.1 EPA 1987 JP

The Ministry of International Trade and Industry (MITI) was a very powerful and internationally famous government ministry of Japan. Credited with being responsible for much of Japan's successful industrial policy in the post WWII era, it was known for using formal as well as informal mechanisms to support and guide Japanese manufacturing interests. Japanese-inspired industrial policy was a major feature of Edward Luttwak's geoeconomics (section 7.3). One striking feature of Japanese politics compared to that of other democratic countries has been the immense power of senior-level bureaucrats in the formation of government policy. More often than not these senior figures had more power than the respective ministers, partly because of their greater expertise and experience. It is possible to describe this system as technocracy. The Economic Planning Agency (EPA) was an agency of the Ministry of Finance. In 2001 it was joined to MITI to form the Ministry of Economy, Trade and Industry (METI). The focus of the EPA is on long-term policy. For that the EPA researches businesses and industries and analyzes economic trends domestically as well as internationally. Prior to 2001, and depending on the issue, the EPA worked in technocratic collusion with MITI on formulating industrial policy.

In 1987 the EPA published the results of a study on national power in a book titled *Japan's Comprehensive National Power: Japan's Rising National Power and Expected International Roles* [*日本の総合国力: 高まる日本の国力と求められる国際的役割*] (EPA 1987). From 1993 to 1995 another series of surveys was conducted in connection with the measurement of national power (NIRA 2004: 44). Not much information is available on the 1987 study, even in Japanese. If this study has had tremendous relevance, then because of the attention that has been paid to it in China (see introduction to chapter 14). Pillsbury mentions this study as one of three major foreign methods discussed by Chinese CNP analysts, the other two being the formulas of Wilhelm Fucks (section 13.10) and Ray Cline (section 13.20) (PILLSBURY 2000: 225).

Similar to the way in which for the last decade it has been the fashion to discuss the rise of China (and now increasingly India), not too long ago the discussion focused on the rise of Japan (LAYNE 2009: 164). In 1979 Harvard professor Ezra Vogel published his book *Japan as Number One: Lessons for America*. Many books on a similar theme were to follow in the 1980s, often predicting the seemingly certain rise of Japan together with the seemingly certain relative decline of the United States. The notion of Japan becoming *ichiban* (一番 means *number one* or *best*) no longer appeared unrealistic, though the United States still had twice the population. On 29 December 1989 the Nikkei 225 reached its all-time high. Then the asset price bubble burst. By 1992 the Nikkei 225 had more than halved in points. A long period of stagnation followed. Still, in terms of GNI, Japan reached its peak in 1995, having about 73% of the United States' GNI, as the following diagram illustrates:

Figure 17: Gross National Income as Percentage of World Total 1960–2009 [World Bank]



Source: http://databank.worldbank.org/ddp/home.do [21 April 2011].

The EPA conducted its study on Japan's CNP two years before the Japanese economic miracle reached its zenith in 1989. At that time Japan had reason to prepare for the political repercussions of becoming the world's leading economy. In their study, the EPA applies the following categorization regarding national power:

> There are three types of national power: 1) capability of contribution to international society in conditions of international cooperation; 2) enforcement capability to influence countries outside international systems to participate in them; and 3) capability of survival to independently ensure national survival against foreign threats. (EPA 1987: 120)[310]

These three types of power are based on 17 factors (economic capability is included in all three types). These factors are then quantified using data from international databases and surveys. The EPA conducted these surveys internationally. Whereas the 17 factors receive different weights, the three types of national power are weighted equally, that is, the simple arithmetic mean is taken for CNP. The following table presents the complete results for the 17 factors as well as the three types and total CNP in 1985. A lot more detailed statistics are available in the book, including numbers calculated for 1965 and projections for the year 2000 (EPA 1987: 13):

[310] The book is in Japanese with the exception of the survey questionnaire for foreigners, which is in English.

Table 81: Japan's Comprehensive National Power 1985 [EPA]

Types of Power / Factors	Japan	United States	United Kingdom	West Germany	France	Soviet Union
Contribution Capability (total)	61	100	43	54	45	50
Economic Capability	50	100	17	34	17	30
Financial Capability	57	100	11	37	11	0
Science & Technology Capability	47	100	13	21	13	79
Basic Capability (subtotal)	51	100	14	31	14	35
Administrative Capability	72	81	100	79	89	93
Readiness for Foreign Activities Capability	54	52	66	96	100	24
International Community Capability	63	100	67	67	67	62
Policy Capability (subtotal)	77	98	95	94	100	77
Survival Capability (total)	56	100	52	49	47	119
Geography	24	100	23	7	16	206
Population	51	100	23	26	23	117
Resources Capability	8	100	64	34	36	103
Economic Capability	62	100	32	58	29	36
Defense Capability	7	100	10	10	10	100
Public Consciousness	100	98	88	89	83	96
Friendly International Alliances	100	88	95	85	95	178
Enforcement Capability (total)	24	100	35	24	42	70
Military Capability	0	100	33	10	57	86
Strategic Capability—Technology	50	100	11	17	16	59
Economic Capability	43	100	39	36	32	23
Diplomatic Capability	27	100	58	50	51	97
Comprehensive National Power (simple average)	47	100	43	42	45	80

Source: EPA 1987: 12, 14.

Notable is the absence of China, India, and Brazil. The selection of countries reflected the spirit of an age in which Japan considered Western countries to be its main competitors. Wan Ming emphasizes that Japan's contributing capability was calculated as being higher than that of the Soviet Union (WAN 1995: 97).[311] According to the surveys done for this study, Japanese as well as foreigners emphasized two obstacles to Japan contributing more to international society. These were (a) the closed nature of Japanese society and (b) the lack of international awareness among the Japanese (AKAHA 1996: 12). Nasif Joomratty notes the strong role soft power plays in this index, national spirit and cultural appeal being necessary ingredients of national power (JOOMRATTY 2006).

In 2004 the National Institute for Research Advancement (NIRA) published a study on "Population Decline and Total National Capacity" ["人口減少と総合国力"] (NIRA 2004). The inquiry itself appears to be largely based on CNP survey and measurement efforts by the Japanese Economic Planning Agency (EPA) from 1993 to 1995. The power measurement of the NIRA (section

[311] He Yinan refers indirectly to the focus of the 1987 EPA study: "This category [peaceful development route] not only refers to the postwar Yoshida Doctrine, which means undertaking minimal political/security responsibility in the world while concentrating on economic activities. It also includes some more active, post-Yoshida strategic options such as 'comprehensive power,' 'international contribution power,' 'normal state,' as long as these options do not require Japan to flex military muscle in international affairs beyond pure national defense" (HE 1998: 51).

14.12) can be considered a continuation of the EPA's measurement efforts. In comparison to the 1987 EPA report, it exhibits some similarities as well as manifest differences.

14.2 Ding 1987 CN

In 1987 a Chinese scholar called Ding Fengjun published a paper titled "On Comprehensive National Strength: 2000 Discussion of China's National Development Strategy" ["综合国力论——2000年我国国家发展战略刍议"]. I have been unable to get hold of this paper and therefore cannot definitively assess whether the formula contained therein is operational or theoretical. However, some details of the variables have been given by authors who accessed the paper,[312] and it seems reasonable to assume the former. The formula is (WANG et alia 1996: 153):

$$CNS = SP \times HP = (P + T + S) \times [R (N + H + E + D)]$$

CNS = comprehensive national strength; SP = soft power (invisible); HP = hard power (physical); P = political power; T = science & technology competitiveness; S = spiritual power; R = hard power coefficient; N = forces of nature; H = human; E = economic strength; D = defense force

Three articles allow a partial reconstruction of assumed input variables (WANG et alia 1996: 153; CAS 2003: 16; RAO 2004: 30): Political power refers to a country's political forces, meaning the political system, political party line, principles and policies, and the leadership of the party and state leaders, as well as decision-making ability. Spiritual power refers, among other things, to the people's enthusiasm, creativity and patriotism, as well as social customs, national traditions, national culture, and national consciousness. The forces of nature refer to the land area (total area, arable land, geographical location) and mineral resources (total amount, type, difficulty of exploitation, self-sufficiency). The human factor includes the quality of people's education and culture. Economic strength includes GNP, economic resources, and economic structure. National defense force includes nuclear capabilities, conventional capabilities, mobilization capacities, and space capabilities. The hard power coefficient seems to be used for adjusting the weight of hard power, possibly depending on whether results appear reasonable or not.

14.3 Huang 1989 CN

Huang Shuofeng (born in 1935) holds the rank of senior colonel of the Chinese People's Liberation Army (PLA), and has worked as a researcher at the Chinese Academy of Military Sciences (AMS). The AMS was founded in 1958 and does research analysis for the Central Military Commission as well as the General Staff Department. The AMS has deep Soviet roots in terms of its military doctrine, among other things, though this intellectual debt is not acknowledged. Huang is also vice-president of

[312] Two Chinese references to the article both cite the original article this way: "丁峰峻. 综合国力论———2000年我国国家发展战略刍议 [J]. 学术界动态, 1987, (6)" (RAO 2004: 31; ZHANG & TAN 2010: 75).

the Chinese Society for Futures Studies (CSFS). In 1957 he graduated from Wuhan University, and in 1958 he graduated in a business course at the Institute of Computing Technology. His interests have been the science of military strategy, military systems engineering, futures research, and the quantification of CNP, in which he is one of the leading pioneers. Huang wrote in his 1992 work *On Comprehensive National Power* [*综合国力论*] that in 1984 he had

> put forward the concept of "Comprehensive National Power," and established a "Comprehensive National Power dynamic equation" model aimed at comprehensively assessing the comprehensive power of different countries in the world, and conducted comparative analysis of the major countries Comprehensive National Power. (Huang, quoted in PILLSBURY 2000: 212)

This was done after studying the formulas of Wilhelm Fucks (section 13.10) and Ray Cline (section 13.20), both of them he found to be inadequate. Huang clarifies the actual purpose of CNP calculations in his 1992 work:

> Comprehensive National Power research is done in order to accurately analyze the international strategic situation and evaluate the comprehensive power of enemy states, allies, and one's own country for the purpose of scientifically planning one's own national strategic decision making. (Huang, quoted in PILLSBURY 2000: 222)

The quantification of national power serves the planning of national strategy, which further leads to the realization that "only relying on theoretical research is therefore inadequate for making this sort of assessment" (PILLSBURY 2000: 222). This observation places emphasis on the insufficiency of theory necessitating a statistical-empirical approach.

As for the AMS approach (PILLSBURY 2000: 222−225, 232−238, 247−250), Huang highlights a dynamic understanding of national power in terms of flows. CNP is constantly changing and evolving, and he uses a motion equation corresponding to Newton's third law.[313] The formula is:

$$Y_t = K_t \times (H_t)^{\alpha} \times (S_t)^{\beta}$$

Y = comprehensive national output; K = coordinated coefficient; H = "mass" of CNP; S = "acceleration" of CNP; t = time; α = hard elasticity index; β = soft elasticity index

In Pillsbury's description it is not clear what parts of the equation stand for the environmental subsystem, nor what the H and S in the equation actually stand for. Huang divides his CNP index system into four subsystems. These are (1) the material power (hard) index system (α), (2) the spiritual power (soft) index system (β), (3) the coordinated power index system (K), and (4) the

[313] The third law is such: "To every action there is always opposed an equal reaction; or, the mutual actions of two bodies upon each other are always equal, and directed to contrary parts" (Newton, as quoted in http://physics.about.com/od/classicalmechanics/a/lawsofmotion_4.htm [16 August 2013]). The formula that corresponds to Newton's third law is:

$$F = kma$$

F = force; k = some constant; m = mass; a = acceleration

(http://en.wikibooks.org/wiki/A-level_Physics/Forces_and_Motion/Dynamics [16 August 2013]).

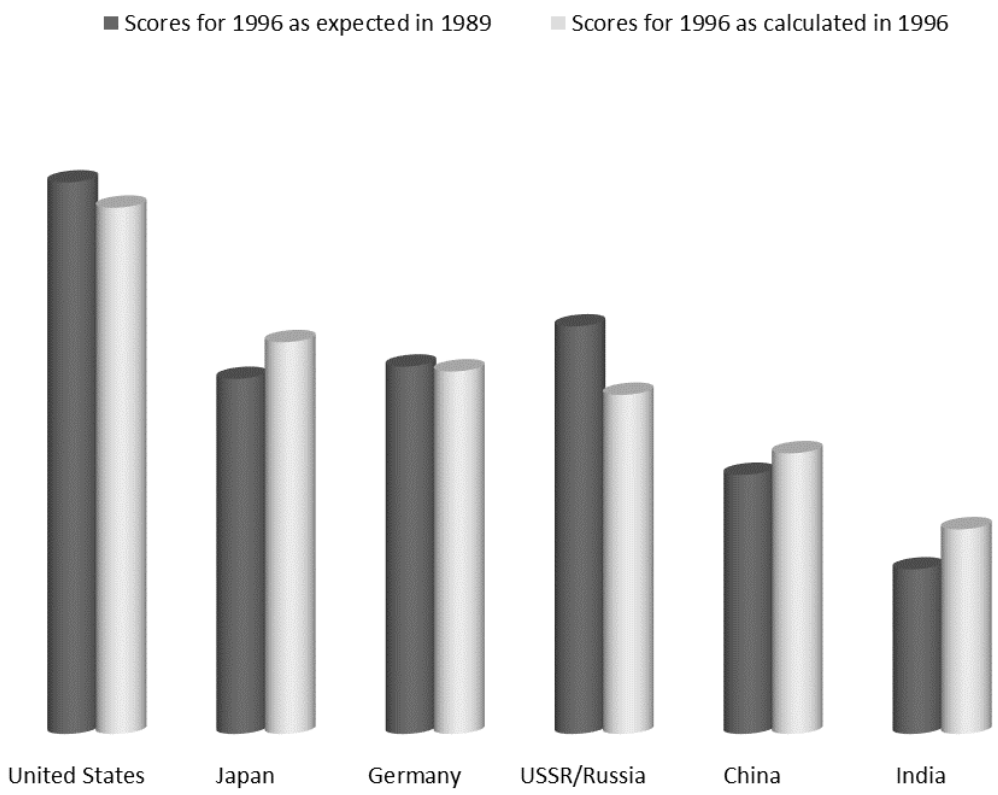
environmental index system. The material power (hard) consists of (a) natural resources, (b) economics, (c) science and technology, and (d) national defense. These factors determine to what degree a country is developed. The spiritual power (soft) consists of (e) politics called "national embodiment", (f) foreign affairs, and (g) culture and education. These factors determine to what degree a country is stable. The coordinated power takes soft power factors, but here they have a different function as they stand for macro adjustment and control. The environmental subsystem consists of the international environment, natural environment, and social environment. This subsystem appears to act as a constraint.

Pillsbury delivers a number of subequations that went into the AMS index.[314] He mentions four assessment and measurement methods that were used to obtain numerical data: (1) the index number method, which means that values for a specific variable are standardized with the numerical value of the United States always set at 100, the (2) specialist evaluation method, which appears to consist of surveys, the (3) weighted coefficients, which are not further explained by Pillsbury, and a (4) vague judgment method, which appears to have some relationship to "vague mathematics" (it is not really clear what is meant by that, though it could be speculated that Huang used dummy variables in these cases). Possibly Huang himself does not elaborate all the details on his methods: Pillsbury notes that for the projections of the AMS index Huang simply mentions using a "leading trend analysis method" (PILLSBURY 2000: 238) – whatever that is.

The 1992 work contains the calculations Huang and his team at the AMS did in 1989. Pillsbury lists for 1989 the scores for the hard and soft factors as well as those for coordinated power in addition to the CNP scores (PILLSBURY 2000: 239). He also presents the scores from the AMS forecasts for 2000 (PILLSBURY 2000: 248–249). In 1996 Huang published another book *On the Rise and Fall of Great Powers* [*大国的兴衰*] with a different set of results and this time without projections for the future. Pillsbury compares the CNP scores of the 1992 work (for 1989 and 2000) with those of the 1996 work (for 1996) (PILLSBURY 2000: 240). These show an acceleration in the decline of the US relative to Huang's expectations seven years earlier. I interpolated scores for 1996 based on the CNP scores for 1989 and 2000 in the 1992 work. The following diagram compares these interpolated scores to Huang's newly calculated scores in 1996. The diagram illustrates the results only for those countries for which scores are available for all years (in Pillsbury's book, that is):[315]

[314] Notably the subequation for military capital (PILLSBURY 2000: 236–237) resembles that of the Virmani Index of Actual Power (VIP), not to be confused with the VIP^2 (both in section 13.37).
[315] This then excludes France, England, Canada, Australia, and Brazil.

Figure 18: A Comparison of 1996 CNP Statistics [Huang]



Source: Pillsbury 2000: 240; author's own calculations.

The collapse and breakup of the Soviet Union was a major unexpected event. The United States as the winner also depreciated relative to projections. Japan and India gained considerably.

14.4 Yu / Wang 1989 CN

In 1989 Yu Hongyi and Wang Youdi published two articles titled "Evaluation of Comprehensive National Strength Measure" ["综合国力测度评价"] (YU & WANG 1989a, 1989b). They were members of the Hubei Science Commission at the time. Pillsbury's briefly describes their approach:

> Their formula for calculating CNP was given as "function (F), dimension (D), structure (S), level (L), and four-dimensional vector comprehensive national strength (CNS) measurement formula, in which CNS = F (FDSL)." (PILLSBURY 2000: 253)

The structure level (L_S) deals with the percentage shares of the three sectors of the economy in terms of employment: agricultural (X_1), industrial (X_2), service (X_3). Considering that the development of the three sectors reflects on the general development of an economy itself, the agricultural sector is strongest in less developed countries, whereas the service sector is strongest in advanced economies. This constitutes a hierarchy of importance. Yu and Wang take a formula using the natural logarithm to allocate different weights to these sectors in line with this perceived hierarchy. The function dimension (F_D) represents GNP (F) and energy consumption (D). The formula is:

$$CNS = L_S \times F_D$$

$$L_S = 0.5\ X_1 + 0.79\ X_2 + X_3$$

$$F_D = F^{0.5} \times D^{0.5}$$

CNS = comprehensive national strength; L_S = structure level; F_D = function dimension; X_1 = percent employment in agricultural sector; X_2 = percent employment in industrial sector; X_3 = percent employment in service sector; F = GNP; D = energy consumption

The following table presents the complete results; data for the components is also available but not presented here:

Table 82: Comprehensive National Strength in 1985 [Yu/Wang]

Country	Function Dimension F_D	Structure Level L_S	CNS
United States	0.5049	0.9262	0.6838
Soviet Union	0.2048	0.8252	0.4111
Japan	0.1434	0.8815	0.3555
Germany	0.0854	0.8839	0.2748
United Kingdom	0.0621	0.9178	0.2386
France	0.0609	0.8907	0.2329
China	0.0757	0.6409	0.2202
Canada	0.0489	0.9225	0.2123
Italy	0.0454	0.8757	0.1993
Australia	0.0207	0.9133	0.1374
India	0.0298	0.6256	0.1365
Egypt	0.0057	0.7509	0.0656

Source: YU & WANG 1989a: 52, or 1989b: 23; also PILLSBURY 2000: 254.

This power formula is a more complicated, morphological measure of economic development, giving agricultural production especially a lower weight. It more or less conforms to the outlook of Mearsheimer, who has stipulated that

> GNP is a poor indicator of latent power when the states being compared are at different levels of economic development. […] much more of China's GNP is tied up in agriculture than is the case for either Japan or the United States (18 percent versus 2 percent). (MEARSHEIMER 2001: 63, 383)

One could also use "value added in manufacturing" as a way to distinguish between degrees of industrialization. Lewis Snider used it as part of his formula (section 13.25). Using energy consumption also gives greater weight to countries with heavy industry.

14.5 Zhang 1991 CN

In 1991 Zhang Wenkui[316] wrote a mimeo draft [油印稿] titled "On China's National Strength" ["论中国的国力"] which I have been unable to get hold of. Instead I rely on indirect sources (Bi 1993: 89–90; CAS 2003: 16). His CNP calculation seems to be based on area, population, GDP, energy consumption, food production, and seven indicators for military capabilities. Results are calculated for at least 14 countries. The formula is:

```
ZG = J + R + D

ZG = comprehensive national power (pinyin: zōnghé guoli); J = basis of national
power; R = national power per capita; D = national power per unit of land
```

It can be assumed that the indicators listed above go into the basis of national power. The three factors of national power in the formula are weighted more or less equally, as can be inferred from the totals for each factor in the table below. The idea of measuring national power per unit of land relates to the concept of GDP/area [地均GDP] and is one measure of land use intensity among several others of land-use-intensity. The use of this measure appears more widespread in China than in the West.[317] This use of national power per unit of land rewards countries that are small in area but powerful otherwise. The following table presents the results as available from Bi Weiming:

Table 83: Total CNP [Zhang]

Country	National Power Basis	National Power per capita	National Power / Area	Total CNP
United States	2,012.81	1,499.98	225.20	3,737.99
Soviet Union	2,134.45	712.28	93.87	2,940.60
Japan	653.34	464.19	1,589.58	2,707.11
West Germany	368.23	558.97	1,523.22	2,450.42
China	1,656.38	101.97	202.25	1,960.60
East Germany	99.49	564.58	1,047.53	1,711.60
Canada	408.49	1,274.45	26.60	1,709.54
UK	240.28	400.42	1,064.32	1,705.02
Australia	265.54	1,282.86	18.38	1,566.78
Italy	248.86	378.40	867.65	1,494.91
France	299.79	465.12	613.13	1,378.04
India	809.10	54.43	400.22	1,263.75
Poland	170.84	415.16	657.25	1,243.25
Brazil	429.90	231.38	42.25	703.53
Total	9,797.50	8,404.19	8,371.45	26,573.14
r	0.704	0.510	0.147	1.000

Source: Bi 1993: 90.

[316] In a country with more than a billion people there can be expected to be more than one person with the name Zhang Wenkui [张文奎]. It is not clear which one wrote the mimeo draft. One scholar with this name has been a somewhat prominent geographer in China. For that reason it is tempting to attribute this mimeo draft to him. In the absence of certainty it appears more prudent to abstain from supplying biographical information.

[317] For more information about 地均GDP, see the entry in the Chinese *MBA Wikipedia*: http://wiki.mbalib.com/wiki/地均GDP [16 August 2013].

Bi Weiming does not state for what year Zhang calculated his CNP scores. The presence of West Germany and East Germany indicates that it cannot have been later than 1990. The Pearson correlation coefficients (r) for the three factors of the formula in relation to the end results show that national power per unit of land has the weakest correlation to total CNP.

14.6 CASS 1996 CN

The Chinese Academy of Social Sciences (CASS) was established in 1977 and now has up to 5,000 scholars doing research there. It consists of 35 institutes, one being the Institute of World Economic & Politics (IWEP), which was established in 1964. The purpose of the IWEP is to provide the central government with information on the world economy. It publishes annually *The Yellow Book of International Economy* featuring analyses and forecasts on the world economy. It also publishes the annual *Yellow Book of International Politics* featuring reports on international politics, which includes an assessment of CNP. The measurement of CNP apparently started when the IWEP conducted *Comparative Studies of the Comprehensive National Power of the World's Major Nations* [*世界主要国家综合国力比较研究*] from 1990 to 1997, with a book of said title published in 1996. The project was funded by the Social Science Foundation of China. Wang Songfen was the project director supervising a team of researchers and the editor of the said book; he has since retired. In Pillsbury's treatment of the CASS index (PILLSBURY 2000: 219–222, 227–232, 245–247), the civilian CASS index is contrasted to the military AMS index (section 14.3).

Wang and his team define CNP in a way that is reminiscent in language and thinking of classical texts in German geopolitics, so

> Comprehensive National Power is the organic sum of the different powers of a sovereign state during a certain period of time, it is the base which all countries rely on for existence and development, […] it is the condensed sum of the entire calculations of societies' various existence and development factors at a certain time, space, and under certain conditions. (Wang et alia, quoted in PILLSBURY 2000: 219)

Karl Haushofer articulated things similarly, so geopolitics "is based on the broad foundations of geography, especially political geography as the theory of states as living political organisms occupying particular territories, and their structure" (HAUSHOFER et alia 1928: 27; also WITTFOGEL 1929: 21, 1932: 583; also section 3.1).[318] Friedrich Ratzel had titled the first chapter of his book *Political Geography* [*Politische Geographie*] "The State as an Organism Rooted to the Soil" ["Der Staat als bodenständiger Organismus"] (RATZEL 1923: 1–17). Chinese scholars freely acknowledge Friedrich Ratzel's work as the beginning of **comprehensive power analysis** along with geopolitics (CAS 2003: 5, 11; further WANG et alia 1996: 6, 11). Besides this rather geopolitical definition of CNP, Pillsbury mentions that the CASS team theoretically distinguishes between material power and spiritual power, latent and actual power (reminiscent of Klaus Knorr's distinction between putative and

[318] German text: "Sie fußt auf der breiten Grundlage der Geographie, insbesondere der politischen Geographie als der Lehre von den politischen Raumorganismen und ihrer Struktur."

actualized power – compare section 8.3). They underscore that the factors have always been changing and will continue to do so in the future. Variables can be added or dropped accordingly.

The 1996 CASS index consists of eight components, which in turn are based on 64 variables. Several calculation methods are employed for the purpose of standardization. Some are taken over from Ray Cline (section 13.20) and the EPA approach (section 14.1), so, for example, the values in each variable are converted into a corresponding index with a range 0–100. "Consequently, in the second stage of CNP measurement, the quantitative results of the basic plan are revised through qualitative analysis, by assigning weights to both the eight major component factors and their specific indexes" (PILLSBURY 2000: 228). The following table presents the eight components and their respective weights in 1996:

Table 84: Weighted Coefficients of Major Component Factors [CASS]

National Power Factor	Weighted Coefficient
Natural Resources	0.08
Economic Activities Capability	0.28
Foreign Economic Activities Capability	0.13
Scientific & Technological Capability	0.15
Social Development Level	0.10
Military Capability	0.10
Government Regulation & Control Capability	0.08
Foreign Affairs Capability	0.08
Total CNP	1.00

Source: PILLSBURY 2000: 229 (original source: Wang, Songfen, ed. 1996. Shijie zhuyao guojia zonghe guoli bijiao yanjiu [*Comparative studies of the comprehensive national power of the world's major nations]*. Changsha: Hunan chubanshe, 169).

Looking at Pillsbury's book, it is not clear how the CASS combined variables, and in the case of its using addition, whether dimensional consistency was ensured to make variables compatible (compare section 15.7; further see section 16.3 for discussion). The variables consist of variables on an aggregate basis, per capita basis, and other ratios and rates (see PILLSBURY 2000: 221).

Pillsbury provides scores from 1996 that also include forecasts (PILLSBURY 2000: 230–231, 246, 249). The CASS predicted that Japan would be more powerful than the United States by 2020. In 1996 there must still have been plenty of faith in Japan's growth potential, but Japan has stagnated economically for most of the time since 1991. Variables, weightings, and method may have slightly changed since 1996. The basic structure appears to have remained the same. The following newspaper page presents the most current rankings at the time of writing:

Figure 19: Chinese Newspaper Featuring CNP Ranking for 2010 [CASS]

A12 [中国] 2009年12月25日 星期五

长沙晚报 CHANGSHA EVENING

责编/屈金轶 美编/屈金轶 校读/贺黎黎 时事信息部主编 电话/82205102 传真/82205042

中国社会科学院发布2010年世界形势黄皮书

综合国力中国排第七

综合国力 美日德居前三位

中国社会科学院24日发布的2010年世界经济黄皮书《2010年世界经济形势分析与预测》(以下简称"黄皮书")指出,包括美国、法国、中国、印度等西方七国和"金砖四国"共计11个国家的综合国力排名,中国排在第七位,美日德综合国力位列三甲。专家分析,综合国力排名在前的国家,在战略上未必居于优势地位,因为国家间的竞争都是在具体的领域。

专家解读 了解自身完善自身

社会发展 社会分配差距超"警戒线"

美国总分90.08分 中国虽居第二但仅为33.3分

军事实力中美差距大

与美国总得分差距很大

中国军人虽多但军费不多

中国武器数量远逊俄

本组图文均据新华社、央视、《法制晚报》

中纪委通报"一揽子"计划违纪违法案件

141人受党纪政纪处分

财政部:

明年用5885亿刺激经济

公安部:

烟花爆竹限在规定区域燃放

李毅中:

六项措施助跑中小企业

央视评出中国十年商业领袖

王健林柳传志等当选

十年商业领袖(排名不分先后)

拾到万元钱两男雨中守候

全国竟有11位失主争领

广东海上丝绸之路博物馆开馆

江苏海安县人大常委会常务副主任孙启明

在阳台晨练时坠楼身亡

自杀者系宁夏组织部副部长

死者赵宪春现年48岁 自杀原因不明

《宁夏一厅官在京酒店身亡》追踪

Source: *Changsha Evening* 2009: A12.

This newspaper page illustrates the importance given to CNP in the Chinese media. No other country in the world measures and celebrates its national power with such excitement.

14.7 Yan 1996 CN

Yan Xuetong (born in 1952) is a Chinese political scientist turned TV commentator. He can frequently be seen on Chinese TV offering his analyses of world politics. An English speaker, he also appears occasionally on the TV channels of other countries. In 1982 he graduated in English from Heilongjiang University in Harbin, where in 1986 he got his master's degree in international relations. In 1992 he got his PhD in political science at the University of California in Berkeley. Nowadays he is director of the Institute of International Studies at Tsinghua University. From 1982 to 2000 he was a scholar at the China Institute of Contemporary International Relations (CICIR), which is associated with the Ministry of State Security. In 1996 he published the book *Analysis of China's National Interests* [*中国国家利益分析*]. A marginally edited English translation is available (YAN 2002).

In the third chapter of his book he discusses the assessment of CNP in the context of the international environment (YAN 2002: 53–76). He mentions a number of previous attempts to measure national power, notably that of Wilhelm Fucks (section 13.10), the EPA (section 14.1), and Wang Songfen (section 14.6). He emphasizes that different variables might have different effects. Taking population would make China appear as a powerful country, whereas per capita GDP would make China appear as a poor country. He mentions in a disorganized manner a diverse list of variables that relate to China's CNP, but does not explain what variables actually go into his calculation of CNP. He explains that his CNP calculation takes the arithmetic average of six elements, and that the elements are standardized using US values (the numerical values indicate that rather arbitrary rounding has been exercised). The following table presents the complete published results:

Table 85: Simple Average Value of Major Countries' CNP in 1996 [Yan]

Elements	United States	Japan	China	Russia	Germany
Manpower	1.00	0.50	0.30	0.50	0.30
Natural Resources	1.00	0.04	0.70	1.00	0.10
Politics	1.00	0.50	0.70	0.50	0.50
Economy	1.00	0.60	0.17	0.10	0.30
Military	1.00	0.14	0.30	0.60	0.11
Culture	1.00	0.90	1.00	0.90	0.90
Total CNP	1.00	0.44	0.52	0.60	0.35

Source: YAN 2002: 63; also PILLSBURY 2000: 255.

For the first five elements the text suggests what variables he might have used for quantification. However, it is totally unclear for culture. The numbers for "culture" seem arbitrary if not a bit chauvinist. The table itself offers two explanatory notes:

> *It is generally believed that a 200 million population is ideal for a big country. China is overpopulated, and the over-population has negatively affected the development of its

national power. In addition, China's total educational level is lower than the other four countries. Therefore the index is smaller than that of the U.S., Japan or Russia.

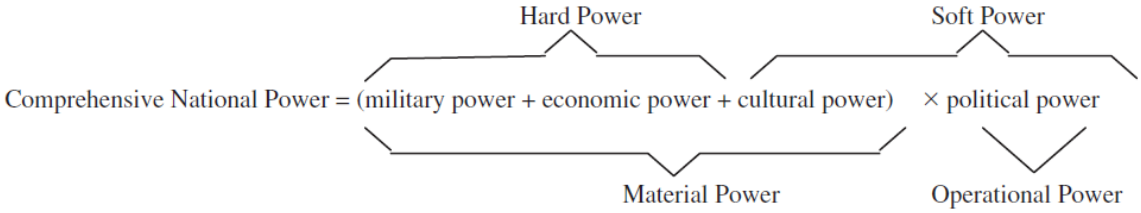
** The economic index is based on the GNP in 1993. The indexes for China and Russia are the average values of the calculation with the par price of exchange rates and purchasing power. (YAN 2002: 63)

Yan seems to have grown frustrated by his attempt and the attempts of others to measure CNP and in 2006 wrote this lamentation:

> The measuring methods used in assessing China's power status have become increasingly complicated. There are neither common standards for measuring nor continuity in methodology development. […] Due to the lack of a common standard, neither increasing the number of factors measured, nor using complicated measurements have led to an improvement in the accuracy of measuring China's current power status. (YAN 2006: 8–9)

In a 2008 article he tries again to develop – this time – a theoretical power formula on the basis of his understanding of Sun Zi. Yan notes that Sun Zi's conception of power is somewhat similar to that of Ray Cline, as expressed in his formula (section 13.20):

Figure 20: Relations among Concepts of Power Elements [Yan]



Source: YAN 2008: 161.

It is relatively easy to find measures for military and economic power – their adequacy is another issue – but more difficult in the cases of political power and especially cultural power. Yan criticizes the Western concept of soft power for not distinguishing between cultural and political power. Political power is to a certain extent akin to governance in domestic matters[319] and trustworthiness in international matters. It has much more significance than cultural power as can be understood from the formula, which proves valuable in visualizing this fact.

14.8 Ou-yang / [Wang] [1997] CN

In 2006 Ou-yang Guo-hua published the article "The Comparison Model of the [sic] Comprehensive National Strength under the [sic] Globalization" in the *International Journal of Business and*

[319] "Xun Zi's understanding of how changes in national power occur represents the traditional 'wise ruler—virtuous minister' concept espoused by ancient Chinese political thinkers, whereby talented political officials constitute the basis for strengthening the state" (YAN 2008: 147). Xun Zi is next to Sun Zi and Sun Tzu just another transliteration for 孫子.

Management (OU-YANG 2006), an English-language magazine now based in Canada (formerly in Australia). Ou-yang appears to be a member of the People's Liberation Army (PLA) and as such a scholar from the Military Economy College located in Wuhan. In 1997 he copublished together with Wang Qihua the book *On the Defense Economy in the Asia-Pacific*. Ou-yang mentions this book in his references (one of only four references), and the book is almost certainly in the Chinese language. Given that the 21 tables in the article do not contain any data beyond the year 1995, it can be assumed that the calculations were originally done for the 1997 book.

Ou-yang defines CNP in Marxist-Maoist style and theory. Accordingly, material and subjective abilities can be objectively assessed. These abilities seek to solve the contradictions between society and nature as well as the contradictions between nations. He discusses five power formulas, that of Wilhelm Fucks (section 13.10), Ray Cline, Robert Thompson, Fukushima Yasuhito (wrongly transliterated as "Fukunaka Kosai") (all in section 13.20), and Huang Shuofeng (section 14.3), commenting that all those "need to be improved further" (OU-YANG 2006: 71). He outlines three premises for his power formula, which are (1) the integration of quantity and quality in accordance to dialectical materialism, (2) economic theory related to the digression of marginal income, (3) and meteorology, Newtonian physics, and the mol equivalent principle used in chemistry. The formula is:

$$P = Z^{0.16}\ J^{0.22}\ E^{0.19}\ K^{0.11}\ W^{0.08}\ H^{0.14}\ D^{0.05}\ Y^{0.05} \times G^{0.19}\ R^{0.14}\ M^{0.10}\ X^{0.22}$$

P = comprehensive national strength; Z = national organizing ability;
J = military strength; E = economic strength; K = science and technology,
W = diplomatic ability; H = culture and education; D = geographical
environment; Y = natural resources; G = GNP; R = population; M = area;
X = military strength

The first set of eight factors stands for quality (sum of exponents is 1) and the second set of four factors for quantity (sum of exponents is 0.65). There are 38 variables that go into the eight quality factors, some of which appear to be quantified on the basis of evaluations. Ou-yang's article is too short to do justice to the complexity of his approach, and a great deal of necessary elaboration is missing. The basic idea that comes across is the need to multiply everything in terms of quality with everything in terms of quantity and thus attain a well-integrated result for national power. The following table presents the published CNP scores for all countries listed in the article:

Table 86: Comprehensive National Strength of Asia-Pacific Nations 1988–1995 [Ou-yang]

Country	1988–1989	1990–1991	1992–1993	1994–1995
United States	268,298	272,381	277,274	273,583
Russia	254,194	240,113	162,972	
China	132,508	137,800	156,496	
Japan	107,911	116,064	119,108	
India	79,230	85,008	87,781	
Australia	44,787	50,975	51,076	
Indonesia	43,256	46,290	49,697	53,655
South Korea	36,536	41,277	43,439	

Thailand	31,633	35,145	37,723	38,325
Vietnam	20,693	22,875	22,711	
North Korea	20,669	20,217	20,867	
Malaysia	18,346	21,232	21,934	
Philippines	18,444	20,126	20,711	
New Zealand	11,714	12,164	12,928	
Singapore	7,320	8,417	8,931	
Brunei	1,715	1,957	2,116	2,200
Total	1,097,254	1,132,041	1,095,764	367,763

Source: OU-YANG 2006: 85.

The index includes results for 16 countries on a ratio scale.

14.9 Zhu / Xiao 1999 CN

Zhu Xian and Xiao Lazhen are two scholars from the Central University of Finance and Economic Planning and Management. In 1999 they published the three-page article "Comparative Study of Comprehensive National Power" ["综合国力对比方法研究"] (ZHU & XIAO 1999). In the article they mention the operational formulas of John Peter Cole (section 13.7), Wilhelm Fucks (section 13.10), and Ray Cline (section 13.20), as well as the theoretical formula by Robert Thompson (also section 13.20). Their own formula is:

$$CNP = (C + E + I + K + X + S + CT + W) \times (R + O + J)$$

C = resources; E = economic activity; I = international competitiveness; K = science & technology capacity; X = sustainable development; S = level of social development; CT = state coercive power; W = diplomatic capability; R = strategic objectives; O = will to pursue national strategy; J = national cohesion

Basically it is a boosted up version of Cline's formula (arguably going beyond a mere modification). The following table presents the tangible factors, their respective weights, the number of variables used for each factor, followed by the weighting coefficients for the intangible factors:

Table 87: Factors, Weights, Number of Variables [Zhu/Xiao]

Factors	Weights	Variables
Resources	200	15
Economic Activity	200	17
International Competitiveness	100	10
Science & Technology Capacity	150	7
Sustainable Development	50	5
Level of Social Development	100	10
State Coercive Power	150	8
Diplomatic Capability	50	5
Total	1,000	77

Strategic Objectives	0.3
Will to Pursue National Strategy	0.2
National Cohesion	0.5
Total	1.0

Source: ZHU & XIAO 1999: 13.

Quite a number of variables are used, though the weighting of factors remains arbitrary. The following table presents the complete published results:

Table 88: Comprehensive National Power 1970−1995 [Zhu/Xiao]

Country	1970	1980	1990	1995
USA	974.8	854.9	832.7	832.2
Canada	563.6	553.8	569.3	536.6
Japan	458.4	506.6	522.7	549.5
Germany	490.4	521.7	510.5	485.4
France	453.6	503.5	488.3	485.5
United Kingdom	465.2	461.3	447.0	434.6
China	357.2	368.5	392.6	414.7
India	236.4	229.5	237.0	261.5
Total	3,999.6	3,998.8	4,000.1	4,000.0

Source: ZHU & XIAO 1999: 14.

Canada has a relatively high score (compare section 14.14). The Soviet Union is missing, perhaps due to a lack of data for all of the 77 variables.

14.10 Hu / Men 2002 CN

Hu Angang (born in 1953) is a Chinese economist who has written more than 50 books. He got his master's degree at Beijing University of Science and Technology in 1984, and his PhD in engineering at the Chinese Academy of Sciences (CAS) in 1988, before doing some postdoctoral studies at Yale University in 1991/1992. He is currently a professor at Tsinghua University, where he is also the director of the Center of China Study, a joint research center of CAS and Tsinghua University. Men Honghua (born in 1969) studied at Shandong University. He did his master's degree and Juris Doctor at Beijing University. He is currently a professor at the Institute of International Strategic Studies at the Central Party School, as well as a research fellow at the Center of China Study.

In 2002 they published the "The Rising of Modern China: Comprehensive National Power and Grand Strategy" in *Strategy & Management*, a Chinese-language publication of the Chinese Society for Strategy and Management (CSSM), which contains articles on the "future security environment" as well as "China's ranking in the various international indices of competitiveness" (PILLSBURY 2000: 373). The English translation of this article was presented at a conference in 2004 (HU & MEN 2002; also Hu 2007: 33−66).[320] In the conference paper they emphasize that, compared to the power analysis by

[320] A translation of the article into Russian is also available: http://www.situation.ru/app/j_art_1195.htm [16 August 2013] and http://www.situation.ru/app/j_art_1196.htm [16 August 2013]. For an article in Russian dealing with the history of measuring power in the United States and China, see BERGER 2006.

Western scholars, "CNP has a wider coverage, stressing comprehensiveness and all aspects, apparently including material strength, ideational ethos and international influence" (HU & MEN 2002: 2; or HU 2007: 34). They state that a unified definition exists for neither the Western concept of power nor the Chinese concept of CNP. They attempt a preliminary definition of the latter:

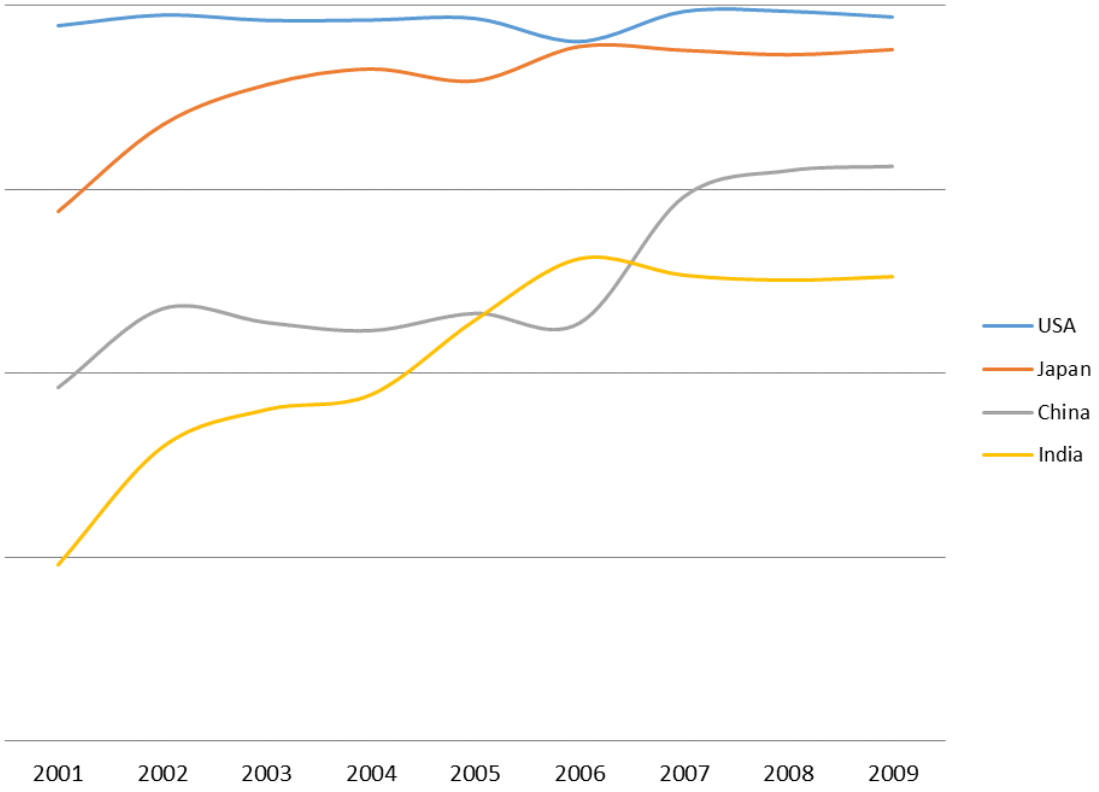
> In a word, CNP may be simply defined as the comprehensive capabilities of a country to pursue its strategic objectives by taking actions internationally and the core factors to the concept are strategic resources, strategic capabilities and strategic outcomes, with the strategic resources as the material base. (HU & MEN 2002: 3; or HU 2007: 34)

This is quite comprehensive, but when it comes to operationalization, it quickly returns to a discussion of resources. As for paying attention to past formulas, they mention Clifford German (section 13.5), Wilhelm Fucks (section 13.10), Ray Cline (section 13.20), the AMS (section 14.3), the CASS (section 14.6), and the CICIR (section 14.7). In addition, they consider the discussions on war potential by Klaus Knorr as a proper power equation, probably because Richard Merritt and Dina Zinnes had done so earlier (MERRITT & ZINNES 1988: 14, or 1989: 14–15).[321]

Michael Pillsbury has mentioned that Chinese scholars are fond of the annual Global Competitiveness Reports by the World Economic Forum (WEF).[322] They are inquisitive about China's international standing in the WEF's Global Competitiveness Index (formerly known as Growth Competitiveness Index) (PILLSBURY 2000: 226, 373). China's ranking has improved as can be seen in the following diagram. Rankings in the competitiveness indexes are standardized to account for the different numbers of countries included in each report:

[321] Klaus Knorr classified the determinants of potential military power into three categories, which were (1) economic competence, (2) administrative competence, and (3) motivation for war (KNORR 1956: 41).
[322] The WEF is best known for its annual meetings of top business leaders and politicians in Davos, Switzerland.

Figure 21: Competitiveness Rankings 2001–2009 [WEF]



Source: PORTER et alia 2001: 20, CORNELIUS et alia 2002: xv, PORTER et alia 2003: xiv, PORTER et alia 2004: xiii, LOPEZ-CLAROS et alia 2005: xvii; LOPEZ-CLAROS et alia 2006: xvii, PORTER et alia 2007: 10, PORTER & SCHWAB 2008: 12, SCHWAB 2009: 14; author's own calculations.

Michael Porter was the designer of the Business Competitiveness Index that merged with the Growth Competitiveness Index to form the Global Competitiveness Index. He teaches at Harvard Business School and is a leading expert on "The Competitive Advantage of Nations", which is the title of one of his major articles as well as one of his books (PORTER 1990, 1998). According to the article, "the only meaningful concept of competitiveness at the national level is *productivity*. […] Productivity is the value of the output produced by a unit of labor or capital" (PORTER 1990: 76). In his book he elaborates on factors in the competitiveness of nations. These factors are not unlike elements of power. He defines five factor groupings, which are (1) human resources, (2) physical resources, (3) knowledge resources, (4) capital resources, and (5) infrastructure (PORTER 1998: 74–75). He divides between basic factors and advanced factors:

> *Basic factors* include natural resources, climate, location, unskilled and semiskilled labor, and debt capital. *Advanced factors* include modern digital data communications infrastructure, highly educated personnel […], and university research institutes […]. (PORTER 1998: 76–77)

The connection to Hu and Men's CNP index becomes obvious when looking at the components:

Table 89: Strategic Resources & Major Indicators [Hu/Men]

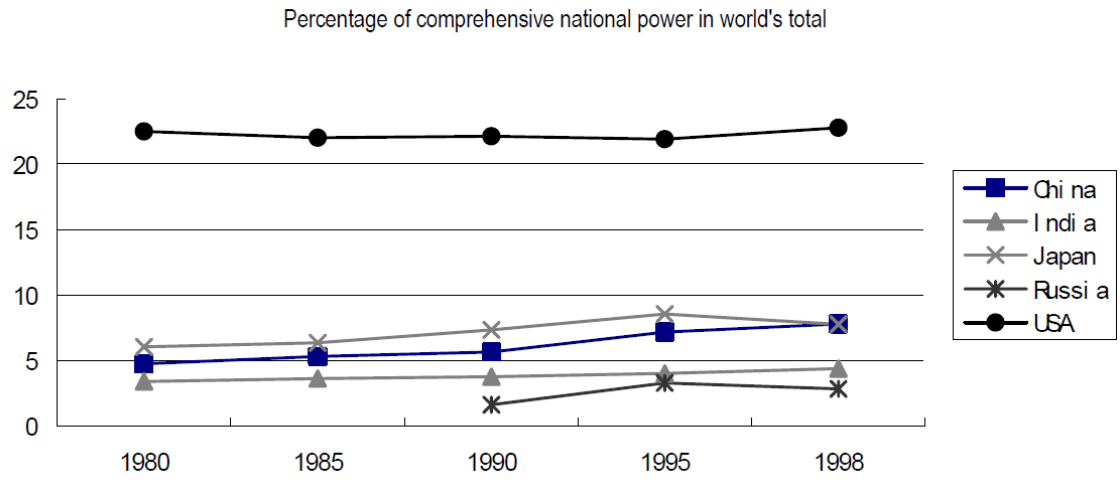
Resource / Indicator	Weight
Economic Resources	0.200
GDP PPP (International Dollar)	0.200
Human Capital	0.100
A. Working Age Population (Aged 15–65)	
B. Human Capital (Average Number of Years of Education Received)	0.100
C. Total Human Capital = A × B	
Natural Resources	0.100
Electricity Royalty and Licence Fees Receipts Production	0.025
Commercial Energy Use	0.025
Sowing Areas of Farm Crops	0.025
Freshwater Withdrawals	0.025
Capital Resources	0.100
Gross Domestic Investment	0.040
Capital Market Value	0.030
Net Foreign Direct Investment	0.030
Knowledge & Technological Resources	0.200
Number of Personal Computers	0.040
Internet Users	0.040
Patent Application Filed by Domestic Residents[323]	0.040
Scientific & Technological Journal Articles	0.040
R&D Spending	0.040
Governmental Resources	0.100
Expenditure of Central Government	0.100
Military Resources	0.100
Armed Forces Personnel	0.040
Military Expenditures	0.060
International Resources	0.100
Export Commodities & Services	0.030
Import Commodities & Services	0.030
Royalty & Licence Fees Receipts	0.020
Royalty & Licence Fees Payments	0.020
Comprehensive National Power	1.000

Source: HU & MEN 2002: 21.

The formula is such that all those resources/indicators are added in accordance with their weight. The weighting itself is arbitrary. The following diagram depicts the changes in CNP from 1980 to 1998. Numerical values are also available for the same five countries (HU & MEN 2002: 22–23):

[323] A Vietnamese article emphasizing the importance of patents as a criterion of national power briefly discussed Hu and Men's CNP approach (*Việt Báo Việt Nam* 2006).

Figure 22: CNP 1980–1998 [Hu/Men]



Source: HU & MEN 2002: 24.

David Kerr criticizes the general approach:

> Besides the methodology of this account—in what sense, for example, can China be considered a 'natural resource great power' when its per capita arable land is less than half the global average and its water resources one-fourth?—it is the relentlessly physical interpretation of what 'power' is that may be questioned. That power in the 21st century might depend on non-tangibles like norm building and compliance receives little consideration. Instead this is the 'rich country, strong state' image of the past re-invented with some technological add-ons. (KERR 2006: 88)

The input variables are not as broad as Hu and Men's definition of CNP, which means that by their own definition their resource-based index is incomprehensive.

14.11 Hai / Yun / Wang [2003] CN

The *2003 China's Sustainable Development Strategy Report* [*2003 年中国可持续发展战略报告*] by the Chinese Academy of Sciences (CAS) mentions a formula by Hai Ping, Yun Ping, and Wang Jingtao without any references (CAS 2003: 17). I have been unable to track down the source document. No results are given in the CAS report. For that reason it is unclear whether the formula is theoretical or operational. The latter is assumed, given that a little information on weight coefficients is provided. The formula is:

$$CNP = Basic\_Entity \times Material\_Power \times Spiritual\_Power$$

$$= CM \times (EC + ST + MC) \times (PC + CE + DC)$$

CM = resource power; EC = economic power; ST = science & technology power; MC = military power; PC = political power; CE = cultural power; DC = diplomatic power

The values for each power factor are standardized using the respective US value.

14.12 NIRA 2004 JP

The National Institute for Research Advancement [総合研究開発機構] (NIRA) was established in 1974 as a semigovernmental think tank. It ceased to be semi-governmental in 2007 and became instead a private-sector think tank. Since its foundation the NIRA has conducted more than 1,000 research projects that have had influence on national policy. Currently the NIRA's three emphasized fields of research are (a) areas of domestic social and economic policy, (b) international relations, and (c) regional issues. As for domestic social and economic policy, it focuses especially on the health and pension systems of Japan with due regard to demographics. Japan's ageing population is an area of special concern in contemporary Japan (EBERSTADT 2004: 10–14; also KOJIMA 2007).

In 2004 NIRA published a study on "Population Decline and Total National Capacity" ["人口減少と総合国力"] (NIRA 2004). The inquiry starts by stating that Japan's CNP is reduced by Japan's declining population. The study mentions Ray Cline (section 13.20) and argues that his equation proves population to be a decisive factor. The NIRA inquiry itself appears to be mostly based on CNP survey and measurement efforts by the Japanese Economic Planning Agency (EPA) (section 14.1) from 1993 to 1995. In discussing power, the study suggests three faces of power, and these serve as a basis for the following formula:

$$TNC = PCI + EVC + ICRC$$

TNC = total national capacity; PCI = power of civic improvement; EVC = economic value of creativity; ICRC = international community response capabilities

The power of civic improvement [市民生活向上力] refers to the ability of each citizen to partake in a rich life in terms of civil society, the "welfare state" (social indicators) being a measure of competence. The economic value of creativity [経済価値創造力] refers to the capability to enrich the life of the nation through business activities that provide a favorable environment, the "national market" (competitiveness) being a measure of competence. The international community response capabilities [国際社会対応力] refer to the ability to contribute to peace and the common prosperity of humankind, and the ability to protect the national interests of citizens, the "world state" (civitas gentium) being a measure of competence.

The NIRA approach to power is a matrix. One dimension is the three faces of power, whereas the second dimension consists of eight sectors (human resources, natural resources, technology,

economy, government, defense, culture, society), with 3 × 8 making for 24 fields. There are 103 variables in those 24 fields. For eight of these variables the NIRA conducted surveys in nine countries (Canada, China, France, Germany, Italy, Japan, Russia, South Korea, the United Kingdom, and the United States). A weighting scheme is implemented, though it is not clear how these weights are determined.[324] The following table presents the complete results for the matrix. The input values from the 103 variables are also available (NIRA 2004: 23–32):

Table 90: Estimated Total National Capacity in 2004 [NIRA]

Total National Capacity	Japan	USA	Canada	United Kingdom	France	Germany	Italy	South Korea	China	Total
Estimate	52.2	63.9	51.3	52.0	50.7	52.6	44.6	39.1	43.7	450.1
Faces of Power	**Japan**	**USA**	**Canada**	**United Kingdom**	**France**	**Germany**	**Italy**	**South Korea**	**China**	**Total**
Power of Civic Improvement	55.0	52.0	55.5	50.4	54.2	54.7	49.2	37.4	41.6	450.0
Economic Value of Creativity	54.4	65.4	48.5	49.4	49.4	49.1	42.8	42.6	48.4	450.0
International Community Response Capabilities	47.5	64.2	48.1	53.8	50.2	52.2	46.4	42.4	45.1	449.9
Sectors	**Japan**	**USA**	**Canada**	**United Kingdom**	**France**	**Germany**	**Italy**	**South Korea**	**China**	**Total**
Human Resources	56.8	59.7	53.4	45.5	37.8	47.5	41.5	40.3	67.5	450.0
Natural Resources	55.2	53.0	64.5	52.0	52.1	58.2	45.1	33.4	36.5	450.0
Technology	58.1	71.1	45.3	49.1	49.7	52.5	40.7	46.4	37.3	450.2
Economy	59.7	72.3	47.5	46.4	46.7	50.1	42.9	40.7	43.6	449.9
Government	45.5	67.3	52.3	57.5	57.6	51.6	41.1	35.8	41.3	450.0
Defense	43.0	72.9	46.5	58.2	50.7	48.7	43.2	41.0	45.8	450.0
Culture	45.7	57.2	41.0	55.6	65.3	54.6	55.5	34.2	40.9	450.0
Society	48.7	56.4	60.4	56.2	50.9	59.5	49.0	39.0	30.0	450.1

Source: NIRA 2004: 43.

In a comment on the study, Kobayashi Yotaro, chairman of the NIRA, writes that "'comprehensive social capability' may be a more appropriate expression than 'comprehensive national capacity'" (KOBAYASHI 2005) in line with the increased focus on corporate social responsibility, "the essential concept [of which] is that a company's value-creation activities must be judged not merely from the economic perspective, but from the perspective of its response to the wider needs of the society, which includes consideration of the environment and of social welfare" (KOBAYASHI 2005).

14.13 Sodekawa 2004 JP

Sodekawa Yoshiyuki is a researcher at the Dentsu Institute for Human Studies (DIHS), which is connected with Dentsu Incorporated, one of Japan's largest advertising companies. The institute itself conducts research on contemporary issues facing Japanese society. He is also a member of the Economic and Social Research Institute (ESRI) under the Cabinet Office of the Japanese government. Its purpose is to serve as a knowledge forum with focus on policy research. He is considered to be one of Japan's leading specialists on soft power. In 2004 he published a paper titled *About an Index of Soft Power* [*ソフトパワー指数について*] (SODEKAWA 2004).

[324] As the cited text is in Japanese, and I do not speak this language, the limits of internet translation are reached here.

While giving due credit to Joseph Nye for coming up with the term "soft power", Sodekawa wants to apply the concept to a socio-economic context. He thinks soft power is somewhat akin to a brand name, which is not entirely within the control of the producer. Most control is actually in the hands of the consumer. He divides soft power into *loose soft power* based on attractiveness and *tight soft power* based on influence (MIYAO 2004; compare FAN 2008: 154–156). An index based on tight soft power could possibly be considered a power index. As a soft power index, Sodekawa's index should theoretically be excluded from discussion in this study, but because it has this *tight* component, based on hard data rather than survey data, I decided to include it.[325]

For his index Sodekawa divides soft power into (1) chosen power [選ばれる力], which reflects on markets and institutions and as such what role a country chooses to play in the global economy, (2) leadership [リーダーシップ], which reflects on information and education and as such intellectual power, and (3) quality of life and culture [文化・ライフスタイルの魅力], which reflects on the cultural attractiveness of a country's culture and its people's lifestyle. Sodekawa admits that for the last one foreigners ought to be surveyed. Still he chooses to rely on hard data for approximation. He uses principal components analysis in some way to combine and weigh the 39 variables that go into the index. Note that "Average Tariffs" can be found twice in the index (3. and 12.):

Table 91: Principal Components and their Weights [Sodekawa]

Chosen Power	31.0%	Leadership	26.6%	Culture & Lifestyle	42.4%
A. Global Literacy	23.7%	C. Media & Frontier Technologies	4.0%	E. Nature	16.4%
1. Private Investment (% of Gross Domestic Fixed Capital Formation)		14. Number of Engineers per capita		24. Water Quality of Lakes	
2. GDP per capita		15. Number of Computers per capita		25. Number of Species of Higher Plants	
3. Average Tariffs		16. Number of Internet Users per capita		26. Emission of Sulfur Oxide	
4. International Tourism Receipts		17. Mobile Phones per capita		27. Emission of Carbon Dioxide	
5. International Flights		D. Intelligence	22.6%	F. Culture	23.1%
6. Number of International Conferences		18. Global Companies		28. Employment Rate in Service Sector	
7. Number of Olympic Games		19. R&D Personnel		29. Proceeds from Book Exports	
8. Stock Market Capitalization		20. Number of Independent Think Tanks		30. Public Expenditure on Education (% of GDP)	
9. Credit Rating by Institutional Investors		21. Amount of Venture Capital		31. Number of World Heritage Sites	
B. External Dependence	7.3%	22. Countries with Close Relations		32. Annual Number of Movies Watched per capita	
10. Foreign Direct Investment (% of Gross Domestic Investment)		23. Math Olympics		33. Sales of CDs et cetera	
11. Trade Dependency Ratio = (Exports + Imports) / GDP				G. Comfort	2.9%
12. Average Tariffs				34. Number of Suicides	
13. Patent Applications (Residents vs. Nonresidents)				35. Traffic Accident Fatalities per car	
				36. Life Expectancy	

[325] In this case "soft power" is similar to hard power factors except that they are not directly concerned with economics and the military. Possible issues could be social justice, life expectancy, education. In this sense it comes close to the "human security" concept (section 15.5).

		37.Population Aged 65 and Over
		38. Unemployment Rate
		39. Public Expenditure on Health
		40. HIV Infection Rate

Source: SODEKAWA 2004: 3–5; GARINGALAO 2006: 30.

As can be seen, except for the exclusion of military power, it is a CNP index in line with the broader Sino-Japanese understanding of national power. Sodekawa does not provide the actually calculated numbers. He only provides the rankings. The following table presents the rankings for all principal components as well as total ranking. Intermediate rankings for the three general divisions are also available but not presented here:

Table 92: Soft Power Ranking in 2004 [Sodekawa]

Country	Global Literacy	External Dependence	Media & Frontier Technologies	Intelligence	Nature	Culture	Comfort	Overall
United States	1	14	2	1	15	1	6	1
United Kingdom	3	6	7	5	13	2	11	2
France	2	7	9	6	9	3	1	3
Germany	4	12	11	4	5	4	2	4
Sweden	11	2	1	13	1	6	5	5
Japan	8	15	8	2	11	9	4	6
Italy	6	8	10	10	8	5	7	7
Australia	9	10	5	9	3	7	8	8
Netherlands	5	4	6	14	6	10	10	9
Switzerland	7	5	3	12	4	11	3	10
Singapore	10	1	4	11	10	12	13	11
China	14	9	13	3	14	8	15	12
South Korea	12	11	12	7	12	14	14	13
Thailand	15	3	14	15	2	15	9	14
India	13	13	15	8	7	13	12	15

Source: SODEKAWA 2004: 6–7.

As far as correlations are concerned, the two highest Spearman correlation coefficients are:

Global Literacy & Culture: +0.789

External Dependence & Intelligence: –0.786

A tentative conclusion could be drawn that economics and culture go hand in hand (MIYAO 2004; also GARINGALAO 2006: 30–31). One must be careful about drawing such conclusions, because of the lack of dimensional consistency. As can be seen in the table listing the input variables, the variables are on an aggregate basis, per capita basis, and other ratios and rates. Adding variables of different dimensions together this way does not work (see section 16.3 for discussion).

14.14 Wang 2006 CN

Wang Defa (born in 1947) is a Chinese statistician. He graduated from the Shanghai College of Finance in 1983 and has a master's degree in economics. He is an associate professor at the Shanghai University of Finance and Statistics and has been to Japan several times as a visiting scholar. He has written several books and many papers. In 2006 he published a course book *Introduction to National Accounts* [*国民经济核算概论*] (WANG 2006). The system of national accounts (SNA) is concerned with measuring economic activity through consistent standards in order to make these measures internationally comparable. In the eleventh and last chapter of the book he presents his own national power formula for comparing different countries (WANG 2006: [chapter 11]).[326] He is familiar with many previous approaches to measuring national power. He compares his results with those of John Peter Cole (section 13.7), Wilhelm Fucks (section 13.10), Ray Cline (section 13.20), the EPA (section 14.1), Huang Shuofeng (section 14.3), Yu Hongyi and Wang Youdi (section 14.4), and the CASS (section 14.6) (WANG 2006: [page 25 of chapter 11]).

Wang defines CNP in relation to **comprehensive development** and views it as a complex large system that is measurable. He emphasizes that (a) CNP consists of material force and spiritual force, and (b) that CNP refers not only to present reality but also potential. His approach to national power is intricate, using 128 indicators within eight categories. His experience as a statistician shows up in his well-defined selection standards and his elaborate method for combining and weighing these indicators.[327] The following table presents the eight categories and their calculated weights:

Table 93: Categories of Comprehensive Development and CNP [Wang]

Categories	Weights
Natural Resources	8%
Economic Power	26%
Technological Power	20%
Military Power	12%
Social Development	10%
Internationalization	10%
Political Power	7%
National Spirit	7%
Total CNP	100%

Source: WANG 2006: [page 24 of chapter 11].

The last two categories recognizably cover spiritual force. For estimating political power and national spirit Wang relies on expert ratings. The following table lists the complete results for the total CNP of twelve countries. Results in seven categories are available for the same twelve countries, with only natural resources missing (WANG 2006: [page 23 of chapter 11]):

[326] It is not clear whether the referenced PowerPoint presentations represent the actual book or are just presentations based on it. In any case, the original work can be cited this way: 王德发. 国民经济核算概论. 上海财经大学出版社, 2006.
[327] Wang's method cannot be presented here, for the cited text is in Chinese, and as I do not speak Chinese, the limits of internet translation have once again been reached.

Table 94: CNP Scores in 1993 [Wang]

Country	CNP Scores	Country	CNP Scores
United States	3.59870	United Kingdom	−0.22785
Former Soviet Union	1.31880	China	−0.29660
Japan	1.06970	Italy	−0.69940
Germany	0.40020	South Korea	−0.98120
Canada	0.17470	Brazil	−2.14940
France	−0.00970	India	−2.26890

Source: WANG 2006: [page 24 of chapter 11].

The CNP scores are on an interval scale and not on a ratio scale. As a result one can say that the United States is more powerful than China, but one cannot say how many times more powerful. That Canada emerges here as more powerful than France and the United Kingdom can be best explained by remembering that Wang's CNP definition explicitly includes future potential. The most important question to answer is whether these results based on 128 variables are really superior to the results of much simpler approaches. Yan Xuetong (section 14.7) has already been quoted as saying that "neither increasing the number of factors measured, nor using complicated measurements have led to an improvement in the accuracy of measuring China's current power status" (YAN 2006: 8–9).

14.15 Kim 2007 KR

Kim Hyung Min is a Korean political scientist, currently professor of political science at Chung Ang University. He studied political science at Sogang University and attained his master's degree in political science at the State University of New York. In 2007 he got his PhD in political science from the University of North Carolina at Chapel Hill with a dissertation titled *Social network conceptualizations of international system structure and national power: A social network perspective on international relations* (KIM 2007). This dissertation contained his initial work on creating a network power index. In 2009 he published an article online titled "Introducing the New Concept of National Power: From the Network Perspective" (KIM 2009). In 2010 his article "Comparing Measures of National Power" appeared (KIM 2010). In both articles he presents his measure of national power that he calls Structural Network Power Index (SNPI).

Kim has a radically different approach to power. He defines power not as the resources a country has in isolation, but rather as something deriving from a country's interaction with other countries. This logically implies that if two countries were equal in all aspects except their level of interaction with other countries, the more interactive country would be considered more powerful than the more isolated country. The following table compares the isolated-attributional power concept as expressed, for example, in the Composite Index of National Capabilities (CINC), which was used in Correlates of War (COW) project (section 13.15), and Kim's social network power concept:

Table 95: Attributional Power Concept versus Social Network Power Concept [Kim]

	Attributional power concept (focusing on the COW index)	Social network power concept
Focus	What a state possesses (i.e., its attributes)	How a state interacts with other states (i.e., its relations)
Aspects of power	Demographic, industrial, and military capabilities	Five different aspects of network power
Independent of other system members	Yes A state's power is not affected by power of the other system members	No A state's power is affected by power of the other system members
Independent of international system structure	Yes A state's power is not affected by system structure	No A state's power is affected by system structure (how a state is positioned in the structure defines its power)

Source: Kim 2009: 3.

The problem with the social network power concept is that a poor but interactive country could be considered more powerful than a rich but isolated country. In the most extreme case this logically implies that two tiny countries interacting with each other would have to be considered infinitely more powerful than a huge empire that were completely closed off. Most geopoliticians of the past would have preferred a higher degree of self-reliance to a lower degree of self-reliance in preparation for an international crisis (compare section 7.1, further section 13.2).

Kim uses six variables to determine his SNPI, which are (1) diplomatic exchanges, (2) foreign student exchanges, (3) international telecommunications, (4) arms transfers, (5) international exports, and (6) international assistance. In his calculations he focuses

> on several different dimensions of structural network power […] based on five different conceptualizations of point centralities from network analyses of different types of interaction data (i.e., degree, betweenness, flow-betweenness, coreness, and ego network brokerage). (KIM 2009: 4)

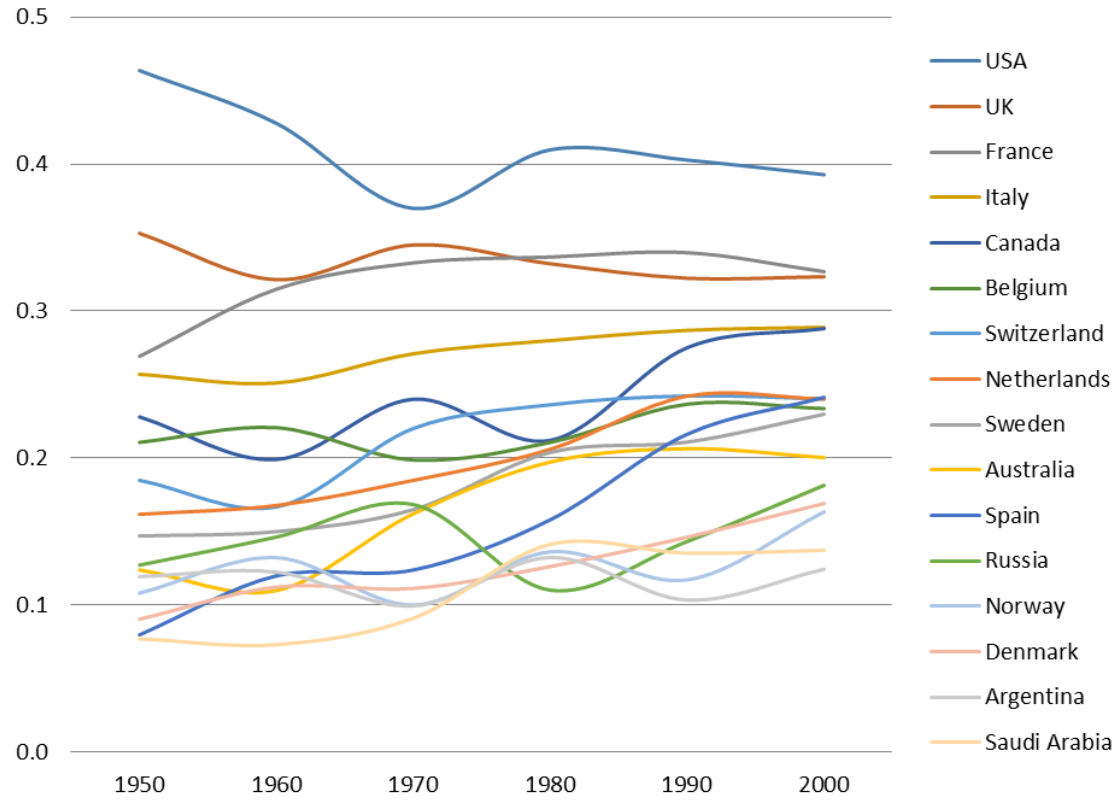
He provides four formulas for some of these dimensions in the same paper (KIM 2009: 4–5). The exact methods on how to calculate the five different conceptualizations of point centralities are probably elaborated in his PhD dissertation. In his dissertation he also provides the SNPI results for all states at decade intervals in the time period 1950–2000 (see KIM 2007). From the provided results in his 2009 article it is clear that the summary formula must be like this:

```
SNP = ( D + B + F + C + E ) / 5

SNP = structural network power; D = degree; B = betweenness;
F = flow-betweenness; C = coreness; E = egonet brokerage
```

The following diagram depicts SNPI results available in his 2009 article, but only for those countries for which results were available in all decades. There is also data available on the five different conceptualizations of point centralities that went into the SNPI (KIM 2009: 6–8):

Figure 23: Ranking of Countries on Structural Network Power Measures [Kim]



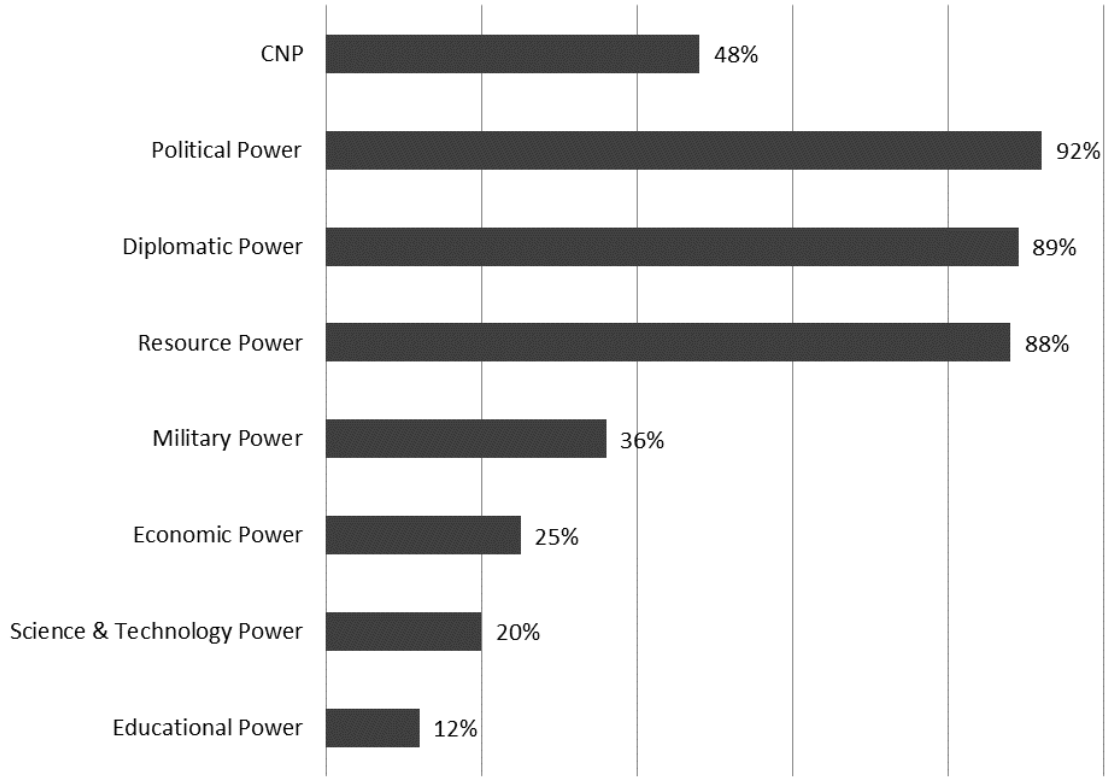
Source: KIM 2009: 9.

For 1980 Russia was calculated to be the least powerful country of all countries in this diagram. This means that Russia was less powerful than Denmark. Kim claims "that the measurement model of the new national power measure performs far better than that of previous national power measures" (KIM 2010: 405). In fact, the SNPI results for 16 countries in 2000 can be compared to the power perceptions of 214 French defense industry experts in 1998 (CARO 2000b: 103–104; also section 13.33). The same is done for the CINC in 2000 (GREIG & ENTERLINE 2010a) to see whether the SNPI is superior to the CINC as claimed. The Pearson correlation coefficient (r) is 0.56 for the SNPI and the expert power perceptions. It is 0.84 for the logarithm of the CINC and expert power perceptions. This demonstrates that the SNPI performs much worse in approximating power perception.

14.16 [US Agency] 2008 [US]

According to a number of Chinese articles and blogs repeating similar information, an unidentified US agency allegedly published a report on 24 August 2008 titled "Tenth Global Comprehensive National Power Ranking" ["第十次全球综合国力排名"]. I have been unable to track down any such report by a US agency. That is why the information here is tentatively listed among the Sino-Japanese formulas. The first four ranks in this unidentified report are given to the United States, Japan, Germany, and China. The following bar chart depicts how China performed vis-à-vis the United States (USA = 100%) in terms of total CNP and its seven components:

Figure 24: Chinese Performance as a Percentage of US Performance 2008 [US Agency]



Source: sybil798 2009.

A number of ranks are also provided for China, such as for CNP (rank 4), for military power (rank 3), for economic power (rank 3), for scientific and technological power (rank 8), and for educational power (rank 10). It is mentioned that China ranks 100th in terms of per capita GDP. Hence it can be assumed that this unidentified report probably covered most countries. There is also a lot of other data, though it is not clear whether it directly relates to this unidentified report.

14.17 Hansun 2009 KR

The Hansun Foundation for Freedom & Happiness is a South Korean think tank founded in 2006. Hansun is the abbreviation for the Korean Peninsula Advancement Foundation [한반도선진화 재단]. Either name can be used. The think tank strives to support the process of unification on the Korean peninsula on the basis of democracy, a market economy, rule of law, and social welfare. 'Social welfare' in this context refers to the notion of a higher quality of life for all Koreans rather than the Western concept and its associated socialistic policies. The Hansun Foundation is a conservative think tank, leaning clearly to the right of the Korean political spectrum. In terms of international relations this means that it tends to be pro-American and anti-engagement vis-à-vis North Korea. Many prominent people are either members or advisors of the Hansun Foundation. Lee Myung-Bak, who became South Korean president in 2008, was a prominent guest at the founding ceremony of the

Hansun Foundation in 2006. Lee reversed the policy of engagement towards North Korea that had been pursued by his two predecessors.

On 15 August 2009, the occasion of the 64th anniversary of independence from Japan, the Hansun Foundation together with *Chosun Ilbo*, one of the major Korean daily newspapers, published a number of articles, the first one titled "'Republic of Korea Power' World No. 13" ["'대한민국 파워' 세계 13위"] (Hansun Foundation 2009; also *Chosun Ilbo* 2009). The series of articles compares the national strength of the G-20 countries. In place of the EU, the CNP for Spain is calculated. Hwang Sung Don (born in 1952) appears to be the project coordinator. He is professor at the Hankuk University of Foreign Studies. A team of ten experts from the Hansun Foundation has worked with him, all of them professors or research fellows at different universities and institutes. The team is aware of previous Japanese calculations by the NIRA (section 14.12) and the EPA (section 14.1) (Hansun Foundation 2009: 7). The Hansun Total National Power Index consists of 13 arbitrarily weighted sectors. Seven sectors represent the hard power category. Six sectors represent the soft power category. The following table displays those sectors and categories with their respective weights:

Table 96: Hard Power & Soft Power Categories [Hansun]

Category / Sector	Weight	Category / Sector	Weight
Hard Power	60	Soft Power	40
Basic Resources (Land & Population)	5	Government	5
Defense	10	Politics	10
Economy	20	Diplomacy	10
Science & Technology	10	Culture	5
Education	5	Social Capital	5
Information	5	Response to Macro Changes	5
Environmental Management	5		

Source: Hansun Foundation 2009: 4; *Chosun Ilbo* 2009.

If anything, the table shows that no clear definition exists on soft power in general. Education and information could just as well be considered soft power. Government and long-term social capital could just as well be considered hard power. In the end, arbitrary decisions based on convenience determine what is soft and what is hard (compare section 9.2). The following table presents the complete published results, including both the soft and hard power categories. Incomplete scores are available for the thirteen sectors in various rankings, though they are not presented here:

Table 97: Hansun Total National Power Index for 2009

Rank	Country	Hard Power	Soft Power	Total National Power
Maximum Possible		**60.00**	**40.00**	**100.00**
1	United States	44.05	25.10	69.15
2	China	32.98	21.75	54.73
3	Japan	31.98	21.47	53.45
4	UK	30.27	22.78	53.05
5	Germany	30.88	22.04	52.92
6	France	30.21	21.95	52.16
7	Canada	30.00	22.16	52.16

8	Australia	29.22	22.00	51.22
9	Italy	28.80	20.55	49.35
10	Spain	28.66	20.23	48.89
11	India	29.39	19.29	48.68
12	Russia	30.91	17.76	48.67
13	South Korea	29.45	19.11	48.56
14	Brazil	28.68	17.87	46.55
15	Turkey	27.50	18.78	46.28
16	Mexico	27.57	17.88	45.45
17	South Africa	25.86	19.09	44.95
18	Indonesia	27.07	17.79	44.86
19	Argentina	27.40	16.73	44.13
20	Saudi Arabia	26.96	14.72	41.68

Source: Hansun Foundation 2009: 1, 3.

North Korea is admittedly not a member of the G-20, yet it is ever present in the South Korean outlook on international relations. It is stated that in the event of unification Korea would be in the top ten. The number of points it would take for South Korea to equal Italy (rank 9) is 0.79. This does not imply a lot of points for North Korea. If per capita rates are mixed into the calculation of values, it makes more sense, as unification would temporarily drag down the per capita economic level of South Korea. The Chinese, especially, have paid some attention to this index.

15. The Indian National Security Index (NSI) 2002–2008[328]

While the NSI is the major power index produced in India, it is essentially an adaptation of the Sino-Japanese CNP concept. Like other power formulas, the NSI includes various indicators of power. It is uniquely Indian in that it initially emphasized human development and later included ecology based on a holistic human security paradigm. The analysis demonstrates that this holistic approach has now been abandoned in favor of a more conventional one, and that the technical formulas and theoretical concepts of the NSI exhibit various inconsistencies and problems. In particular, one can recognize the indisputable need for dimensional consistency when adding variables, applicable to the construction of composite indexes in general (section 15.7; further see section 16.3 for discussion).

It can be assumed that "any non-omniscient Being (i.e. any frail human being) probably can never apprehend the true objective fact" (KENT 1951: 42), but subjectivity may indeed be useful in contributing new ideas from previously ignored perspectives. The National Security Index (NSI), which was developed by the Indian National Security Council Secretariat in 2002, has an Indian flavor: it initially emphasized human development and later included ecology, since India, where the population density is higher than in Japan, is known for mass poverty and overcrowding. It is tempting to suspect that Indian IR analysts in general would be rather fond of GDP at purchasing power parity (PPP) rather than at the official exchange rate (OER) as this would immediately triple their economic size, but such a general subjective preference cannot be confirmed.[329]

The argument could be made that the NSI is relevant because India is increasingly relevant. This would then imply that the other power indexes of smaller countries are less relevant. If the NSI is so relevant as to deserve its own section in this study, then this has nothing directly to do with the rise of India. It is rather that the NSI represents the latest major development in the construction of power formulas, drawing upon the heritage of both Western power formulas as well as Sino-Japanese CNP. The NSI may also be regarded as a symptom of India's ascendancy to global power, but any hypothetical attribution of power indexes to growth in power can be expected to suffer from self-selection bias. This means that the increased public availability of some indexes' data vis-à-vis less available indexes distorts perception. Indians have most likely constructed power indexes before, but, if so, they have disappeared from view. It may simply be the internet that makes today's new power indexes internationally traceable. Pre-internet Indian power indexes may never be resuscitated without substantial research on the part of Indian scholars themselves.

[328] This section has already been published as a working paper (HÖHN 2010).
[329] The NSI uses GDP-OER. The Indian economist Arvind Virmani developed his own power index in 2004/2005 (section 13.37). He insists that GDP-PPP is the better measure and resents any notion that GDP-OER may be as good or even better. The basis for his claim is an unconcealed nationalist bias regarding the ranking of India (see VIRMANI 2005b: 7).

15.1 Geopolitical Challenges in India's Quest for Great Power Status

> I have a THIRD vision. India must stand up to the world. Because I believe that unless India stands up to the world, no one will respect us. Only strength respects strength. We must be strong not only as a military power but also as an economic power. Both must go hand-in-hand.
>
> Avul Pakir Jainulabdeen Abdul KALAM
>
> 11th President of India (2002–2007), 2006

In the index of Mearsheimer's *The Tragedy of Great Power Politics* from 2001, one finds 65 entries for the People's Republic of China and three entries for India (MEARSHEIMER 2001: 538, 543), a fact which is symptomatic of the low prestige that India has so far suffered. Yet in recent years it has become increasingly fashionable to laud India's ascendance to the rank of global power (BASU 2008: 396). The problem is pinpointing the timing of India's entry into the league of great powers. The Pokhran-II nuclear tests from 11–13 May 1998 could represent a suitable date, but only because India successfully weathered the resulting sanctions. These tests were surely meant to validate India's claim to great power status (NAYAR & PAUL 2003: 27; PERKOVICH 2003: 5).[330]

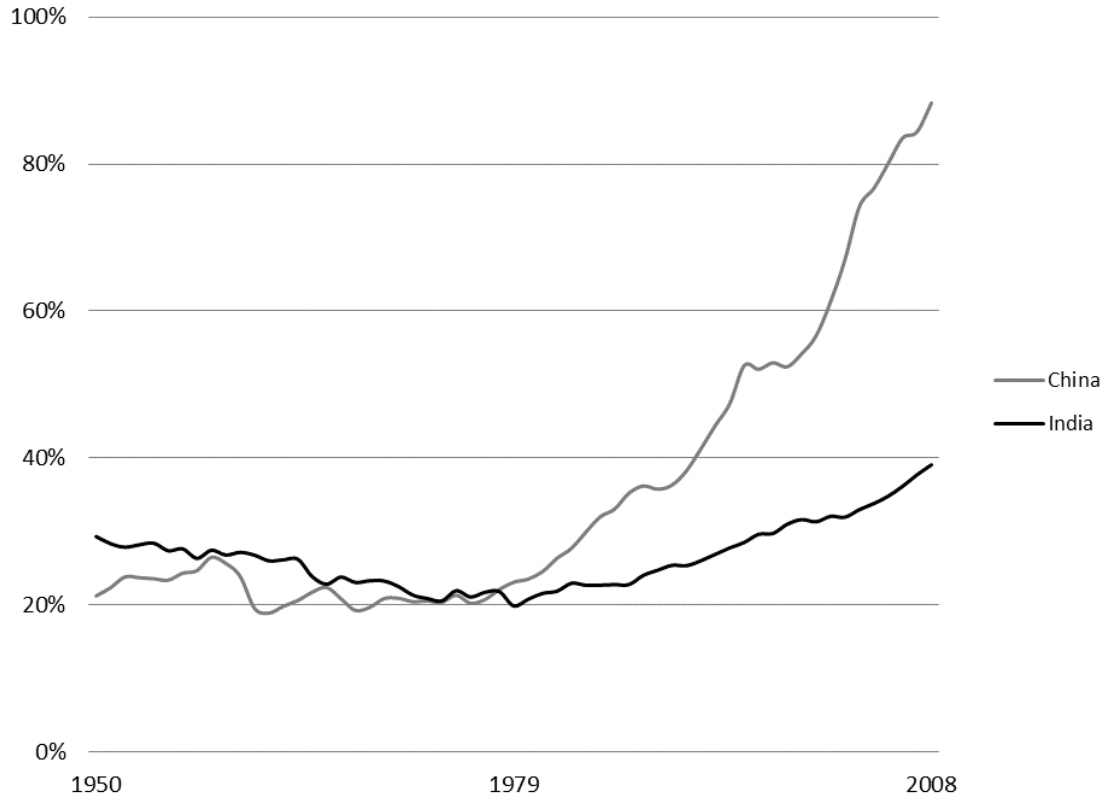
In contrast, India's low point in economic development may be established as 1979. Though relative to China the difference in wealth has never been as great as today. The time period 1947–1979 was marked by Fabian semi-socialism, less so in terms of direct state ownership than in terms of control through the ill-famed Licence Raj.[331] The relatively stable per capita growth rate of just over 1 percent during this time period became known as the "Hindu rate of growth". Moderate reforms were initiated in the 1980s. Large fiscal deficits during this time period spilled over into the trade deficit and brought about a serious balance of payments crisis in 1991, when the Indian government came close to defaulting on its external obligations. From 1991 to 1993 this crisis sparked the push for more drastic reforms aimed at further economic liberalization. Compared to its unsustainable growth track of the 1980s, India now looks to be on a sustainable path as all critical debt ratios have developed in a favorable direction.[332]

[330] In this regard the role of the Bharatiya Janata Party (BJP) elites in pushing for an overt nuclear program in 1998 can also be mentioned. The BJP bases its ideology on "Hindutva", which demands Hindu nationalism in the form of one nation, one religion, and one country. Its ideology comes from the *Arthashastra* and states that India should be strong. A pertinent book on this issue is: Jaffrelot, Christophe. ed. 2007. *Hindu Nationalism: A Reader.* Delhi: Permanent Black.

[331] The Licence Raj (1947–1990) refers to a bureaucratic system that set quotas for businesses as to how much of a certain product they were allowed to manufacture. The quantity of goods was therefore not determined freely by supply and demand.

[332] (1) Debt Stock-GDP Ratio 1990–1991: 28.7; 1999–2000: 22.0; (2) Debt-Service Ratio 1990–1991: 35.3; 1999–2000: 16.0; (3) Debt-Exports Ratio 1990–1991: 491.7; 1999–2000: 258.6; (4) Short-term Debt/Total Debt 1990–1991: 10.3; 1999–2000: 4.1; and (5) Short-term Debt/Foreign Currency Reserves 1990–1991: 382.3; 1999–2000: 11.5 (BARU 2003: 186–187).

Figure 25: Per Capita GDP-PPP as Percentage of Per Capita GWP-PPP 1950–2008 [Maddison]



Source: MADDISON 2010.

Countless scholars have emphasized the importance of war in proving national power. Karl Haushofer stated that the ultimate test of national strength is war (HAUSHOFER 1913: 8). Nicholas Spykman stated likewise (SPYKMAN 1942: 22). AJP Taylor stated that traditionally "the test of a Great Power is then the test of strength for war" (TAYLOR 1954: xxix). George Perkovich stated in a more recent lecture on India that war provides the empirical test of military power (PERKOVICH 2003: 14, 2004: 136). Chang Chin-Lung referred to "one-on-one all-out conflicts, as the acid test for power equations" (CHANG 2004: 21). India was clearly beaten in the brief Sino-Indian War in 1962. In comparison, Vietnam performed better in the brief Sino-Vietnamese War in 1979. Historically, major victories and major defeats have been the entry and exit points for membership in the league of great powers. The pressing problem for India "is the absence of a peaceful mechanism for rising powers to gain acceptance in the international hierarchy" (NAYAR & PAUL 2003: 7–8, 35).

Great power status may well be an arbitrary judgment. Most definitions of it are near tautological, employing arbitrary cutoffs as to capability and timing (see LEVY 1983: 11–19). Mathematically the issue is one of determining thresholds for dividing countries into divergent classes with emerging attributes clearly associated with a higher level of capability.[333] A promising indicator of great power capability may be the level of employment in arms production. The five members of the UN Security Council happened also to be the five countries with the largest employment in arms

[333] For the application of the Herfindahl-Hirschman index of concentration to determine a rather abstract system threshold, see HÖHN 2008a: 18.

production as late as 2003. Arms production is India's weak point "as it is heavily dependent on external suppliers for major weapons systems such as fighter aircraft and advanced munitions" (NAYAR & PAUL 2003: 44; compare *Economic Times* 2004).

Table 98: Estimated Level of Employment in Arms Production 2003 [BICC]

Country	Employees
United States	2,700,000
China	2,100,000
Russia	780,000
France	240,000
United Kingdom	200,000
Ukraine	180,000
India	170,000
North Korea	120,000
Germany	80,000
Japan	80,000

Source: http://www.sipri.org/databases/first [20 April 2009] (original source: Bonn International Center for Conversion – BICC).

Many Indians insist as a matter of principle that India deserves a permanent seat on the UN Security Council. China seems to act as an obstacle to this aim (PERKOVICH 2004: 142; NAYAR & PAUL 2003: 12). Brazil and Germany are geographically far away from China, so two permanent seats for Brazil and Germany would have no direct bearing for China. However, given India's and Japan's geopolitical positions as China's direct neighbors and competitors, China cannot really benefit from supporting India and Japan. Perkovich puts the challenge this way:

> One measure of Indian diplomacy in the future will be how it either lowers the value of a Security Council seat and therefore makes India's power ranking independent of such a position, or alternatively how India attains a seat. (PERKOVICH 2003: 19)

Some people like to imagine India as a vegetarian elephant (VIRMANI 2005a: 8). However, sooner or later frustration and impatience may lead to adventurism.[334] India's peaceful nature, especially as a democracy, can be asserted, particularly in the context of democratic peace theory, but the latter merely states that democracies do not fight other democracies (MEARSHEIMER 2001: 16). India's neighbors have not been fully-developed, stable democracies for long periods of time. As a result they "remain part of the devalued out-group, and legitimate targets of violence" (JOHNSTON 1995: 60–61). Indians understandably resent the disadvantages that can come from being underestimated but tend to overlook the disadvantages that can come from being considered too powerful too soon. The latter situation could turn out to be a lot worse than the former. The Chinese have wisely followed Deng Xiaoping's 24 Character Strategy[335] in order to avoid preemptive containment strategies.

[334] Charu Majumdar (1918–1972) eloquently expressed this frustrated impatience in the context of guerrilla warfare: "Mere collection of arms does not alter the character of struggle—the guns collected have to be used" (MAJUMDAR 1965–1967: VIII).
[335] "冷静观察, 站稳脚跟, 沉着应付, 韬光养晦, 善于守拙, 绝不当头" translated as "observe calmly; secure our position; cope with affairs calmly; hide our capacities and bide our time; be good at maintaining a low profile; and never claim leadership" (USDOD 2007: 6).

15.2 The Role of Power in Kautilya's *Arthashastra*

Given that the *Arthashastra* is the key text on Indian strategic culture, it is expedient to say a little about the role of power in it. Kautilya lived circa 350–283 BC. He was largely responsible for the creation of the Mauryan Empire in his role as advisor and prime minister to the first Maurya emperor, Chandragupta. In addition, he was a professor at Takshashila University. Kautilya wrote the *Arthashastra* as a treatise on statecraft. According to Roger Boesche, it is

> a book of political realism, a book analysing how the political world does work and not very often stating how it ought to work, a book that frequently discloses to a king what calculating and sometimes brutal measures he must carry out to preserve the state and the common good. (BOESCHE 2002: 17)

For Kautilya power is the means and not the end, so "strength is power, and happiness is the end. […] Hence a king shall always endeavor to augment his own power and elevate his happiness" (Kautilya, *Arthashastra* 6.2). Further, "the possession of a prosperous treasury and a strong army is the strength of sovereignty" (KAUTILYA, *Arthashastra* 6.2). As for the seven "constituents of the state," Kautilya listed "Swamy (King), Amatya (Prime Minister), Janapada (populated territory), Durga (fort), Ksha (treasury), Bala (force / army) and Mitra (ally)" (NAIK 2004).

For the augmentation of power the general rule applies that "whoever is inferior to another shall make peace with him; whoever is superior in power shall wage war" (KAUTILYA, *Arthashastra* 7.1). Power is the basis for the acquisition of more power. For successful warfare "the conqueror should know the comparative strength and weakness of himself and of his enemy" (KAUTILYA, *Arthashastra* 9.1), and comparison entails measurement, at least according to Sun Zi.[336]

As for the important connection between economics and military matters, Sanjaya Baru has recently reiterated Kautilya's argument as follows:

> The management of the economy, and of the treasury, has been a vital aspect of statecraft from time immemorial. Kautilya's *Arthashastra* says, "From the strength of the treasury the army is born. …men without wealth do not attain their objectives even after hundreds of trials… Only through wealth can material gains be acquired, as elephants (wild) can be captured only by elephants (tamed)… A state with depleted resources, even if acquired, becomes only a liability." Hence, economic policies and performance do have strategic consequences. (BARU 2009)

15.3 The Institutional Background

Given that every power index is the idiosyncratic product of its designer and its institutional environment, some information regarding which people and institutions the NSI has depended on in its

[336] "The rules of the military are five: measurement, assessment, calculation, comparison, and victory. The ground gives rise to measurements, measurements give rise to assessments, assessments give rise to calculations, calculations give rise to comparisons, comparisons give rise to victory" (SUN TZU, *The Art of War* 4).

formation and evolution is provided here. This provides some context regarding the motivations and viewpoints that went into the NSI.

The National Security Council (NSC) was set up on 19 November 1998 to overcome structural deficiencies in the coordination of national security. The council originally included the newly created national security advisor (NSA); the ministers of defense, external affairs, home, and finance; and the deputy chairman of the Planning Commission. The National Security Council Secretariat (NSCS) was established in April 1999 and succeeded, with expanded responsibility, the existing Joint Intelligence Committee (JIC), which had been largely limited to producing a monthly intelligence review (CHANDRA 2006: 209, 215).

The nationalist Bharatiya Janata Party (BJP), with Atal Bihari Vajpayee as prime minister, had come to power on 19 March 1998, two months before the Pokhran-II nuclear tests from 11–13 May 1998. It had established a task force to study the national security mechanisms of other countries and to submit recommendations on revamping the Indian system, the result being the NSC and other subgroupings (RAMAN 2004, 2005). Apurba Kundu comments that "in a marked departure from previous national governments, those led by the Bharatiya Janata Party (BJP) sought to address national security issues both proactively and strategically in line with the party's philosophy of achieving a strong India" (KUNDU 2004a: 4).

Satish Chandra served as chairman of the JIC from January 1999 to April 1999, and then as deputy NSA and secretary of the NSCS from April 1999 to February 2005. He emphasizes that the NSC was intended to be geared towards a more holistic view of national security that included "issues like good governance, health, water management, environment, technology or even the economy" in addition to conventional topics such as "insurgencies and law and order, terrorism, foreign policy, etc" (CHANDRA 2006: 202, further 207). In addition to evaluating the intelligence collected by other agencies, the NSCS became a quasi think tank that initiated papers on human security as well as national security (CHANDRA 2006: 217). The NSI appears to have been one outgrowth of the secretariat's assertive creativity.

There appears to have been some institutional resentment between the traditional ministries and the newly established NSC and NSCS as a result of their different outlooks. Chandra states that "regrettably, the political and bureaucratic leadership continues to remain wedded to a damage control mode rather than a more cerebral long-term policy evolution mode" (CHANDRA 2006: 224). The relatively new NSCS seems to have lost out in this institutional power struggle: ministries have not sought advice from it on a routine basis, and it has not been informed on all relevant issues (CHANDRA 2006: 224–225). The return to power of the left-leaning Indian National Congress (INC) party on 22 May 2004 has not helped either. The deputy chairman of the Planning Commission is no longer a member of the NSC, and the JIC has been revived in competition with the NSC; as stated above, the NSC had originally replaced the JIC.

As one of its many projects, the NSCS has funded the *India's National Security Annual Review* (*INSAR*) series, though it has been clearly stated in each volume that the views expressed in

the *INSAR* are not those of the NSCS. The Confederation of Indian Industry (CII) joined as another sponsor starting with the *INSAR 2004*. The aim of the *INSAR* is to bring together essays on different national security issues as well as to provide a review of events for a particular year. Regarding the *INSAR*, the first NSA, Brajesh Chandra Mishra, stated, "we have a book which takes a holistic and integrated view of internal and external security challenges being faced by India" (KUMAR 2004a: jacket). With the *INSAR 2008*, published in 2009, the series now consists of eight volumes.

Satish Kumar has been Editor of the *INSAR* since its inception in 2000.[337] He was born in 1933, and from 1961 to 1998 was a professor of diplomacy at Jawaharlal Nehru University (JNU) in New Delhi. He has written several books, especially on Pakistan, and has traveled to several countries as a visiting scholar. He is considered one of India's preeminent IR scholars and has trained many cadres of India's Foreign Service through his position at JNU.

Kumar is most often associated with the NSI, though the original idea as well as the first index were developed by the NSCS. Kumar was then asked by the NSCS to continue the project and to update the index either annually or periodically. Since then he has revised the index four times in consultation with a subgroup of the *INSAR* editorial board. The NSI has been published irregularly: it was published for 2002, 2003, 2004, 2006, and 2007, but not for 2005 and 2008. Econometric experts from JNU have done the calculations for the index.

15.4 Possible Inspirations behind the NSI

The original NSI was published in the *INSAR 2002*. In the first *INSAR 2001* Satish Kumar already exhibited a determined interest in quantification measures:

> Any national security review would require that an ongoing assessment of the power profile of the nation is made. It may not be possible to assess all the components of national power at a given time, or quantify all of them. And yet, it is worthwhile to attempt as many as possible. (KUMAR 2002: 21)

In this regard all the *INSAR* publications, from 2001 to 2008*,* have included a statistics section unrelated to the NSI. Though no direct link exists, the pattern is reminiscent of the *Journal of Geopolitics* [*Zeitschrift für Geopolitik*], published from 1924 to 1944, which regularly featured sections on statistics (section 10.3). Geopolitics has been understood from the very beginning as a practical and empirical science as opposed to excessively abstract theorizing (RATZEL 1923: 1; also HÖHN 2008b: 3–5, 2009: 101–102). A geopolitical triangle consisting of geography, statistics, and international politics can be depicted (chapter 2). Given that the *INSAR* seeks to provide practical information and guidance for long-term policies and emphasizes geography, as can be seen in the map on India's strategic neighborhood (KUMAR 2006: 318, 2007a: xxi), alongside its regular statistics section, its structural patterns and emphases are unquestionably in the tradition of geopolitics.

[337] Satish Kumar looked at the initial draft of the working paper (now chapter 15) and kindly contributed many comments and suggestions that corroborate some of the information presented here.

In terms of a rough genealogical outline (HÖHN 2008a: 5–9; also section 11.1), the inspiration for this power index most likely came from the United States and China. The United States has had something of a self-referencing quantitative community partially concerned with the measurement of power at least since 1960. From 1987 onwards the Chinese have developed a vibrant community focused on measuring comprehensive national power (CNP). They took their inspiration from the United States and Japan. India has not yet developed a community proper concerned with the measurement of power, then again this index could be a creative spark in this direction.

Satish Kumar mentioned the Tellis approach in the *INSAR 2001* (KUMAR 2002: 20–21). It seems likely that this approach, published by the RAND Corporation, a well-known American think tank, in 2000 (TELLIS et alia 2000a, 2000b), was widely known at that point and may have inspired the construction of the NSI. Ashley Tellis and colleagues wanted to measure national power, which was divided into three realms: national resources, national performance, and military capability. Each realm consisted of numerous variables, the appendix of the more detailed work listing 41 suggested indicators in total (TELLIS et alia 2000a: 179–182). The Tellis approach has not produced a working formula or results since that time, possibly due to quantification problems encountered in transforming a great deal of meticulously detailed theory (212 pages!) into practically useful calculations. In the introduction to the NSI 2003 Kumar states in regard to the Tellis approach that "it is obvious that all these factors are not quantifiable" (KUMAR 2004b: 228).

The same introduction to the NSI 2003 mentions Michael Pillsbury's work on Chinese geopolitical power calculations starting in the late 1980s (KUMAR 2004b: 228–229). Before Pillsbury's groundbreaking work in English, access to information on China's vibrant efforts in the calculation of CNP was limited to Chinese-language sources. Like the Tellis papers, Pillsbury's work was published in 2000, but it is not clear whether it received the same immediate publicity in India. While Satish Kumar focused on the CNP formula from the Chinese Academy of Social Sciences (CASS), he did not show any interest in the other CNP indexes, nor in the power indexes by Wilhelm Fucks (section 13.10), Ray Cline (section 13.20), and the Japanese government (section 14.1), all of which inspired the Chinese (PILLSBURY 2000: 225–226).

The CASS index was created by Wang Songfen (section 14.6) consisting of 64 variables grouped into eight major areas. Similar to his comment on the Tellis approach, Kumar states that "many of these factors are again not quantifiable" (KUMAR 2004b: 229), which is not true, as total CNP values have been calculated using the CASS formula. Kumar is probably referring to factors for which experts had to be surveyed. It can be argued that perception values are less reliable than material data, while at the same time perception surveys are much more work. In terms of basic structure the CASS is somewhat similar to the NSI, and Sanjaya Baru (former media adviser to the prime minister) comments that "based on such concepts, the *INSAR*'s National Security Index (NSI) for India is an attempt to construct a simpler index" (BARU 2005: 113).

Looking at Pillsbury's book, it is not clear how the CASS combined variables, and in case it used addition, whether dimensional consistency was ensured to make variables compatible (compare

section 15.7; further see section 16.3 for discussion). The variables consist of variables on an aggregate basis, per capita basis, and other ratios and rates (see PILLSBURY 2000: 221). The social development level in the CASS formula consists of (1) educational level, (2) cultural level, (3) health-care level, (4) communications, and (5) urbanization (PILLSBURY 2000: 221). As such it preceded the NSI in using human security variables. Human security accounts for perhaps 5 percent of the index. This small percentage does not indicate a conscious paradigm shift. In contrast, human security in the original NSI stood at 26.67 percent, a whopping difference from the CASS index.

Chinese scholars showed considerable fondness for the Growth Competitiveness Index (GCI) published annually by the World Economic Forum in the *Global Competitiveness Report* (GCR) (compare section 14.10). The GCI focused on macroeconomic conditions and was complemented by the Business Competitiveness Index (BCI), which focused on microeconomic conditions. Both were revamped and consolidated into a new Global Competitiveness Index in 2004 (BANDURA 2008: 42). Y.S. Rajan mentions the GCI in relation to national power (RAJAN 2002: 255). He also mentions the Tellis approach in relation to competitive commercial technologies (RAJAN 2002: 252–253). Though competitiveness is not directly part of the NSI, it can be noted that technology has received a relatively high weighting at 15–20 percent.

Despite its name, the NSI does not directly measure national security. It does so only indirectly, as evidenced by the introduction of the original NSI, where it is stated that "a country's national security is safeguarded not just by its armed forces but by its comprehensive national power" (NSCS 2003: 349). The difference between national power and security is that the notion of national power tends to take a short-term view of international relations, whereas national security provides a long-term perspective on international relations, psychologically speaking.

15.5 From National Security to Human Security

Interstate military conflicts have decreased relative to domestic conflicts and violence. This tendency has changed the focus of security thinking. National security has traditionally been concerned with territorial integrity and arms races. Given that the international environment is relatively stable and that international treaties no longer guarantee domestic peace, a closer look at conflicts is required in order to link domestic stability and security with human development. For that reason individuals rather than states move to the center of attention, for individuals are the primary 'consumers' of insecurity in terms of civilian deaths and, equally, they are the primary 'producers' in terms of insurgencies and socioeconomic motion. The concept of **human security** promotes a holistic convergence of war studies with development studies.

The UNDP's *Human Development Report 1994* promotes human security as its central theme. It provides an explicit definition of human security by focusing on two key aspects: "It means, first, safety from such chronic threats as hunger, disease and repression. And second, it means protection from sudden and hurtful disruptions in the patterns of daily life—whether in homes, in jobs or in

communities" (UNDP 1994: 23). Human security consists of (1) economic security, (2) food security, (3) health security, (4) environmental security, (5) personal security, (6) community security, and (7) political security (UNDP 1994: 24–25). Critics have argued that human security may altogether be a manipulative attempt "'to capture some of the more substantial political interest and superior financial resources' associated with more traditional, military conceptions of security" (PARIS 2001: 95).

The problem with concepts of human security is that they tend to be too broad and fuzzy, making it hard to discern a difference between human development and human security. Sanjaya Baru states that "the UNDP's *Human Development Report* tries to capture trends in 'human security' through measurement of human development" (BARU 2005: 112). It can be argued that human security runs counter to national security, so that human security can be construed as an invitation to humanitarian intervention that disregards and undermines state sovereignty (TRACHSLER 2003: 70, 77–78, 85–86, 102). Skepticism is abundant as to whether human security is really a feasible security concept or merely an attempt to impose a development agenda on security issues. Daniel Deudney discussed the same problematic in regard to so-called environmental security, which appears as a motivational strategy of environmentalists to get the attention from scholars on national security as well as access to financial resources linked to national security (DEUDNEY 1999).

Efforts have been made to quantify human security (TRACHSLER 2003: 79–81), one of them being the Index of Human Insecurity (IHI) from 2000 (BANDURA 2008: 54–55). One of the 16 variables of the IHI is "public expenditures on defense versus education", which is reminiscent of the variable that measures "military spending in relation to health spending" in the Global Militarization Index (GMI) by the Bonn International Center for Conversion (BICC). It is unclear how such variables, which bring military spending in opposition to social spending, could ever convince more conservatively minded scholars. Human security is the product of the UNDP milieu. However, devoid of any political agenda, a holistic and integrated approach to security is also compatible with more conservative views (compare PARIS 2001: 97).

Apurba Kundu considers human security to be the basis of the original NSI, and he implicitly commends the NSI for this (KUNDU 2004b). Kundu displays some naïveté when he asks "What do highly expensive military modernisation items do for the human security of the individual citizen?" (KUNDU 2004b:7). In a democracy human security should be more the concern of the police and not a question of military prowess, as the question implies.[338] Yet despite its impressive economic development in recent decades, India remains a poor country where capital is scarce. Therefore synergy effects are desirable in order to optimize the use of resources and capabilities. This may suggest that expenditures on national security enhance human security, at least with regard to insurgencies such as the Maoist-Naxalite insurrection and the conflict over Kashmir.

[338] Kundu may be trying to make a strict separation between civilians and military and to suggest that what you give to one has been in a sense taken from (or at least denied to) the others, whereas a more holistic approach might see a country's armed forces as the armed wing of the popular will, as the expression of popular needs and desires. Indeed, the obvious answer to this question is: "It depends." That is, it depends on the security context of each individual country. If a country has expansionist ambitions supported by the popular will (e.g. the Argentinean desire to possess the Falklands), or feels threatened by a stronger neighbor, then highly expensive military modernisation items do add something to the human security of the individual citizen.

15.6 Human Development Index and Environmental Vulnerability Index

The first two NSI publications contained the Human Development Index (HDI), which was a more prominent feature of the NSI. The HDI was developed by Pakistani economist Mahbub ul Haq (1934–1998). Prior to its development Haq had explained to fellow Indian economist Amartya Sen that "'we need a measure of the same level of vulgarity as the GNP—just one number—but a measure that is not as blind to [sic] social aspect of human lives as the GNP is'" (SEN & DALYELL 1998). This vulgar measure happened to be then the HDI, which was published with the first *Human Development Report 1990* and has been published annually ever since. The HDI basically tends to inflate the development level of poor countries compared to GDP, whether at the official exchange rate (OER) or in terms of purchasing power parity (PPP). Sen explains that Haq was an optimist opposed to the pessimism that the exclusive reliance on GDP generates.[339]

The third NSI included the Environmental Vulnerability Index (EVI). The EVI was initially developed by the South Pacific Applied Geoscience Commission (SOPAC) for small island developing states (SIDS) in 1999. It was then expanded to all states in 2004 and 2005. The EVI consists of 50 indicators grouped into (1) hazards, (2) resistance, and (3) damage. All indicators have a scale of 1–7 to make them directly comparable. The cutoff values for each indicator on this scale are arbitrary, but they represent the best estimate possible given the complexity of matter (PRATT et alia 2004: 14). A composite score is calculated from these 50 indicators. The EVI has a number of problematic indicators that construct an irreconcilable opposition between human development and environmental sustainability. For example, one indicator ("use of electricity for industry over the last 5 years per square kilometre of land") negatively evaluates economic activity per se. It does not take into account the type of industry, the source of electricity, or the environmental standards in place to limit and compensate for damage to the environment. This means that a primitive lifestyle always scores better regardless of the actual damage caused. Another issue is those indicators that are a fixed feature of the environment and independent of human action ("number of volcanoes"). Practically, they may render the index static.

[339] The NSI has adopted some of the basic methodology of the HDI for standardizing values (see section 15.10), though without ensuring dimensional consistency in treating values either as national sum totals, per capita rates, or other ratios and rates (section 15.7; further see section 16.3 for discussion). The HDI seeks to represent *per capita* development, and the NSI seeks to represent the *total* power of nations. In using the HDI methodology without adjustment, the result is a technical disaster that produces questionable end results. In any case, the HDI is not without flaws either, and therefore it is useful to take a critical look at the HDI itself. The HDI consists of three subindexes: (1) life expectancy, (2) education comprising adult literacy and gross enrollment, and (3) GDP-PPP. Whereas the areas of these subindexes seem optimal for its purpose, the HDI's method of calculation is careless and inconsistent. For life expectancy 85 is arbitrarily taken as the upper limit and 25 as the lower limit, instead of the real maximum and minimum values. The CIA Factbook explains most eloquently that "rounding of numbers always results in a loss of precision—i.e., error" (CIA 2009: FAQ). For literacy and gross enrollment no minimum value is used in the calculation. For gross enrollment and GDP-PPP a completely arbitrary upper limit is applied, beyond which no differences will be registered. For GDP-PPP an equally arbitrary lower limit is applied. Given that adult literacy has reached saturation in developed countries, the measure is worthless in comparing such countries. The logarithm is used only for GDP-PPP, though it would be consequent to apply it then to all subindexes, so that relationships are preserved in the composite index scale. Instead, the numerical value of the HDI is more or less devoid of meaningful information. The only usefulness is in determining rank. India is ranked 128 out of 177 countries measured (UNDP 2007: 128).

15.7 The Lack of Dimensional Consistency

The changing composition of the NSI in various years is documented in section 15.10, the results in terms of changing country scores in section 15.11. The most important observation from a technical point of view is that the different subindexes of the NSI have random numbers of variables in incompatible formats (dimensions) (see section 16.3 for discussion). When it comes to the NSI, no systematic approach for the use of variables can be discerned beyond the inertia of initial availability. It means that if the designers of the NSI find a variable on an aggregate basis (e.g. "total number of patents"), that is, in the format of national sum totals (total size or gross size), they use it directly without adjustment, which in the case of national sum totals may actually be appropriate. However, if they find them on a per capita basis (e.g. "researchers per million"), or in some other ratios or rates format (e.g. "high technology exports as percentage of manufactured exports"), these values are not disentangled and transformed into values on an aggregate basis (national sum totals). Such *prior* transformations are necessary in order to make the variables dimensionally consistent for the purpose of addition when calculating national power.

In constructing an index it is necessary to decide on a unified standard with regard to dimensionality. This means one has to conceptualize and determine in advance, if the intended end result is to be a measurement of national power on an aggregate basis or per capita basis or some other basis. This requires the transformation of all variables to one consistent dimension for further processing (primarily addition). All variables have to be converted into national sum totals (total size or gross size) or per capita values or something else, and one has to stick with this decision. Only then does it make sense to combine those values by addition. The following table shows the percentages of variables of different dimensions. Negative national sum totals are counted separately:[340]

Table 99: Different Dimensions of NSI Variables

Function	2002	2003	2004	2005	2006	2007	2008
Positive National Sum Totals	56.00%	52.00%	55.00%	—	57.25%	60.25%	—
Negative National Sum Totals	0.00%	0.00%	0.00%	—	10.00%	10.00%	—
Per Capita Values	28.00%	28.00%	26.00%	—	14.50%	15.25%	—
Other Ratios and Rates *neither* national sum totals nor per capita values	16.00%	20.00%	19.00%	—	18.25%	14.50%	—

Source: Author's own calculations; see section 15.10 for detailed indexes.

The NSI scores are neither national sum totals indicating the *total* power of India compared to other countries, nor are they *per capita* rates enabling the indirect measurement of the level of security for the average Indian compared to the average citizens of other countries. The NSI is in dire need of dimensional consistency in handling variables on an aggregate basis (national sum totals), or per

[340] Negative sum totals are sum totals of something evaluated to be of negative impact, where an increased magnitude implies less national power rather than more national power (e.g. "energy imports"). Negative sum totals are national sum totals proper, but they have the unfortunate side effect that they may produce countries with negative power, which is illogical, unless one reconceptualizes power radically. How to process negative variables is a problem without any obvious solution. Lacking a proper method, it may be better to avoid them altogether, unless one develops a method that really ensures that it is logically impossible that countries end up with a negative power score. For a contrary view: Sayed Hadi Zarghani advocates the usage of negative variables (ZARGHANI 2010; also section 13.41).

capita basis, or any other basis. The most straightforward solution to accomplish the compatibility of variables is to transform all values into positive national sum totals as far possible. The combined NSI value would then indicate national power as a national sum total, allowing the simple comparison of national power totals. If the desire is to measure the average level of security of Indian citizens in comparison to the citizens of other nations in terms of national power per capita,[341] then all variables have to be transformed to per capita values.

The criticism can be made that ongoing changes in composition and weighting prohibit year-to-year comparisons. While this is to some extent true, it is precisely these ongoing changes that mark the NSI as a creative and well-run experiment, despite the aforementioned misgivings. Any demand for temporal uniformity would kill this creativity, as the NSI designers would no longer feel free to use all available variables, including many of recent origin, to sustain continuous quality improvement.

Four minor issues remain: (1) To multiply the HDI by the population leads to imprecision because HDI values are in theory stretched between maximum and minimum and are not precise values with fixed ratios. The NSI no longer uses the HDI; (2) Economic growth as a component of the NSI does not represent current abilities but rather future expectations on the basis of past performance. Rapid economic growth also means that the infrastructure is increasingly deficient relative to economic activity, so economic growth may confer an inflated picture of economic conditions in the short run; (3) "Population by itself can be a strength as well as weakness" (NSCS 2003: 351). The addition of "population aged 15–64" to the NSI 2007 contradicts this earlier realization by taking demography solely as a strength without adjustment for qualitative factors such as health and education that could demonstrate population to be a weakness. Demography alone does nothing but boost India's rank.[342] It can be assumed that population is already included in most aggregate values (MEARSHEIMER 2001: 61); (4) The NSI 2004 included Hong Kong, which is a subnational area.

While the weighting of technology was decreased from 20 percent to 15 percent, the number of variables in technology was increased from three in the NSI 2002 to five in the NSI 2007. The inclusion of numbers on main battle tanks, aircraft, and principal surface combatants[343] does not account for quality differences, though no better measure is readily available.[344] Given that the total

[341] See section 13.24 for the only example for a *per capita* index of national power.
[342] The NSI designers put some effort into measuring what they call "effective population" (the Population Index in the NSI 2002 and 2003) by changing the components of this subindex three times (see section 15.10). It indicates that they have not yet found a satisfactory measure. The obvious aim is to measure the population without omitting the quality dimension of this population, such as pertaining to health and education for example. The CIA Factbook, with similar intention, has also calculated a variable called "manpower fit for military service": "This entry gives the number of males and females falling in the military age range for a country (defined as being ages 16–49) and who are not otherwise disqualified for health reasons; accounts for the health situation in the country and provides a more realistic estimate of the actual number fit to serve" (CIA 2009: [Definitions and Notes]). Herman Kahn and Anthony Wiener also briefly mentioned the issue of "'useful' adults" (KAHN & WIENER 1967: 131).
[343] Principal Surface Combatants (PSC) do not appear to be counted in a consistent manner in *The Military Balance*. This means, for instance, that sometimes corvettes are included and sometimes not. An alternative to counting PSC is to look at tonnage (MARTELLO 1990: 16–17, 67–68).
[344] In 1976 the Pentagon developed the concept of "Armored Division Equivalent" (ADE), which combined many factors to measure conventional force. By 1988 this had been refined into "Division Equivalent Firepower" (DEF) (MARTELLO 1990: 36; also CBO 1977; CARLUCCI 1988). The information available on the internet about these measures is limited.

number of variables in the NSI increased from eight in the NSI 2002 to 17 in the NSI 2007, parsimony seems advisable, which in statistics refers to a general preference for fewer variables (Occam's razor).

15.8 Trend in the Composition of the NSI

As can be seen from the following table, the first three publications of the NSI had a relatively strong human security element. This is most evident in the NSI 2004. Then a break occurred in 2005, when the NSI was not published. Now the element is hardly visible anymore:

Table 100: Decomposed NSI According to National Security and Human Security

Thematic Sectors	2002	2003	2004	2005	2006	2007	2008
National Security	73.33%	73.33%	65.00%	—	85.00%	97.00%	—
Economy	33.33%	33.33%	25.00%	—	25.00%	28.00%	—
Military	20.00%	20.00%	25.00%	—	25.00%	25.00%	—
Technology	20.00%	20.00%	15.00%	—	15.00%	15.00%	—
Energy				—	20.00%	20.00%	—
Demography				—		9.00%	—
Human Security	26.67%	26.67%	35.00%	—	15.00%	3.00%	—
Education	13.33%	13.33%	7.50%	—	7.50%	3.00%	—
Health	13.33%	13.33%	10.00%	—			—
Poverty			7.50%	—	7.50%		—
Ecology			10.00%	—			—

Source: Author's own categorizations; see section 15.10 for detailed indexes.

This transition can be further documented by looking at the results of the NSI, as shown by the following Pearson correlation coefficients for the results of successive publications of the index:

NSI 2002 & NSI 2003: 0.97

NSI 2003 & NSI 2004: 0.91

NSI 2004 & NSI 2006: 0.88

NSI 2006 & NSI 2007: 0.99

The latest correlation coefficient is the highest, which could suggest that the NSI has settled somewhat and that less variation in its composition might be expected in future revisions.

Satish Kumar points out that "these long-term [nontraditional security] issues […] cannot be mixed with indices of instantly usable power" (KUMAR 2007b: 446). This provides one hint of justification for this drastic measure of excluding human security. The justification itself may be of a practical nature, as any advances in the national security sectors tend to directly increase the power of government: a better economy immediately contributes higher tax revenues, military assets are directly available in a conflict, and so on. Any advances in human security tend to increase national power only indirectly: education provides a basis for technology, decreased poverty may support political stability, and so on. Another reason for excluding human security is that sometimes no changes seem to take place for years in the status of a country on issues such as health, education,

and the environment. These three issues have thus been put in a separate index in the *INSAR 2006*, because they may not need to be reproduced every year. Kumar is aware that India still has a lot to do on these issues in order to move up the ladder of international rankings.

The *INSAR* has regularly included one or two articles on human security issues. Kumar himself has stated that military capability is still the most important component of national power (KUMAR 2002: 20). The progressive force behind the original NSI was probably Satish Chandra, the secretary of the NSCS from 1999 to 2005. He vehemently pushed a holistic line in a retrospective essay on the NSCS, going so far as to imply that a holistic understanding of security was what necessitated the NSC's and NSCS' coming into being (CHANDRA 2006: 201–202, 205–208). Chandra seems to have had the support of his superiors Brajesh Chandra Mishra, who served as NSA from 1998 to 2004, and Jyotindra Nath Dixit, who served as NSA from 2004 to 2005 and died in office.

The NSI's two most recent publications now make it fall into the category of Chinese CNP indexes as it has broadened the concept of national power but has not firmly committed itself to a paradigm shift towards human security.[345]

15.9 Reception and Critiques of the NSI

Pranab Kumar Mukherjee, the minister of defense from 2004 to 2006, commented with pride on the NSI in one of his speeches:

> Compilation of the National Security Index (NSI) by the National Security Council in 2002 has been the first systematic effort in India towards evolving an indigenous database to calculate comprehensive national power. India is ranked 10th among 30 nations in terms of its NSI and it is pertinent that in relation to other indicators, the Defence expenditure is among the lowest in relative terms. The greater emphasis on non-military dimensions of national security in case of India dispels the impression emanating from a few quarters that India's military capabilities may be motivated by the quest for power status. (MUKHERJEE 2004; compare MUKHERJEE 2006)

The NSI gained the attention of the Indian and Chinese media in 2003/2004. *The Financial Express* ran a string of articles on it (*Financial Express* 2003a, 2003b, 2003c, 2004; also *Hindu* 2004), and the 2004 piece was noticed by China's *People's Daily*, which subsequently echoed it in a string of articles (*People's Daily Online* 2004a, 2004b, 2004c). One of these articles was in turn picked up by an Indian journalist (SHAHIN 2004). The Chinese were satisfied with China being ranked second by its neighboring competitor and stated that "India's NSI is a variant of the Chinese Comprehensive National Power (CNP) index and an American index constructed at the Rand Corporation" (*The Financial Express* 2004; also *People's Daily Online* 2004c).

[345] UPDATE: In response to my well-received criticism that human security has been abandoned, the NSI 2010 indeed features human security again with an increased weight of 8%. Further, the HDI is again part of the NSI.

The introduction to the original NSI states that it has some limitations, that the NSI does not "take into account resource abundance, environmental health and good governance" (NSCS 2003: 351). Resource abundance was partially taken care of through the introduction of energy security in the index in 2006 and 2007. Environmental health was addressed in the NSI 2004 but dropped afterwards. For good governance, the World Governance Indicators (WGI) by the World Bank (World Bank 2010) might be good for use in future revisions of the NSI. Meetu Jain criticizes the NSI 2006 as "the index ignores non-conventional threats like health, environment and HRD [Human Resource Development]" (JAIN 2007), which were included in the previous publications of the NSI and then dropped. Jain further criticizes the fact that a powerful army and robust economy do not compensate for deficient security due to terrorists and insurgents. He finds support for his view in Satish Chandra, who stated: "'Look at policing, it's a mixed experience. You cannot really call it number four'" (Chandra, quoted in JAIN 2007; compare AYAR 2006).

Table 101: Top Ten Countries According to the NSI 2002–2007

2002	2003	2004	2005	2006	2007	2008
United States	United States	United States	—	United States	United States	—
Japan	China	China	—	China	China	—
China	Japan	Japan	—	Norway	Norway	—
South Korea	South Korea	Sweden	—	India	Russia	—
Germany	Sweden	Finland	—	Japan	India	—
France	Russia	Russia	—	Russia	Japan	—
Russia	Germany	Canada	—	Saudi Arabia	South Korea	—
United Kingdom	India	South Korea	—	United Kingdom	United Kingdom	—
Israel	France	India	—	Germany	Germany	—
India	United Kingdom	Germany	—	South Korea	France	—

Source: NSCS 2003, KUMAR 2004b, 2005, 2007b, 2008.

Retired Lieutenant General V. R. Raghavan is considered one of India's leading strategic thinkers. His criticism of the NSI 2007 as a feature of the *INSAR 2007* is that the "rankings in the book seem to bear no relation to the real security status of these states" (RAGHAVAN 2008). Raghavan seems to object to India being ranked above the United Kingdom, Germany, and France, and also to Sweden being ranked above Brazil and Pakistan. Raghavan states that "these rankings do not also help in formulating security policy and plans for the future. It is hoped that a more realistic security ranking of states can be presented in the next volume of the series" (RAGHAVAN 2008). The *INSAR 2008* did not include an NSI. The major reason that some NSI values are inadequate is the technicality of dimensional consistency (section 15.7; further see section 16.3 for discussion). Following these criticisms, it is possible that major revisions are being undertaken.

15.10 NSI Components for 2002, 2003, 2004, 2006, and 2007

Table 102: NSI 2002 for 30 Countries

A	20.00%	Human Development Index (HDI)
1	20.00%	Human Development Index (HDI) 2000
B	20.00%	Research and Development Index (RDI)
2	4.00%	Patents granted to residents per million 1998
3	12.00%	Research and development expenditure as % of GNP, 1999–2000
4	4.00%	Scientists and engineers in R&D per million, 1990–2000
C	20.00%	GDP Performance Index (GDPPI)
5	16.00%	GDP at official exchange rate, 2000
6	4.00%	GDP growth in per cent, 2000
D	20.00%	Defense Expenditure Index (DEI)
7	20.00%	Defense expenditure at official exchange rate, 2000
E	20.00%	Population Index (PI)[346]
8	20.00%	Population × Human Development Index (HDI), 2000

Source: NSCS 2003.

Subindexes are identified by capital letters A–E, components are numbered 1–8. Their respective weighting is given in the second column. Information for these indexes came from the *Human Development Report 2002* (1, 2, 3, 4, 8) and the *Military Balance 2001–2002* (5, 6, 7). This is the original NSI by the NSCS. For 1, values are taken directly from *HDR 2002*. For 2, 3, 4, 5, 6, 7, values are normalized using the maximum value, which is the method used by the HDI for the education subindex:

```
actual_value / maximum_value = index_value
```

For 8, values are normalized using the maximum value and the minimum value, which is akin to the method used by the HDI for the life expectancy subindex:

```
( actual_value - minimum_value ) / ( maximum_value - minimum_value )
                                                    = index_value
```

Table 103: NSI 2003 for 50 Countries Selected on the Basis of Defense Expenditures

A	20.00%	Defense Index (DI)
1	10.00%	Defense expenditure at official exchange rate, 2001
2	10.00%	Armed forces personnel
B	20.00%	GDP Index (GDPI)
3	12.00%	GDP at official exchange rate, 2001
4	8.00%	GDP growth in %, 2000–2001
C	20.00%	Human Development Index (HDI)
5	20.00%	Human Development Index (HDI) 2000

[346] George Perkovich mentioned the Population Index (PI) in a lecture, but incorrectly stated that the PI ranked India 27th of the 29 countries included (PERKOVICH 2003: 9). In fact this is the HDI ranking by itself, without being multiplied by population. In an article based on his lecture, he corrected his mistake and stated correctly that India is ranked second out of 29 countries (PERKOVICH 2004: 131). As can be seen from the table, the PI was only one subindex among the five equally weighted subindexes. Perkovich neither mentioned the other four subindexes nor the NSI itself.

D	20.00%	Research and Development Index (RDI)
6	12.00%	Research and development expenditure as % of GNP, 1999–2000
7	4.00%	Patents granted to residents per million, 1998
8	4.00%	Scientists and engineers in R&D per million, 1990–2000
E	20.00%	Population Index (PI)
9	20.00%	Population 2001 × Human Development Index (HDI) 2000

Source: KUMAR 2004b.

The only change in the NSI 2003 as compared to the NSI 2002 is the addition of armed forces personnel (2) for the Defense Index (A), which was called the Defense Expenditure Index in the previous index. Information for these indexes came from the *Military Balance 2002–2003* (1, 2, 3, 4), the *Human Development Report 2002* (5, 6, 7, 8, 9: HDI), and the *World Development Report 2003* (9: population). For 5, values are taken directly from *HDR 2002*. For 6, 7, 8, values are normalized using the maximum value. For 1, 2, 3, 4, 9, values are normalized using the maximum value and the minimum value. Also an alternative NSI without the Population Index (E) is offered, which may indicate that the inclusion of it was up to the NSI's designers, who were unsure whether to include this subindex in the NSI.

Table 104: NSI 2004 for 50 Countries Selected on the Basis of National Income

A	25.00%	National Income
1	15.00%	GNI at official exchange rate, 2002
2	10.00%	GNI growth rate in %, 2001–2002
B	25.00%	Defense Capability
3	12.50%	Defense expenditure at official exchange rate
4	12.50%	Size of army in terms of personnel
C	15.00%	Effective Population
5	15.00%	Population × adult literacy 2001 × percentage of population above poverty line
D	15.00%	Technological Strength
6	3.00%	Patents granted to residents per million, 1999
7	9.00%	Research and development expenditure as % of GDP, 1996–2000
8	3.00%	Scientists and engineers in R&D per million, 1996–2000
E	10.00%	National Health
9	3.33%	Life expectancy at birth, 2001
10	3.33%	Incidence of tuberculosis per 100,000 citizens, 2000
11	3.33%	Prevalence of HIV as percentage of adults
F	10.00%	Environmental Vulnerability
12	10.00%	Environmental Vulnerability Index (EVI)

Source: KUMAR 2005.

A notable change for the NSI 2004 is the addition of the EVI, which had then been recently created by SOPAC. Another change is that the HDI was dropped and replaced by similar measures in effective population (C) and national health (E). Information for these indexes came from the *World Development Report 2003* and *2004* (1, 2, 5, 9, 10, 11), the *Military Balance 2002–2003* (3, 4), the *Human Development Report 2003* (6, 7, 8), and the *Technical Report No. 356* (12) by SOPAC. For 6, 7, 8, values are normalized using the maximum value. For 1, 2, 3, 4, 5, 9, 10, 11, 12, values are normalized using the maximum value and the minimum value.

No NSI was calculated for 2005.

Table 105: NSI 2006 for 50 Countries Selected on the Basis of GDP at Official Exchange Rate

A	25.00%	Gross Domestic Product
1	15.00%	GDP at official exchange rate, 2003
2	10.00%	GDP growth rate in %
B	25.00%	Defense Capability
3	12.50%	Defense expenditure at official exchange rate, 2003
4	12.50%	Armed forces personnel, 2003
C	20.00%	Energy Security
5	10.00%	Per capita energy production in kilo ton oil equivalent, 2002
6	10.00%	Energy imports in kilo ton oil equivalent, 2002
D	15.00%	Technological Strength
7	6.00%	Research and development expenditure as % of GDP 2002
8	4.50%	Researchers per million
9	2.25%	High technology exports as percentage of manufactured exports, 2003
10	2.25%	Total number of patents
E	15.00%	Effective Population
11	15.00%	Population × adult literacy 1998–2002 × percentage of population above poverty line

Source: KUMAR 2007b.

A notable change is the addition of energy security (C). National health and environmental vulnerability indicators are dropped altogether. Information for these indexes came from the *World Development Indicators 2004* and *2005* (1, 2, 5, 6, 7, 8, 9, 10, 11) and the *Military Balance 2003–2005* (3, 4). For 5, 7, 8, values are normalized using the maximum value. For 1, 2, 3, 4, 6, 9, 11, values are normalized using the maximum value and the minimum value. Supplemental indexes on health, education, and environmental security are offered.

Table 106: NSI 2007 for 50 Countries Selected on the Basis of GDP at Official Exchange Rate

A	25.00%	Economic Strength
1	18.75%	GDP at official exchange rate, 2005
2	6.25%	Average annual GDP growth rate in %, 2000–2005
B	25.00%	Defense Capability
3	10.00%	Armed forces personnel
4	7.50%	Defense expenditure at official exchange rate
5	2.50%	Main battle tanks
6	2.50%	Aircraft
7	2.50%	Principal surface combatants
C	20.00%	Energy Security
8	10.00%	Per capita energy production in metric tons of oil equivalent, 2004
9	10.00%	Net energy imports in millions, $ 2004
D	15.00%	Technological Strength
10	2.25%	High technology exports as percentage of manufactured exports, 2004
11	2.25%	Total number of patents, 2000–2004
12	6.00%	Research and development expenditure as % of GDP
13	2.25%	Researchers per million
14	2.25%	Scientific and technical journal articles, 2004

E	15.00%	Effective Population
15	9.00%	Population aged 15–64, 2004
16	3.00%	Population educated up to postsecondary level, 2000
17	3.00%	Per capita GDP at official exchange rate, 2005

Source: KUMAR 2008.

A notable change is the addition of "population aged 15–64" alongside other variables to effective population (E). This variable is purely demographic and has nothing to do with human development, the previously synthetic variable for effective population having been dropped. Other changes are the addition of more variables for defense capability (B) and technological strength (D). Information for these indexes came from the *World Development Indicators 2007* (1, 2, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17) and the *Military Balance 2006–2007* (3, 4, 5, 6, 7). For 5, 6, 7, 8, 11, 12, 13, 14, values are normalized using the maximum value. For 1, 2, 3, 4, 9, 10, 15, 16, 17, values are normalized using the maximum value and the minimum value.

No NSI was calculated for 2008.

15.11 Complete List of Results from the NSI 2002–2007

Table 107: Composite Index Values from the NSI 2002–2007

Country	2002	2003	2004	2005	2006	2007	2008
United States	0.726	0.687	68.51	—	56.50	57.5	—
China	0.411	0.551	52.93	—	45.90	42.5	—
Japan	0.480	0.481	40.61	—	26.67	24.1	—
Russia	0.330	0.386	35.40	—	26.60	24.8	—
Norway		0.321	32.87	—	31.36	29.1	—
India	0.296	0.384	34.73	—	27.05	24.6	—
South Korea	0.363	0.404	34.92	—	19.29	17.4	—
Germany	0.358	0.384	34.40	—	19.50	16.7	—
France	0.346	0.376	32.55	—	18.18	15.6	—
United Kingdom	0.329	0.358	30.67	—	19.89	17.2	—
Sweden		0.400	36.33	—	17.80	14.1	—
Australia	0.294	0.334	33.14	—	18.42	15.0	—
Belarus		0.255		—			—
Israel	0.328	0.352	29.89	—	15.02	11.9	—
Canada		0.320	35.13	—	17.56	14.9	—
Vietnam		0.230		—			—
Switzerland		0.344	33.36	—	13.28	10.6	—
Finland		0.233	35.91	—	17.93	13.2	—
United Arab Emirates		0.225		—			—
Denmark		0.314	27.43	—	16.03	13.0	—
Oman		0.219		—			—
Saudi Arabia	0.201	0.216	27.79	—	24.44	14.8	—
Italy	0.275	0.307	25.34	—	13.00	9.9	—
Hong Kong			20.68	—			—
Ukraine		0.306		—		10.7	—
Netherlands		0.324	25.87	—	13.07	10.2	—
Kazakhstan	0.202			—			—
Uzbekistan	0.179	0.223		—			—

Brazil	0.240	0.267	26.81	—	12.58	9.4	—
Kuwait	0.184	0.213		—			—
Morocco		0.198		—			—
Spain		0.291	25.59	—	13.25	10.2	—
Belgium		0.304	25.94	—	12.42	8.8	—
Iran	0.198	0.257	23.83	—	15.46	11.5	—
Austria		0.297	25.87	—	12.16	8.9	—
Greece	0.222	0.266	24.99	—	12.01	8.2	—
Turkey	0.210	0.202	25.96	—	14.97	10.8	—
Egypt	0.213	0.272	24.10	—	11.77	7.9	—
Mexico		0.238	27.24	—	12.50	8.7	—
Singapore		0.255	21.34	—	13.55	11.7	—
Algeria	0.157	0.200	24.86	—	16.55	12.0	—
Poland		0.258	25.40	—	12.20	7.2	—
Malaysia	0.199	0.214	21.92	—	13.99	9.7	—
New Zealand			29.58	—	12.37	8.4	—
Thailand		0.222	22.35	—	13.45	8.4	—
Indonesia	0.191		22.27	—	14.47	10.0	—
Ireland			27.07	—	11.89	10.0	—
Colombia		0.203	23.57	—	12.88	8.1	—
Argentina	0.205	0.217	18.72	—	13.95	6.1	—
Chile		0.242	25.51	—	8.90	4.4	—
Peru			22.27	—	9.04		—
Portugal		0.253	23.56	—	8.67	4.7	—
Czech Republic			26.90	—	12.03	7.6	—
Pakistan	0.138	0.193	20.78	—	13.13	9.0	—
Venezuela		0.220	21.40	—	7.55	7.8	—
South Africa	0.185	0.221	11.47	—	10.54	7.1	—
Hungary			23.91	—	10.95	6.8	—
Philippines	0.188		16.09	—	12.11	7.5	—
Angola		0.136		—			—
Bangladesh			17.18	—	9.89		—
Nigeria	0.121			—		8.1	—
Romania				—	11.29	7.3	—
Iraq	0.017			—			—

Source: NSCS 2003; KUMAR 2004b, 2005, 2007b, 2008.

16. Major Findings and General Analysis

International relations occur in a multidimensional and changing context. The measurement of national power reflects this diverse set up. Mark Polelle writes that "the Heraclitean maxim that 'all is in flux' seemed to apply with special force to the difficulties associated with measuring the power of nations" (POLELLE 1999: 37–38). For the first time such a vast number of power formulas have been presented along with their background. This allows some preliminary analyses regarding the designers of power formulas as well as trends in the numbers of variables used. Subsequently, on a more technical level, the need for dimensional consistency and logic is emphasized, followed by a tentative discussion on what may constitute the dimensions of national power. The most important conclusion of this study may be the presentation of three distinct approaches of operationalizing any measurement of national power. This refers to the presentation of three nonarbitrary weighting schemes and their theoretical bases. Though this study is unable to provide a final solution to the problem of measuring national power, it provides the first general overview of what is out there.

16.1 Background Information

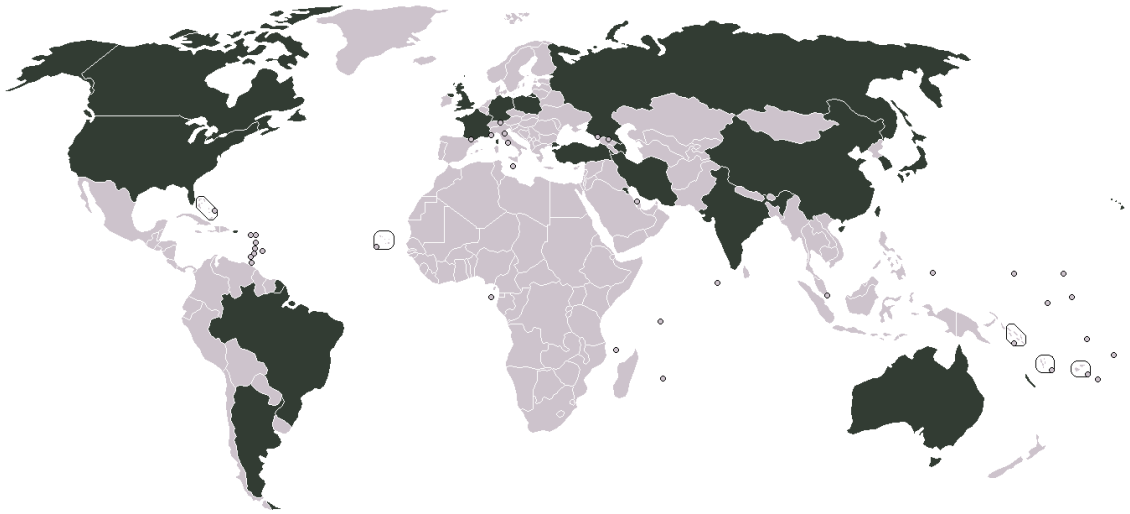
Most power formulas are arbitrary to some degree. Therefore it is important to look at their designers to gain insights into, or at least hints at, the explicit or inexplicit biases that arise from the cultural forces that have shaped them. As the Romanian aphorist E. M. Cioran once remarked: all writing is at heart autobiographical. By extension, the same or something similar may apply to power formulas. The compiled data is neither complete nor precise, so the following statistics merely provide a rough picture of age, nationality, profession, and bias. To commence with the simplest to calculate: the average age of the designers. This is 47 years, the standard deviation being +/–10 years, so most designers should be 37–57 years old at the time they first publish their power formula. This age could be the product of a self-selection bias, that is, accomplished scholars may have a greater chance of getting something published, and subsequently getting their work noticed, than some young students experimenting with numbers.[347] Whatever the reasons may be, the average age of 47 has not changed much in the last 50 years (1960–2010).

In terms of nationality, the distribution is this: United States 37%, China 16%, Germany 7%, Japan 6%, Brazil 5%, Poland 5%, Russia 4%, India 4%, South Korea 3%, United Kingdom 3%, Canada 2%, Taiwan 1%, France 1%, Iran 1%, Australia 1%, Argentina 1%, Kuwait 1%, Turkey 1%, Azerbaijan 1%.[348] As far as self-selection bias is concerned, obviously it is much easier to track formulas in the English language, for it has the greatest community of scholars to reference each other. But China has been busy producing power formulas, so its actual share might be larger. It is sensible to assume that Soviet scholars did many power calculations as well, so Russia's share is probably much larger in reality. Overall these shares indicate very little except that the United States

[347] Another technical self-selection bias is the simple fact that it is much easier to track information on the age of an accomplished scholar than that of a younger person.
[348] In 3 out of 69 cases, the nationality is deemed by guessing.

and China stand out. The following map shows all countries that have contributed to the construction of operational power formulas:

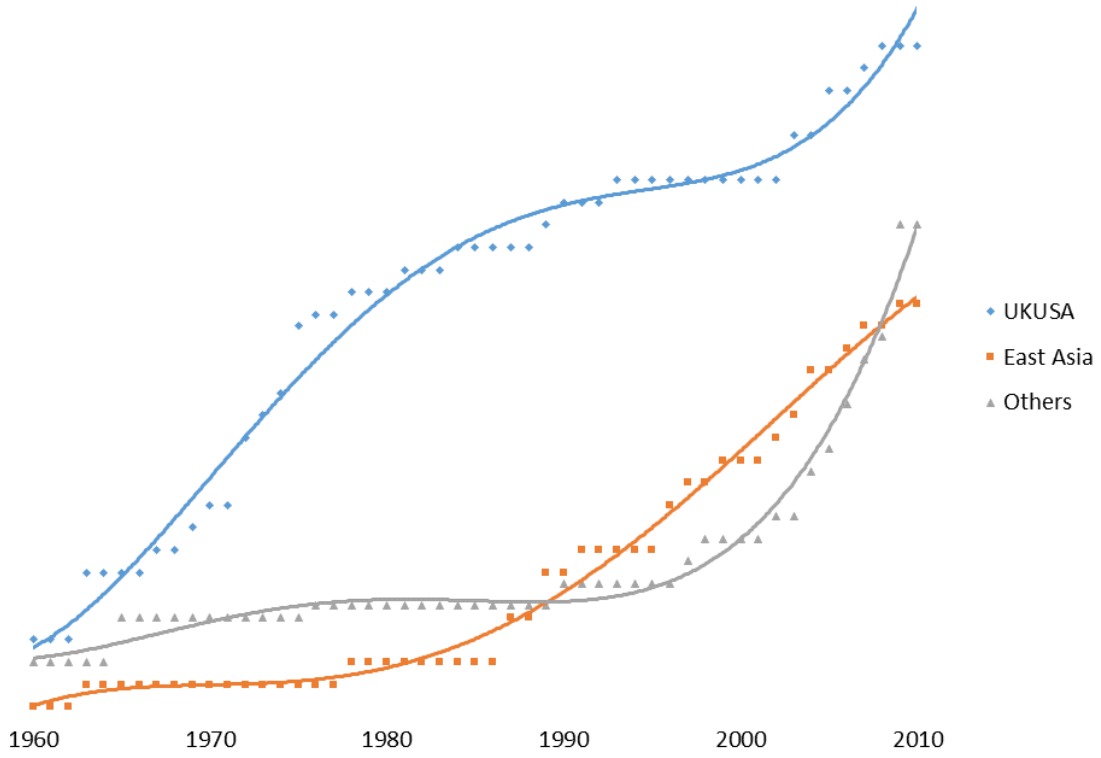
Figure 26: National Origin of Power Formulas



Source: Author's own illustration; original map from *Wikipedia*.

In looking at the countries where power formulas have been produced, it can be observed that the more powerful countries appear more likely to produce power formulas. In fact only Kuwait and Azerbaijan stand out as smaller countries. Moreover, some trends are discernible. The following diagram shows how the cumulative total of power formulas has changed for three groups of countries in the last 50 years (1960–2010). These three groups are (1) the UKUSA bloc (Australia, Canada, United Kingdom, United States), (2) East Asia (China, Japan, South Korea, Taiwan), and (3) the "Others" (the rest of the world, including continental Europe, Latin America, and South Asia):

Figure 27: Trends in the National Origin of Designers 1960–2010



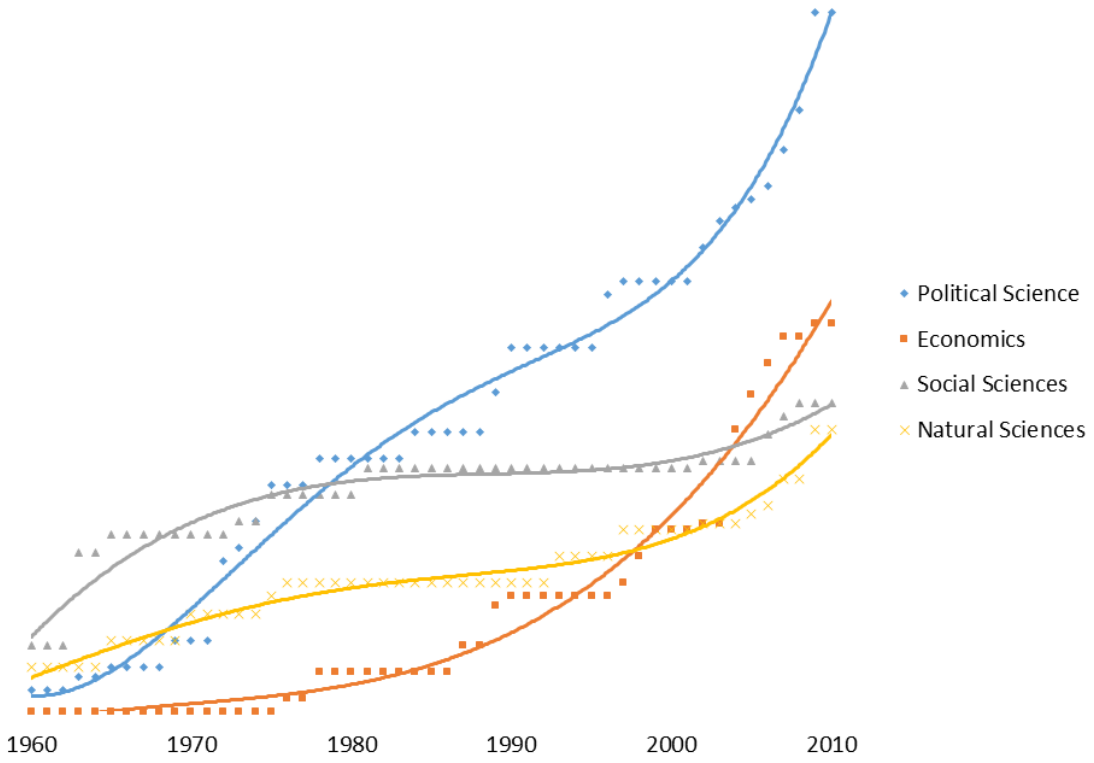
Source: Author's own calculations.

It can be observed how dominant the position of the United States was from 1972 to 1984. A renaissance in the construction of power formulas started in China from 1987 onwards. However, one surprising trend is that the "Others" appear to have dramatically increased their production of formulas. No particular nation/region is dominant in that group. It is undeniably a trend towards greater diversity.

The professions of designers were determined by what they studied and, if they are instructors or professors, what they teach. This cumulates into the following distribution: political science 38%, economics 19%, geography 5%, physics 4%, information technology 4%, sociology 4%, business 4%, military science 4%, history 3%, mathematics 3%, law 2%, engineering 2%, psychology 2%, chemistry 1%, Spanish 1%, forestry 1%, medicine 1%, theology 1%, geology 1%.[349] It is unsurprising that political science and economics stand out. However, the share of geography, though it still holds the third place, appears lower than what might have been anticipated. The following diagram depicts the cumulative totals of four groups, namely (1) political science plus military science, (2) economics plus business, (3) other social sciences or related to it: geography, sociology, history, law, psychology, Spanish, theology, and (4) natural sciences or related to it: physics, information technology, mathematics, engineering, chemistry, forestry, medicine, geology:

[349] In 6 out of 69 cases the professions of the designers are unknown. In these cases no effort is made to guess. As for guessing the professions of some of the other designers, most guesses are still based on a good amount of information, so that probabilities should favor these judgments.

Figure 28: Trends in the Professional Disposition of Designers 1960–2010



Source: Author's own calculations.

Political science and the natural sciences have been making a more or less steady contribution to the construction of power formulas. It is unsurprising that political science should dominate as a background profession and that economics backgrounds should have entered the picture later but with increasing frequency. It appears that the other social sciences (including humanities) have withdrawn from this specific field, which may speak for decreasing diversity, things perhaps coming down to math, money, and politics.

The issue of bias is related to the issue of professions. Sayed Hadi Zarghani, for example, talks about the "emphasis of economists on economical variables, military Strategists on military variables, geographers on natural variables" (HAFEZNIA et alia 2008: 232; also section 13.41). Six categories are used to classify the variables of all power formulas: (1) geographic (includes natural resources, transportation), (2) demographic (includes human capital, health), (3) military (includes defense industry), (4) political (includes strategy, diplomacy), (5) economic (includes electricity, technology), (6) psychological[350] (includes intelligence, cohesion, morale). The weights of variables in the power formulas are not considered.[351] It is simply noted whether one variable for each category is present or not (dummy variable). Having determined the Pearson correlation coefficient for the

[350] In this category fall most syntality variables. Syntality is defined as "behavioral characteristics of a group perceived as parallel to or inferable from the personality structure of an individual" (http://dictionary.reference.com/browse/syntality [16 August 2013]).
[351] It is relatively easy to determine the weights of variables in linear and/or simple formulas. However, it can be dreadfully difficult to determine the effective weight of variables in nonlinear formulas that contain many variables.

background professions (dummy variable) in relation to the categories of variables used in the power formulas, the following table provides the results:

Table 108: Bias in the Construction of Power Formulas

Professions	Categories for Variables					
	Geographic	Demographic	Military	Political	Economic	Psychological
Political Science	–0.30	–0.27	0.01	0.24	–0.21	–0.13
Economics	–0.21	–0.24	–0.17	–0.27	0.15	–0.22
Social Sciences	0.20	0.19	–0.08	–0.02	–0.04	0.00
Natural Sciences	0.46	0.40	0.22	0.05	0.12	0.61

Source: Author's own calculations.

The correlations are too weak to be convincing. This may be due partly to the crude method (dummy variables) that has been used. All the same, political scientists have the strongest positive correlation to the political category (though not by extension the military category as claimed by Zarghani), and economists to the economic category. A more refined method could possibly yield more convincing results with regard to the degree of bias.

16.2 Variables of National Power

The initial problem of power analysis and measurement is that no long-term, comprehensive quantification[352] exists for many variables considered important, such as national cohesion, carrying capacity, educational performance. With regard to still more basic matters of critical importance like effective military power, John Mearsheimer testifies to the fact that "there is no good database that can be tapped to measure military power over the last two centuries. Developing such a database would require an enormous effort" (MEARSHEIMER 2001: 134). Klaus Knorr and James Rosenau summarize the general dilemma this way:

> Another major source of contention that marks the study of international politics is the inaccessibility of crucial types of data. […] the student of international politics is more dependent on indirect methods of observation. Access to international phenomena must be created and data must often be made. (KNORR & ROSENAU 1969: 10–11)

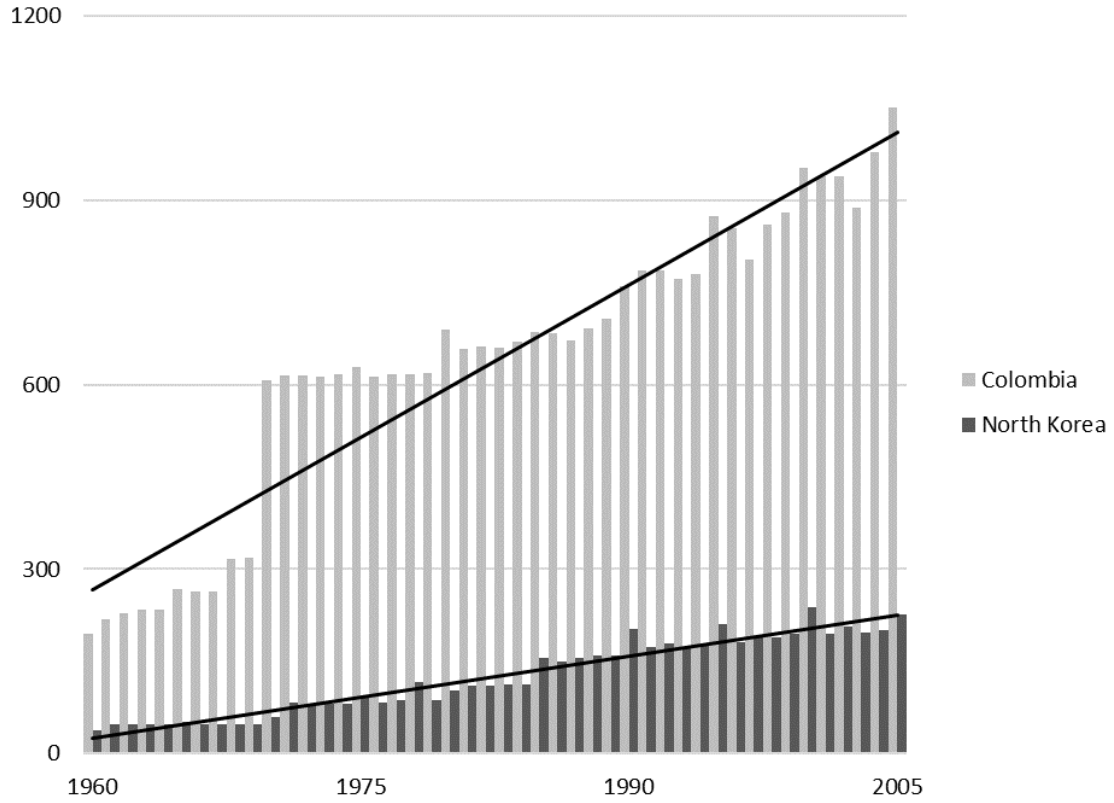
A connected problem then is double bias. Scholars are already biased in selecting and employing variables in such a way that best affirms their theoretical inclinations. Now if scholars also start to produce their own data to measure the performance of their theories, then the data itself is likely to be biased to varying degrees. It is normally better for scholars gathering the data and scholars interpreting the data to be as unconnected as possible.

A positive development with regard to data availability is that more data is becoming available as time proceeds. Governance was another important area without adequate variables available.

[352] "Long-term" excludes ad hoc one-time creations of comprehensive datasets as published in some articles. "Comprehensive" excludes long-term comparative studies limited to relatively few countries such as OECD data.

Since 1999 the Worldwide Governance Indicators (WGI) have become available. The WGI compile data from various surveys to construct six indicators for governance. The World Development Indicators (WDI) & Global Development Finance (GDF) dataset from the World Bank is perhaps the largest public database for country statistics with data for currently 1,239 variables covering the time period since 1960; in reality it is a bit less as some variables appear more than once in different forms. Colombia is the country with the most data available for the time period 1960–2010. North Korea can be considered as being at the opposite extreme. Looking at the number of variables available each year for Colombia and North Korea for the time period 1960–2005 results in the following graph:

Figure 29: Availability of Indicators in WDI Database 1960–2005 [World Bank]



Source: http://databank.worldbank.org/ddp/home.do [June 14, 2011].

What this graph cannot show is the quality and relevance of different data. Some variables are available but not necessarily accurate (for example, the military expenditures for China or Russia, for which it might be more sensible to consult the *WMEAT* or *Military Balance* than to rely on SIPRI data). The amount of variables available for Colombia in 2005 is around 5.4 times as much as the amount available for 1960. For North Korea it is around 6.1 times as much. The number of available variables has an influence on the number of variables used in power formulas. The following table presents the minimal number of variables used for all formulas presented in previous chapters:

Table 109: The Number of Variables in Power Formulas 1741–2010

Pre-Internet Era Formulas	#	Internet Era Formulas	#
Süßmilch 1741 DE	2	CASS 1996 CN	64
Friedensburg 1936 DE	2	Yan 1996 CN	6+
Stewart 1945 / 1954 US	3	Ou-yang / [Wang] [1997] CN	38
Wright 1955 US	2	Chaczaturov 1997 RU	4
German 1960 UK	20	Caro 1998 FR	4
[Guetzkow] [1963] US	5	Zhu / Xiao 1999 CN	11
Cole 1963 UK [AU]	3–6	NSI 2002–2008	8–17
Shimbori / Ikeda / Ishida / Kondô 1963 JP	5	Hu / Men 2002 CN	23
Cohen 1963 US	7–9	Hai / Yun / Wang [2003] CN	6
Fucks 1965 DE	2	Volgy 2003 US	2
Schwartzman / Mora y Araujo 1965 BR / AR	3	Newsweek 2003 US	22
[Anonymous] [1967] [US]	2	NIRA 2004 JP	103
Shinn 1969 US	3	Ageev 2004 RU	48
Alcock / Newcombe 1970 CA	2–3	Virmani 2004 IN	2
Singer / Bremer / Stuckey 1972 US	6	Sodekawa 2004 JP	39
Rummel 1972 US	236	CIA / IFs [2005] US	5
Ferris 1972 US	8	Gonçalves 2005 BR	3
Cox / Jacobson 1973 CA / US	5	GlobalFirePower.com 2005 US	25–33
Rosecrance / Alexandroff / Healy / Stein 1974 US	25	Wang 2006 CN	128
Cline 1975 US	12+	Zarghani / [Hafeznia] 2006 IR	86
Midlarsky 1975 US	7	Höhn 2006 DE	8
Udell 1975 US	3	Kim 2007 KR	6
Saaty / Khouja 1976 US / KW	5	McCool / Gerth / Ferguson 2007 US / UK	4–4+
Organski / Kugler 1978 US	9	MGIMO 2007 RU	13
Liu 1978 TW	5	Orłowski 2007 PL	8–11
Farrar 1981 US	2	Lach / Skrzyp / Łaszczuk 2008 PL	8
Beckman 1984 US	3–5	[US Agency] 2008 [US]	7+
EPA 1987 JP	17+	Hansun 2009 KR	13+
Ding 1987 CN	7	Jaishankar 2009 IN	4
Huang 1989 CN	7+	Davutoğlu / Aslanli 2009 TR/AZ	10
Stoll 1989 US	6–22	Zahreddine / Gomide 2009 BR	25
Yu / Wang 1989 CN	4	Milewicz / Nothdurft 2009 PL / DE	10
Sullivan 1990 US	3	Serrão / [Pirró e Longo] 2009 BR	186
Sułek 1990 PL	3		
Zhang 1991 CN	12		
Barcia 1993 US	5		

Source: Author's own compilation.

The table shows that power formulas in the pre-internet era had 13+ variables on average, whereas power formulas in the internet era have 28+ variables on average. This demonstrates a clear increase.

To return to North Korea, it is one of only nine nuclear weapons states in the world. It has the fourth largest army in the world. Regardless of how North Korea is perceived in overall national power, it is at least important enough to deserve to be included in any sort of country ranking based on national power. But often it is absent because of simple lack of data, as the earlier graph illustrated.[353] If one accepts "GDP (current $)" as a most common variable, then North Korea is one of the countries

[353] Marina Muscan remarks that "North Korea is probably the most mysterious and inaccessible country in the world today," (MUSCAN 2007: 67), further explicating that "although, economically, North Korea can be considered one of the weakest country [sic] in the Asia – Pacific region, through its military force it became one of the strongest actors on the regional geopolitical scene" (MUSCAN 2007: 72). Han So Suk highlighted the psycho-political factor in stating that "North Korea has not only the military power but also the political will to wage total war against the United States" (HAN 2003).

(next to Tuvalu and Myanmar) for which there is no data whatsoever, though the *WMEAT* and *CIA Factbook* supply "rough" estimates. Admittedly, North Korea is a special case. Still the problem is that in almost every variable one can find gaps for some more or less important countries. Only variables directly related to territory and population (including life expectancy) constitute exceptions to this rule. The World Bank provides data for 1,239 variables on 213 countries and territories (WDI & GDF database [14 June 2011]). For the average variable one can find data (that is, only one data entry for the time period 1960–2010) for about 22–102 countries and territories, the average being around 62 and the standard deviation around 40.

These data gaps are a veritable problem, because any effort to fill them via alternative data sources or estimates can be, at the very least, extremely time consuming. If the gap is simply one of time availability, meaning that some years are missing but some are not, one can interpolate or extrapolate for these missing years. The problem with interpolation and extrapolation is that sometimes years are missing for an important reason. For example, a lost war, disintegration, or revolution. No standard way exists for dealing with these gaps when one is unable or unwilling to invest that much time in filling them. Here is a list of the more common methods for dealing with data gaps for a specific variable: (a) the exclusion of countries with gaps (postselection), (b) excluding the small countries in the hope that this will eliminate the gaps or reduce their number (preselection), (c) using a zero value in place of the gap, (d) averaging the available values to ignore the gap;[354] of course, one can also exclude variables rather than countries. In a nutshell, whether the nonavailability of important variables forces a designer to use poor proxy indicators, or whether holes in the data force a designer to find a way of filling these gaps artificially, the victim is credibility.

16.3 Dimensional Analysis and Logic

At least two power indexes using sophisticated approaches have claimed at some point that Denmark is more powerful than Russia (sections 13.51, 14.15). Another sophisticated approach calculated Belgium as being more powerful than France in 1980 (section 13.28). A less sophisticated index found a non-state actor like Bermuda to be 6.5 times more powerful than Brazil (section 13.35). Even a relatively prestigious index such as India's National Security Index (NSI) has ranked Norway as the third most powerful country among 50 countries listed (section 15.11; compare section 15.7). These distortions are partly the result of ignoring dimensional analysis. Dimensional analysis is concerned with identifying the dimensions of variables in order to check their relations for consistency. This is necessary for verifying the plausibility of derived equations and computations.

Likewise for statistical purposes one needs to be able to distinguish between the logic of the subject matter itself [Sachlogik] and numerical logic [Zahlenlogik]. For numerical logic it suffices that there are no errors in the input data and calculations. However, to be meaningful, the figures being

[354] Averaging available values constitutes no major problem when using many variables and the arithmetic mean. The arithmetic mean is less sensitive to differences among values in comparison to the geometric mean. This concerns mainly lopsided countries excelling in some areas and performing poorly in other areas. For that reason the geometric mean should not be used when the data is incomplete or unreliable.

calculated should represent things that have some logical relation in reality as well. For example, one can multiply the number of frogs by the number of volcanoes. For all practical purposes the numerical result may then be undisputedly correct as far as the data and the calculations are concerned. Yet if one has made this calculation in order to determine the number of stars in a distant galaxy, then something is not quite right with the logic of the subject matter.

In computer programming one refers to three basic types of errors: syntax errors, runtime errors, and logic errors. Syntax errors occur when the programming code has not been entered correctly in accordance with the rules of the programming language. As a result the program does not compile until corrected, so that the program will not run in the first place. Runtime errors are only detected when the program is running, an example being division by zero. Logic errors arise when the programmer has made a mistake somewhere in the conceptual design of the program, so that the program does not deliver what the programmer intended it to do, though there is nothing whatsoever wrong with the programming code and the operation of the program as such. Syntax and runtime errors relate to numerical logic, whereas logic errors relate to the logic of the subject matter.

To return to dimensional analysis, it is the formula that expresses how variables are related to one another. For example, the volume of a box is determined this way:

```
volume = height × width × breadth
```

If, from the viewpoint of numerical logic alone, one were to construct the following equation:

```
volume = height + width + breadth
```

then the numerical results might be totally correct if properly calculated, but they would not represent the volume. For all practical purposes, assuming that most human-created boxes will seek to maximize volume, the calculated results may seem to be more or less proportional to the actual values. This does not change the fact of faulty reasoning.

With regard to the box, things are relatively straightforward to conceptualize. When it comes to more complicated matters, such as national power, confusion is easier to achieve. By different tricks and twitching, things can always be adjusted to look somewhat normal and palatable. In deductive logic, if all the premises are true, it follows that the conclusion must be true. However, if all the premises are false, it does not follow that the conclusion must be false. A true conclusion can still be produced as a matter of pure luck and/or manipulation.

When approaching national power, one finds variables in three different formats. The reason for using the term "format" is that some so-called variables are one and the same variable displayed in various forms. For example, energy consumption, energy consumption per capita, and energy intensity (energy consumption / GDP) represent three times the same variable displayed in a different format. Assuming that one has access to population and GDP figures, energy consumption per capita and energy intensity are *redundant* as far as data availability is concerned.

The three basic formats are (1) variables on an aggregate basis (total size or gross size), (2) variables on a per capita basis, and (3) other ratios and rates that relate two variables or more. These three formats can be also thought of as dimensions (discussion continued in the next section):

(1) A variable on an aggregate basis represents the national sum total of a variable in a given country. This format summarizes the total *undivided* quantity of some defined entity within the given geographic area such as the nation. In other words, this format counts the total number of beans within a nation's boundary. Examples are: population, area, GDP, military expenditures, total number of patents, et cetera.

- Complications arise when these national sum totals happen to measure something negative, for example energy imports, which implies that the more energy imported, the weaker the country is. They are still national sum totals proper. The problem in general is that the more negative national sum totals are added in power calculations, the more likely the linear calculations could result in negative national sum totals. This means a country could then have a negative value as total power, which seems illogical. For that reason it may be better to avoid using negative variables, unless they are standardized in a way that avoids negative end results.[355]

(2) A variable on a per capita basis represents the national sum total of a given variable *divided* by a given population. A variable on a per capita basis does not represent a national sum total. Instead this format represents the average level of something with regard to individuals. In other words, the total number of beans within a nation's boundary is divided by population to determine how many beans there are (on average) per person. Examples are GDP per capita, researchers per million, et cetera.[356]

- Instead of population, one may take just as well a more refined population set like labor force. As an example, it is possible to find military personnel divided by population, and it is possible to find military personnel divided by labor force.

(3) Ratios and rates typically consist of variables that have been divided or multiplied by another variable. Ratios, strictly speaking, have two variables with the same units, as a result the units cancel each other. In other words, the number of red beans is divided by the number of green beans to determine the ratio. Examples are high technology exports as percentage of manufactured exports, military spending in relation to health spending, the human sex ratio (males / females), et cetera. Rates refer to the comparison of two measurements with different units. It basically means that any variable can be divided by

[355] Sayed Hadi Zarghani has voiced a contrary view and approach, and he advocates the usage of negative variables (ZARGHANI 2010; also section 13.41).

[356] Some variables may be by their intrinsic nature per capita. The best example is life expectancy. In addition to that, life expectancy appears to behave in a quasi-logarithmic way. For an approach to convert life expectancy into a viable measure of development comparable to something like GDP per capita, see section 13.42. *After* such conversion, it is then arguably possible to calculate national sum totals (total size or gross size) as a proxy for total development.

another variable to arrive at some sort of rate. Examples are tractors per 100 km^2 of arable land, energy intensity (energy consumption / GDP), et cetera.

These formats are incompatible as far as adding them up is concerned. Variables have to be transformed to one and the same format before they can be added.[357] For example, if one wants to determine the total number of fruits, one can add the total number of oranges and the total number of grapefruits. If one wants to determine fruits per capita, one can add oranges per capita and grapefruits per capita. However, adding "total oranges" and "grapefruits per capita" violates dimensional consistency (even when values are standardized), and the result is nonsense.

In physics dimensional consistency requires that only entities of the same type (unit) can be added.[358] For the purpose of calculating national power indexes, more lenient standards can be used, because variables are made compatible by assessment, using diverse schemes for weighting and standardization. This approach is comparable to the use of money to make different products and services compatible for exchange by assessing their respective monetary values. A clear, unambiguous understanding of the three different formats is nevertheless necessary, nothing less applies to the logical accounting of money either.

The following example is equivalent to the above example with the box. The single variable of military expenditures is divided into three dimensional components:

$$ME = POP \times GDPPC \times ME\%$$

ME = military expenditures; POP = population; GDPPC = GDP per capita; ME% = military expenditures as percentage of GDP

POP is on an aggregate basis. GDPPC is on a per capita basis. ME% is a percentage share ratio. Note the cancellation of denominators when multiplied together, which is the purpose of dimensional analysis. Without dimensional analysis, it is possible to construct the following power formula:

$$POW = POP + GDPPC + ME\%$$

POW = national power; POP = population; GDPPC = GDP per capita; ME% = military expenditures as percentage of GDP

The numerical results are what follow in the table below. Values are standardized with maximum value being 100.0 for each variable. Abbreviations are from the formulas above:

[357] The third format of ratios and rates other than variables on a per capita basis is less a format and more a summary category of remaining formats. Variables on a per capita basis are also ratios and rates, and so the second and third format could be joined into one category. The reason that variables on a per capita basis are separate is that they represent a major dimension of their own (discussion continued in the next section). As for calculations, depending on how ratios and rates of the third format are standardized and used for what purposes, it may or may not be reasonable to add them. This has to be decided on a case by case basis. In the end every specific action always depends on the logic of the subject matter, and any general rules can never be more than rough guidelines to avoid more common problems.

[358] Meter for length, kilogram for mass, second for time, ampere for electric current, kelvin for temperature, candela for luminous intensity, mole for the amount of substance. In addition, Mirosław Sułek (section 13.30) provides an alternative, short introduction to dimensional analysis in the text that is attached to this study: see section "1.1 Dimensional analysis" in Appendix B. He has often emphasized that more attention needs to be paid to dimensional analysis, and the empirical overview of power formulas in this study confirms that he has reason.

Table 110: Top Ten Most Powerful Countries in 2005 (Without Dimensional Analysis)

Country	nonstandardized			standardized			POW	ME
	POP million	GDPPC US $	ME%	POP	GDPPC	ME%		million US $
China	1,310.0	1,720	3.8	**100.0**	2.2	12.2	114.4	85,300
North Korea	22.2	973	31.1	1.7	1.2	**100.0**	102.9	6,720
Luxembourg	0.5	78,000	0.7	0.0	**100.0**	2.3	102.3	244
India	1,090.0	742	2.3	83.2	1.0	7.4	91.6	18,800
Norway	4.6	65,700	1.6	0.4	84.2	5.1	89.7	4,880
United States	296.0	42,000	4.1	22.6	53.8	13.2	89.6	503,000
Qatar	0.8	54,000	2.9	0.1	69.2	9.3	78.6	1,240
Switzerland	7.5	48,900	1.1	0.6	62.7	3.5	66.8	3,990
Ireland	4.0	49,900	0.6	0.3	64.0	1.9	66.2	1,160
Denmark	5.4	47,600	1.3	0.4	61.0	4.2	65.6	3,470

Source: AVC 2009; author's own calculations.

The incongruous 'method' of adding up (a) variables on an aggregate basis, (b) variables on a per capita basis, as well as (c) other ratios and rates, usually creates a bias favoring small but highly developed countries (e.g. Nordic countries). Countries with extreme values in one dimension (e.g. North Korea) may also benefit depending on the chosen ratios and rates. Countries with big populations will normally not end up at the bottom of such indexes, though it is quite probable for them to be ranked lower than some really small countries.

In the made-up power index above Russia holds rank 35, two ranks below Cyprus. In fact this result is arguably close to the results of Nathalie Serrão (section 13.51), where Russia has rank 32 – one rank below Malta. The only difference is that my method simply averages a measly three variables, whereas she uses principal component analysis on 186 variables. Her logic error and that of others is not that difficult to replicate and demonstrate. Her study is valuable nevertheless.

This 'method' of adding variables without dimensional consistency has produced again and again incoherent dimensional hybrids with results of dubious value. If one wishes to measure national power, then the numerical values have to be transformed into national sum totals *before* addition. If one wishes to measure national power per capita,[359] then all the variables have to be transformed to per capita values *prior* to addition. The logically equivalent alternative is to transform all variables to national sum totals and divide them by population *after* addition.

Instead of addition, one can also opt for multiplication altogether, if such action is justifiable, because with multiplication one has more leeway in using variables of different dimensions. Many different methods (not explicitly suggested) are also possible.

Either way designers of power formulas have to know what they want in order to achieve results in a logically consistent manner. Logical consistency must refer not only to numerical logic but also to the logic of the subject matter. Throwing numbers into a mixer without *prior* thinking is not a

[359] See section 13.24 for the only example of a *per capita* index of national power.

viable method. Otherwise all subject expertise would be unnecessary and statisticians alone could analyze the world. Onesidedness has often produced needless acrimony between subject experts and mathematicians. The ever-present hope is to find the lowest common denominator.

16.4 The Dimensions of National Power

As far as going for the actual dimensions of national power via the empirical way of factor analysis, two studies need to be mentioned in the context of power analysis and measurement, that of R.J. Rummel (section 13.16) and Richard Stoll (section 13.28):

- R.J. Rummel directed the Dimensionality of Nations (DON) project that lasted from 1962 to 1975. One result was to determine three dimensions that account for 40.1% of the variation in the 236 variables: size, wealth, and politics (RUMMEL 1972: 269). Size relates mainly to variables on an aggregate basis (total size or gross size), wealth relates mainly to variables on a per capita basis, and politics relates mainly to ideological affiliation (whether a country is communist, capitalist, or neutral).
- In 1989 Richard Stoll coedited with Michael Ward the book *Power in World Politics*. In a chapter of his own, he used factor analysis on 22 variables to arrive at three factors for 1980, indicating to him that power is indeed multidimensional. He interpreted the first factor as promoting large, advanced, internationally active nation states, the second factor as promoting advanced industrial states that are not necessarily large, and the third factor as promoting large nations but not necessarily developed ones.

Rummel and Stoll both list three dimensions identified by factor analyses. As discussed in the last section, when approaching national power, one typically finds variables in three different formats. These formats I had identified deductively on logical grounds, and these formats can be considered equivalent to dimensions. The following table then compares three sets of dimensions with concrete variables as examples:

Table 111: Dimensions of National Power (Exemplary Variables)

Dimensions	Rummel 1972	Stoll 1989	Höhn 2010
Size × Development	population GNP	imports GNP	total number of patents
Size	total energy production area	area population	population
Development	telephones per capita GNP per capita energy consumption per capita	life expectancy GNP per capita	researchers per million GDP per capita
Structure	bloc membership freedom of group opposition communist party membership (% of population)		high-technology exports (% of manufactured exports) energy intensity (energy consumption / GDP)

Source: RUMMEL 1972: 221–231; STOLL 1989: 152; HÖHN 2010: 18–19; author's own categorizations.

If one looks at Stoll's three dimensions, one can see that his first dimension *size × development* is the product of the two following dimensions: *size* in terms of population and area, and *development* per capita. This is demonstrated by the fact that:

```
GNP = population × GNP_per_capita
```

For that reason the *size × development* product is not a proper dimension as much as it is the result of multiplying two dimensions.

In Stoll's factor analysis population and area come out as a dimension of their own. In Rummel's factor analysis population and area still belong to the same *size* dimension as the other major variables on an aggregate basis, such as total energy production and GNP, which is not unreasonable given that *size* is the more decisive factor in the *size × development* product.[360] He suggests that "the size dimension may also be interpreted as a power bases dimension" (RUMMEL 1972: 225). Likewise in my logical-deductive scheme for classification, all variables on an aggregate basis are considered as being of the same format (gross size or total size).

If area and population as the most basic variables seek to indicate *size* devoid of any notion of *development*, then conversely variables on a per capita basis seek to indicate *development* devoid of any notion of *size*. Population may stand for the amount of presence, land for the amount of ownership, whereas the level of development may stand for organization and technology. In any event, all three columns concur that there is a *development* dimension on a per capita basis.

[360] Decisive insofar as *size* varies more than *development* and thus tends to have more impact on the variation of the end product. The largest UN member has more than 100,000 times the population of the smallest UN member, whereas the richest UN member has less than 1,000 times the nominal GDP per capita of the poorest UN member.

Max Krahmann had proposed that geopolitical space consists of territory as the horizontal dimension and technology as the vertical dimension (KRAHMANN 1927, translation plus original text available in Appendix A; also section 3.4). His vertical dimension relates to the *development* dimension in the table, and his horizontal dimension relates to the *size* dimension. Alexander Supan had interpreted national power to consist of three elements: area, population, organization (SUPAN 1922; also sections 3.4–3.6). Area and population can be related to the *size* dimension, organization can be related to the *development* dimension.

Rummel's political dimension is structural: communist countries have differed in structure from capitalist countries. Structures have direct and indirect effects on national power in the short-run and in the long-run, though these effects are not necessarily obvious or predictable.[361] As a simplistic interpretation, it is possible to say that communist organizations have proved robust in wars (WWII, Vietnam war) but inefficient economically in the long run (in the short run communist systems had periods of industrial achievement). The third format in my deductive classification scheme consists of ratios and rates other than variables on a per capita basis. It also reflects on structures, though these structures are not as ideologically aligned and conditioned as during the time of the Cold War.

Another important dimensional issue is not covered in the table: Rummel defined power as the linkage between potentialities and actualities (RUMMEL 1976: 165). If the aim is to define the difference between potential power and actual power on grounds of dimensionality (compare sections 8.3, 13.30, 13.43), then the perceived difference has to proceed from the physical dimension of *time*. The derivatives with respect to *time*, such as speed, play a ubiquitous role in strategy.[362] The physical concept of power (watts) is a *time* derivative of energy (joules):

```
power = energy / time

watts = joules / seconds
```

The discussions on these issues in this section and the previous one are in no way perfect and much more introductory and suggestive in character than descriptive and determinate.

16.5 The Need for Nonarbitrary Weighting Schemes

The weighting of variables in power formulas is perhaps the single most important and unresolved issue in the design of power formulas. More than 73% (50 of 69) of designers use arbitrary weighting in their formulas. In this context the assignment of equal weights to variables is not less arbitrary than

[361] Theoretically structures should be neutral in their effect on power, simply marking different pathways, and useful for cluster analysis to distinguish different types of countries and/or roads of development. In reality, however, few things are as neutral as the choice for the color of a car. For these *structural* variables, as compared to variables on a per capita basis, one cannot as often and easily judge that one point in the scale is preferable to another one. An example is energy intensity (energy consumption / GDP). It is possible to demonstrate that advanced economies are more energy efficient, therefore it is possible to argue that energy intensity is something bad. Equally it is possible to demonstrate that if countries are at a similar economic level (GDP per capita), the country using more energy will be perceived as more powerful, therefore it is possible to argue that energy intensity is something good. Indicators of *structure* are surrounded by more theoretical and empirical ambiguity.

[362] This may refer to the lead-time necessary to mobilize economic and human resources (war potential) into actual military power. This lead-time may have to be assessed relatively to the estimated time it may take an advancing enemy to invade and occupy a country's territory. Equally one can also refer to the time a country may need to adjust to economic shocks and trade disruptions. These are merely examples, for *time* plays a decisive role in everything.

the assignment of different weights: "To repeat, weighting each component equally is a *studied* confession of ignorance of the proper mixtures for each great power over a long period of time" (MOUL 1989: 113; compare section 13.17). Assuming that the designers have above average knowledge about national power in the context of international relations, one may also agree with Mearsheimer that "it is important to emphasize that an informed author's estimate […] is superior to uninformed guesswork" (MEARSHEIMER 1989: 56).

For that reason pure deductive methods should also be taken into account, even though they are not discussed further in this study. Pure deductive methods seek to apply expertise and logic in such a way as to produce consistent theory, with consistency here referring to the absence of contradiction. Expertise delivers general statements referred to as premises, while logic refers to the use of valid reasoning in order to proceed from these premises towards a definite conclusion. Assuming the premises to be true, the use of deductive logic should in turn result in conclusions that have to be true by necessity. However, in a field as elaborate and entangled as international relations, it does not seem quite possible to test if premises hold in all anticipated circumstances.

If the conclusions follow from the premises, even if the truth value of these premises is merely assumed, then the argument is *valid* irrespective of the truth value of the premises. The argument is *sound* in turn only if both (a) the premises are true and (b) the argument is valid. A weighting scheme can be considered nonarbitrary if based on valid reasoning, though the choice of premises may not make it necessarily sound. Such can be said for **game-theoretic approaches**. If no method exists to determine the truth values of given premises, then pure deduction can only prove that a formula's underlying reasoning does not contradict itself. Given the diversity of formulas and their implicit theoretical assumptions, one cannot even see a preliminary consensus emerging on premises.

Scientific credibility demands endeavors to come up with nonarbitrary weighting schemes. Being nonarbitrary does not ipso facto imply greater accuracy right from the start. Initially a nonarbitrary weighting scheme is likely to produce less accurate numbers than an arbitrary, intuition-based weighting scheme. Unlike an arbitrary, intuition-based weighting scheme, the nonarbitrary weighting scheme then represents a crude basis to work from, that is, from then on one can either work to refine the scheme gradually or come up with better nonarbitrary schemes. This way one gains theoretical and methodological insights into the subject matter, that one does not gain if one continues to rely on intuition and expertise alone.

Diplomatic historian Paul Schroeder draws attention to this important point in his criticism of the power formula by Rosecrance and colleagues (section 13.19):

> Any weighting scheme, however crude, unscientific, or rule of thumb, would be better than none. If there is no satisfactory theory (which I readily accept), then one needs to be developed; again, an unsatisfactory theory would be better than none. (SCHROEDER 1977b: 74)

The statement also relates the issue of weighting to the issue of theory. Any operational, nonarbitrary weighting scheme necessitates some basic theory to define power.

Overall less than 27% (19 of 69) of designers use weighting schemes that are, at least in part, nonarbitrary. Nonarbitrary weighting schemes can be divided into three basic categories:

(1) determination of weights solely on the basis of available/selected variables themselves in conjunction with some statistical technique for dimension reduction (includes principal component analysis, factor analysis, discriminant analysis),

(2) determination of weights based on perception surveys (includes multiple regression analysis correlating variables with the results of perception surveys),

(3) determination of weights based on empirical data on the performance of national power (also includes multiple regression analysis, this time in the service of correlating variables to empirical data).

In comparison, Wang Defa (section 14.14) has listed subjective and objective methods that can be used to construct power formulas (WANG 2006: [page 16 of chapter 11]). The first three items are subjective methods, listed separately, while the fourth item lists objective methods:

(1) arbitrary selection of factors and weights,

(2) consultation of experts,

(3) usage of eigenvectors and eigenvalues in line with a matrix,[363]

(4) objective weighting methods: the coefficient by variation method, multiple correlation coefficient method, entropy method, principal component analysis, factor analysis.

His categorization is somewhat different but compatible with mine. The three following sections discuss and elaborate the three nonarbitrary approaches of my classification attempt along with the implications on underlying theory.

16.6 Data-Based Weighting Schemes

In the first category (data-based weighting schemes), one relies on variables alone in conjunction with some statistical reduction technique, such as principal component analysis, factor analysis, and discriminant analysis. The expectation is that much, if not most, of the information contained in a multidimensional data set (more than one variable) can be distilled into a unidimensional data set (one variable), and that the results contained in this unidimensional set will be meaningful. In operational terms one aims at minimizing factor redundancy,[364] which refers to the degree that variables convey similar information (colinearity) in order to include a maximum of information in as little data as

[363] See section 13.23 for the only example of an index of national power based on eigenvectors and eigenvalues.
[364] Designers of multivariate indexes inadvertently face a contradiction in aims: robustness versus redundancy. Ideally one wants variables that are robust *and* nonredundant. For a treatment of this problematic, see PERMANYER 2011.

possible. Around 17% (12/69) of designers have used some dimension reduction method on the basis of available/selected variables alone:

Table 112: Data-Based Power Indexes

Data-Based Indexes	Dimension Reduction Method	Variables
Rummel 1972 US	Cluster analysis (dendrogram)	236
Ferris 1972 US	Principal component analysis	8
Stoll 1989 US	Factor analysis	6–22
Ou-yang / [Wang] [1997] CN	*Unknown method*	38
Sodekawa 2004 JP	Principal component analysis	39
Wang 2006 CN	*Unknown method*	122
Kim 2007 KR	Network analysis	6
MGIMO 2007 RU	Discriminant analysis	13
Lach / Skrzyp / Łaszczuk 2008 PL	Method of ranks and weights	8
Zahreddine / Gomide 2009 BR	Principal component analysis	25
Milewicz / Nothdurft 2009 PL / DE	Factor analysis	10
Serrão / [Pirró e Longo] 2009 BR	Principal component analysis	186

Source: Author's own compilation.

As can be seen in the table above, most data-based indexes[365] are of more recent origin. This is unsurprising, given that the calculation of these indexes may require sophisticated statistics software. Another feature is that the number of input variables included tends to be larger than usual.

The advantage of these data-based weighting scheme methods is that they are not arbitrary as far as the *determination of weights* is concerned. They intend to maximize the information contained in the unidimensional output. One can throw a huge amount of data into the calculations without having to be particularly selective, which in turn means that data-based indexes with more input variables tend to be less arbitrary as far as the *selection of variables* is concerned. Data-based indexes with fewer variables are still rather arbitrary in this regard.

Even if one were ultimately to use all available country statistics, as R. J. Rummel (section 13.16) and Nathalie Serrão (section 13.51) aimed to do, there remains a self-selection bias in the data. In general, it can be assumed that the country data is collected for variables that are more or less considered important. In this regard the *availability of data* remains arbitrary. Robert von Keller emphasized the temporal contextuality of "total statistics" ["totale Statistik"]:

> In the viewpoint of statistics there is always a whole: world trade, a national economy, a regional economy, this or that economic group. However, statistics may direct only a limited number of inquiries into this whole; the choice of inquiries mirrors itself in each epoch's assessment of political, economic, and scientific problems. (KELLER 1938: 29)[366]

[365] To avoid confusion: all indexes use data, but only those "data-based" indexes base the weighting of variables solely on the data itself, rather than perception or some empirical measuring rod.

[366] German text: "Im Blickpunkt der Statistik steht immer ein Ganzes: der Welthandel, eine Volkwirtschaft, eine Regionalwirtschaft, die oder jene Wirtschaftsgruppe. An dieses Ganze kann die Statistik jedoch nur eine begrenzte Anzahl von Fragen stellen; in der Auswahl dieser Fragen spiegelt sich die politische, wirtschaftliche, und wissenschaftliche Problemstellung jeder Epoche wider."

If these all-encompassing, data-based weighting scheme methods work at all, the reason is that much, if not most, data about countries still appears to be collected with the perhaps *subconscious* aim of estimating national power or something closely related to it. [367] In fact, the generally available statistics aim at measuring country size and per capita development. The resulting operational definition of national power involves equating it with country performance (in effect the dissolution of national power as a political concept). This is somewhat akin to the broader concept of comprehensive national power (CNP).

16.7 Perception-Based Weighting Schemes

In the second category (perception-based weighting schemes), one relies on the quantified and averaged perceptions of surveyees to estimate either (a) how important variables are or (b) how powerful nations are. Those schemes rely in one way or another on perception surveys to determine the weighting of variables.

In terms of providing an operational definition of power, they basically define power via perception: whatever people perceive as powerful, is therefore powerful.[368] The concept of power might be socially constructed without having a fixed meaning for all times and situations. Though most designers who use weighting schemes based on perception surveys can hardly be considered constructivists, both their approach and their implicit definition of power place them closest to this school of international relations.[369] In reality, this approach is pragmatically empiricist in that it abandons the ambition of using logical deduction to provide a simple solution to the puzzle.[370] The implicit assumption is that some objective basis of power provides external stimuli to these perceptions (see section 13.13). It means that humans know what power is through their daily experiences, though they are unable to describe it adequately.

Around 10% (7 of 69) of designers created power indexes using perception-based weighting schemes based on perception surveys. The following table presents those perception-based indexes:

[367] Otherwise, logically speaking, there should no be no correlation whatsoever between the extract of these weighting schemes and the perception of national power. One simply needs to imagine throwing a lot of geological and environmental variables and the like into such a weighting scheme, for example volcanic activity or the local number of frog species, to realize that numbers by themselves alone are incapable of rendering value judgments – as implied in different weights.
[368] "It has been said that power is what people think it is" (KNORR 1975: 13), which can still be taken further: "[…] international relations are what people think they are; […] perception probably plays as important a role in international relations as does objective reality itself" (STOESSINGER 1990: 401).
[369] Thomas Hobbes was certainly not a constructivist, though he can be quoted to the effect that "reputation of power is power" (HOBBES, *Leviathan* X).
[370] The puzzle is a set of three questions: Which elements does national power consist of? What weights do these elements have? How are the elements related to each other? The last question asks about the operational structure of the formula, that is, whether it is multiplicative, additive, a combination of both, or something else entirely.

Table 113: Perception-Based Indexes of National Power

Perception-Based Index	Focus of Perception Survey	Multiple Regression Analysis
Shimbori / Ikeda / Ishida / Kondô 1963 JP	Three variables ranked according to their perceived importance	
Shinn 1969 US	Estimated power of hypothetical countries based on a set of three variables	X
Alcock / Newcombe 1970 CA	Countries ranked according to their perceived importance	X
Saaty / Khouja 1976 US / KW	Estimated importance of five variables in pairwise comparisons of countries	
Liu 1978 TW	Estimated importance of a number of variables ("people's concerns")	
Caro 1998 FR	Estimated importance of different countries	X
Zarghani / [Hafeznia] 2006 IR	Estimated importance of a number of variables within nine predetermined categories	

Source: Author's own compilation.

In four of seven cases surveyees rated/ranked the importance of variables. This does not automatically result in a weighting, which makes this emphasis somewhat problematic. Just because we know one variable is more important than another, this in itself does not state what weights these two variables should have. The consequence is that the methods for transforming these rating values into weights are more often than not somewhat arbitrary. In the remaining three cases surveyees rated/ranked the importance of countries. This emphasis is less problematic, because multiple regression analysis can be used to automatically determine the optimal weights of variables. This also takes care of colinearity, something that the ranking/rating of variables does not.

As for criticism, it can be argued that perception-based weighting schemes simply replace the arbitrary weighting of an individual by the arbitrary weighting of the many individuals. It comes back to social construction. If power is altogether a social construction without an objective base (conveyed through external stimuli) in this universe, then this criticism is valid. If power has an objective base conveyed through external stimuli, and it is taken for granted that individual perception may err, the probable effect of random error on the end result should decline with the amount of surveyees. Increases in sample size should be able to produce increased confidence levels, providing some sort of relative, probabilistic accuracy.

Assuming that whole nations and cultures could be biased, it is important to conduct cross-national and cross-cultural surveys. The perception of power is also situation-dependent. For example, Norman Alcock and Alan Newcombe (section 13.14) concluded that

> perceived national power is some junction of GNP or military expenditure (in purchasing-power-equivalent dollars) if none of the nations has been at war recently, but is a function of military expenditure alone if warring nations are included in the rating. (ALCOCK & NEWCOMBE 1970: 342)

Furthermore the foundations of power may be changing with time. Cross-temporal surveys are also likely to produce different effects as far as the weighting of variables is concerned.

16.8 Empirical Weighting Schemes

In the third category (empirical weighting schemes), one is looking for an objective measuring rod for national power, or in the absence of such, to come up with an appropriate proxy. War is the measuring rod of national power most often referred to (HAUSHOFER 1913: 8; SPYKMAN 1942: 22; TAYLOR 1954: xxix; PERKOVICH 2003: 14, 2004: 136; CHANG 2004: 21; further KLUETING 1986: 38, 305; BALDWIN 2002: 182–183). National power is then operationally defined as *war potential*. The power of nations determines their fate in conflict, be it victory, defeat, or some form of stalemate. War can test whether perception-based notions of national power can hold up to reality. Ayn Rand philosophized about this inescapable force of reality when she stated that "we can evade reality, but we cannot evade the consequences of evading reality" (Rand, quoted in BERWICK 2011: 585).

Singer and colleagues tested how the six indicators in the CINC (section 13.15) perform in wars for the time period 1816–1976, the results showing that victory is more often associated with superiority in steel and energy (WAYMAN et alia 1983: 509). No empirical power indexes are known to exist. It is sensible to assume that various scholars at various times carried out multiple regression analyses on the CINC indicators, providing different weights to different variables. Richard Stoll (section 13.28) mentions that in a 1984 conference paper he had experimented with various weights for the CINC indicators (STOLL 1989: 153). Apparently no attempt at empirical weighting ever did so well as to convince members of the COW project to continue using these adjusted weights.

An empirical power index based on war poses many problems. First of all, there were only 95 wars within the timeframe for accessible data (1823–2003). The next problem is that these 95 wars are extremely diverse. They are spread out in time and in terms of technology. The Franco-Spanish War of 1823 was something quite different from the Invasion of Iraq in 2003. Few of these wars were total wars like WWI or WWII, mobilizing whole economies and resulting in total defeat. A limited war with limited objectives is obviously a more limited test of national power than a total war. Some wars are between coalitions, members of the coalitions differing in capabilities and commitment.

At the other end there remains the issue of how to measure victory. Here Singer and colleagues relied on "relatively unambiguous, if not always precise, *nominal* categories [to] classify as successful those states or coalitions that 'won' in each dispute and each war, no matter how pyrrhic the victory" (WAYMAN et alia 1983: 500). Thus a "scholarly consensus" (equivalent to a perception survey) decided who won and lost (two cases of 69 were judged as draws). This in effect means that if one were carrying out a multiple regression analysis based on this, the result would again be a perception-based index, this time indirectly.

To reiterate: unlike data-based or perception-based weighting schemes, an empirical weighting scheme requires an objective measuring rod (or proxy) for some type outcome associated with national power. It is possible to approximate national power by looking at fatalities suffered and inflicted. I propose the following formula for inferring the power of the two sides in a war:

$$relative\_power = military\_personnel \times enemy\_fatalities^{0.5} / own\_fatalities^{0.5}$$

The logic is simple: inferring capabilities by the power to kill without being killed (HOEHN 2008: 3–4).[371] The data for battle field fatalities in all major wars between 1823 and 2003 can be obtained from the COW website.[372] The following table presents the results for the three major post-WWII conflicts:

Table 114: Estimated Capabilities of Belligerents in 3 Major Wars

		Calculation Values			Values for Comparison				
War	Belligerents	Military Personnel	Battle-related Combatant Fatalities	Estimated Capability	Military Expenditures	Urban Population	Primary Energy	Iron & Steel	Total Population
Korean War	North Korea Coalition Side	33.5%	81.2%	10.5%	5.1%	27.7%	2.2%	0.9%	58.1%
1951–1953	South Korea Coalition Side	66.5%	18.8%	89.5%	94.9%	72.3%	97.8%	99.1%	41.9%
Vietnam War	North Vietnam	10.5%	67.4%	5.4%	0.6%	2.5%	0.3%	0.2%	7.5%
1965–1975	South Vietnam Coalition Side	89.5%	32.6%	94.6%	99.4%	97.5%	99.7%	99.8%	92.5%
Iran-Iraq War	Iran	33.2%	60.0%	24.9%	48.7%	61.3%	72.7%	97.2%	75.3%
1981–1988	Iraq	66.8%	40.0%	75.1%	51.3%	38.7%	27.3%	2.8%	24.7%
Pearson Correlation to Estimated Capability		0.95	−0.94	1.00	0.93	0.78	0.75	0.55	0.29

Source: SARKEES & WAYMAN 2010; GREIG & ENTERLINE 2010a; author's own calculations.

The estimated capabilities appear to correlate well enough with the comparison values. Given the limited sample size in terms of wars (only three), this could change if more wars were added. A problem is that short or limited wars have a tendency to deliver less reliable estimates, because temporal idiosyncrasies (surprise, location of troops, et cetera) play a larger role.[373]

[371] This quasi-operational formula is more complicated than necessary to demonstrate a conceptual point. For all practical purposes, one gets identical power ratios if one uses one of the simpler formulas:

$$relative\_power = military\_personnel \times enemy\_fatalities$$

$$relative\_power = military\_personnel / own\_fatalities$$

Assuming that fatalities could be zero, the first formula may be preferable.

[372] Website: http://www.correlatesofwar.org/ [16 August 2013].

[373] "[…] the longer a war, the more time for factors involving the entire national society and economy to be brought into play and the less important the initial deployments, doctrines, and plans become" (PILLSBURY 2000: 356).

17. Conclusion

It may be helpful to recapitulate some, though not all, of the major observations and findings of this study in order to underline the intended aims and to highlight the achieved insights. This is done in the first section below. The subsequent two sections are suggestive in character with a view to future research. A tentative theoretical power formula is presented that summarizes one featured model of national power in its simplest terms. This theoretical power formula links at least five power formulas (three theoretical, two operational) to existing if not prevailing theoretical conceptions and approaches on national power. The issue of correlation and prediction is discussed briefly and emphasized for the purpose of creating robust, perception-based power formulas in the future, linking the key areas of power surveys and power formulas. Also the issues of how power perception may relate to national power and how location affects perception are touched upon. The study closes with a final section consisting of a few words on the aim of power analysis and a call for the bridging of theory and empiricism.

17.1 Selective Summary

Power is the most ubiquitous, if not important, concept in politics, international relations, geopolitics, and political geography (section 3.2). It has often been said that power is for politics what money is for economics – or energy for physics (section 1.4). Qualitative judgments about the future may never escape the taint of being ideologically-influenced unless supported by quantitative methods.

No other school of thought has placed as much stress on national power, its elements, and its measurement as traditional geopolitics. Saul Bernard Cohen listed four (later six) approaches to the study of political geography, the first approach being power analysis (section 13.9). Scholars from the premier Chinese think tank CASS (Chinese Academy of Social Sciences) explicitly acknowledge Friedrich Ratzel's work (*Political Geography* 1897) as the beginning of comprehensive power analysis along with geopolitics (section 14.6).

Power is the linkage between potentialities and actualities (RUMMEL 1976: 165). Alexander Supan defined national power, in terms of political geography, as consisting of three elements: space, population, organization (sections 3.4–3.6). They correspond to the qualifications for sovereign statehood under international law (codified, for example, in the Montevideo Convention of 1933).

The Total War Paradigm, which subsequently evolved into the Cold War Paradigm, features three types of power: military power, economic power (war potential), and psychological power. Psychological power corresponds in imperfect ways to soft power (chapter 9). These paradigms are similar to the Chinese strategic paradigm (ancient and present): that is, that in the absence of military conflict, economic and psychological warfare still proceed (introduction of chapter 14).

The underlying drive of this study has been summed up in the first sentence that "if international relations is to become a science it will have to establish a definitive quantitative measure for its most basic variable—national power" (ALCOCK & NEWCOMBE 1970: 335). Measurement is the

foundation of science, enabling empirical confirmation through experiments and observational studies. A relatively accurate measure of national power should be able to validate or invalidate balance of power, power transition, and power cycle theories. Even subjective power indexes may still be of value in shedding light on cultural and strategic differences in the way states, or academics in those states, perceive their priorities. An example is the Indian National Security Index (NSI) (chapter 15).

This study marks the first systematic attempt to collect as many power formulas and indexes as traceable, in accordance with the original intent of "statistics" (section 10.2). John Sinclair, who imported the term "statistics" into the English language, wrote:

> […] in 1786, I found, that in Germany they were engaged in a species of political inquiry, to which they had given the name of *Statistics*; […] by Statistical is meant in Germany, an inquiry for the purpose of ascertaining the political strength of a country, or questions respecting *matters of state* […]. (SINCLAIR 1798: xiii–xiv)

The explicit but long forgotten, pre-1850 definition and purpose of "statistics" was to assess and compare the power of states.

Statistical data has been collected since antiquity. States want to be prepared for cases of war, siege, and natural catastrophe, such as droughts. Statistical data enables states to assess more objectively their resources and capabilities and compare their performance to other states both in the present and over time. Studies in social psychology have shown that some wars were started and lost because countries overestimated their own strength while underestimating the strength of others.

The assumption of psychometrics is that nothing comes from nothing (see section 13.13). Consequently, the reputation of power and status has an objective basis even as subjectivities exist and interfere. The permanent members of the UN Security Council were not randomly assigned their positions. A purpose of this study has been to draw attention to the subjectivity of many aspects of power formulas, thereby encouraging future objectivity.

Nonarbitrary weighting schemes are needed to ensure that overall approaches and measurements are as objective as humanly possible. Three types of nonarbitrary weighting schemes (sections 16.5–16.8), the presentation of which are one of the major results of this work, can certainly still be improved upon. They point to differences regarding how broadly to define national power (from the most general to the most specific):

country performance ⇔ power perception ⇔ war potential

It might be useful to relate these nonarbitrary weighting schemes to a similar typology of definitions and theories of national power in international relations and geopolitics.

The purpose of this study has been to collect all traceable information that may be useful to experts in their construction of future power formulas, providing:

- an examination of how theories in geopolitics and international relations apply to measurement (chapters 2–9)

- a history of power measurement (chapters 10–11)
- a detailed description of existing power formulas (chapters 13–15)
- an analysis that summarizes the collected data, identifies trends and, most importantly, suggests three nonarbitrary approaches for power measurement (chapter 16)

17.2 A Tentative Theoretical Formula

In what follows, five formulas are briefly presented to show and deduce a pattern, followed by a brief look at theoretical conceptions and approaches on national power that emphasize exactly three faces of power, followed by a proposed theoretical formula that consolidates and merges the five mentioned formulas with the mentioned theories:

- Steven Rosen emphasizes that a country is as strong as its capabilities multiplied by its cost-tolerance (willingness to suffer) (ROSEN 1972; also footnote #227 in section 13.20):

  $power\_ratio = CT_A / CT_B \times NS_A / NS_B$

  CT = cost-tolerance; NS = national strength; A = country A; B = country B

- Robert Thompson claimed that the following formula represented the Russian understanding of power (THOMPSON 1974: 166; also section 13.20):

  $power = (manpower + applied\_resources) \times will$

- Ray Cline's formula is from an international viewpoint the best known power formula ever produced (CLINE 1975; also section 13.20):

  $P_p = (C + E + M) \times (S + W)$

  P_p = perceived power; C = critical mass = population + territory; E = economic capability; M = military capability; S = strategic purpose; W = national will

- In his work on conflict and war, R. J. Rummel (section 13.16) proposed the following formula for power in general (RUMMEL 1976: [section 21.1]; also section 9.1):

  $P_g = C_g \times I_g \times W_g$

  P_g = power to achieve goal; C_g = capabilities to achieve goal; I_g = interest in achieving goal; W_g = will power to achieve goal

- Yan Xuetong developed this power formula on the basis of his understanding and interpretation of Sun Zi (YAN 2008: 161; also section 14.7):

  $CNP = (M + E + C) \times P$

  M = military power; E = economic power; C = cultural power; P = political power

The pattern is that all five formulas emphasize that power consists of material and nonmaterial factors, and that if either the material or nonmaterial part of the formula is zero, then the result of the entire formula is zero.[374]

In a theoretical context, all five formulas roughly correspond to a theoretical approach emphasizing three categories of national power: military, economic, and psychological power. This tripartition is a recurring feature of the Total War Paradigm that had its heyday after WWI, and which subsequently evolved into the Cold War Paradigm after WWII (chapters 5, 9).

As for a theory of national power, that is, what constitutes national power in theory, even assuming that national power and its elements may not be perfectly quantifiable, the following theoretical formula represents my best guess:

```
NP = ( E + M ) × P

NP = national power; E = economic factor; M = military factor;
P = psychological factor
```

This formula represents the three categories of power discussed (section 9.1). This theoretical formula emphasizes material (E + M) and spiritual factors (P) equally via *multiplication*. It is a merger and consolidation of the five mentioned formulas with the mentioned theories.

It needs to be emphasized that in all material factors there is a spiritual component and vice-versa. The division into material and spiritual is useful for conceptual demonstration. The unfortunate side effect is that it can be misinterpreted as philosophical dualism (mind/matter or mind/body dichotomy). There is no economics without psychology. Equally, it does not follow that all major psychological factors are represented in their proper significance by GDP.

A purely logical-deductive argument in favor of the inclusion of the psychological is that without it, the unity of the nation is taken for granted. That is, something is either deemed a nation or not, which represents a dummy variable (1 or 0) based on a Boolean evaluation (true or false). It is a binary, simplistic view of national unity imposing a discrete function. In reality, national unity operates as a continuous function covering an infinite amount of numbers between 0 to 1. Some nations are more unified and less unified depending on structures and popular opinion, and this coefficient of unity is changing constantly and depending on issues (compare sections 3.5, 3.7).

[374] Partly similar as well is Peter Beckman's 1984 formula to be used for the time period 1900–1910 (section 13.27):

```
power = ( steel + pop × pol_stab ) / 2

steel = percentage of world steel production; pop = percentage of world
population; pol_stab = score for political stability
```

The "pop × pol_stab" part is obviously in the same line as the five mentioned formulas, though the *addition* of steel is not. As such the formula can be considered a hybrid.

17.3 Power and Perception

Jean-Yves Caro conducted a survey with 214 French defense experts as surveyees to produce average power perception scores for 40 countries in 1998. He used the power perception scores to produce a formula using five variables that correlates to the power perceptions with a Pearson correlation coefficient of 0.98 (section 13.33). Squaring it, we get a coefficient of determination of 0.9604, which means we can explain 96% of the variation of power perception.

If his formula were applied to another survey, the correlation would likely be less, since his formula is the attempt to give the optimal correlation with his data and not with some other, differing, hypothetical survey data. What is required additionally is **cross-validation**, testing his formula for its correlation to different surveys, preferably at different times. The reason is as simple as it is not obvious: correlation and predictive value are not the same.

Given sufficient variables and a small number of observations, it is possible to boost any multivariate correlation to something close to a perfect 1.00, without it possessing any predictive value. This peculiar phenomenon is known as *overfitting*. The purpose of science is not description but prediction. Overfitting means that the quality of description improves at the cost of the quality of prediction. There is a point at which more variables result in poorer predictions. It has not been the purpose of this study to conduct cross-validation tests.

This problematic also relates to Occam's razor, the preference for the hypothesis consisting of fewer variables, when choosing from competing hypotheses of equal explanatory power. To return to Caro, his five-variable formula may perform adequately in cross-validations, or it may not. It may well be possible to construct formulas with fewer variables and yet a higher coefficient of determination (see section 13.13 as a possible example). Such formulas, in accordance with Occam's razor, should perform better at predicting.

Without actual testing, we do not know, and we should not assume that we do. Science must be in the last instance empirical. Cross-validations are a necessary step for improving future research on the topic, if the aim is to create robust perception-based power indexes. Putting too much faith in correlation indicators alone without cross-validation is a logic error.

This also partly and indirectly provides an idea why indexes with many variables usually do not perform better. Indeed, more often than not, they seem to perform worse. Simplicity is not just beautiful, it is useful too.

Separate from the correlation and parsimony issue, Caro's power perception data, along with the subsequent power perception surveys by Mirosław Sułek (section 13.30), are useful in distilling the relation of power perception and national power. The survey data intimates this relation:

$$PP = NP \times NPPC$$

PP = perceived power; NP = national power; NPPC = national power per capita

This formula is morphologically analogous to the Süßmilch formula (section 13.1):

```
power = population × population_density
```

Likewise it is morphologically analogous to the Hillebrand formula (section 13.38):

```
TechPower = GDP × GDPPC
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TechPower = economic-technological capability; GDPPC = GDP per capita
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The conceptual commonality of these three formulas is that they either explain or seek to explain why sometimes small states manage to be powerful or appear powerful. The morphological analogy itself is irrelevant, it is the survey data that suggests so.

Another issue that warrants further interest and analysis is that of geographic differences. It has been tested and confirmed that power surveys are fairly reliable cross-nationally, producing Spearman correlation coefficients of 0.90 or above (DORAN et alia 1974; also section 13.14). However, geographic differences do exist. Even as the correlation coefficients confirm that there generally is agreement on the big picture, the relative ranking of particular countries may still differ dramatically depending on locations.[375]

One possibility is that these discrepancies are more or less unimportant short-term fluctuations, or some form of random error in the data for diverse reasons. If not, at least two reasonable hypotheses can be formulated: either that power as a field does differ with location, or that cultural and national idiosyncrasies do influence perception of power to varying degrees. More research on these and related questions could promise stimulating results.

17.4 Narrowing the Range of Guessing

No power index has (yet) been produced that looks indisputably credible. In some cases the numbers may look persuasive, but the variables, formulas, and weights do not. It is always possible to manipulate data to make it look convincing. Or a particular formula with its variables may sound convincing in theory, but then the resulting numbers are a disaster.

The notion of power in politics being analogous to energy in physics and money in economics corresponds to a lasting demand to acquire a clear-cut theoretical conception of power. In physics power can be expressed via a large set of formulas, three examples are:

[375] For example, taking the case of Britain vis-à-vis Japan, a 2006 study by the Chicago Council of Global Affairs surveyed perceptions in the United States, China, and India. Accordingly, Americans ranked Britain number two and Japan number three. The Chinese ranked Britain number five and Japan number seven. The Indians, however, ranked Japan number three and Britain number seven (The Chicago Council on Global Affairs 2006). The Indian perception is clearly different from the American and Chinese perceptions.

$$power = work / time$$

$$power = force \cdot velocity$$

$$power = current \cdot voltage$$

Note that terms have a specific meaning in physics that does not always correspond to their meaning in everyday language. An example is mechanical work defined as force times distance.

In economics things are much more arbitrary than in physics. Nevertheless we have a number of measures for national income and output, that even if not perfect, are in frequent use, and for these measures we have formulas that summarize the inputs. Examples are (World Bank 2011):

$$GDP = C + I + G + (X - M)$$

C = private consumption; I = gross investment; G = government spending; X = exports; M = imports

$$GNI = GDP + (FL - DL) + NCI$$

FL = income from foreign labor; DL = income from domestic labor; NCI = net capital inflow

An unresolved issue is whether it is more appropriate to use official exchange rates (OER) or to adjust these measures by purchasing power parity (PPP). It makes a difference.

The reason for listing these formulas from physics and economics is to display how beautiful and useful conceptual clarity or its appearance can be. Ultimately, something similar would be pleasing to have for international relations and geopolitics as well.

As for the three nonarbitrary weighting schemes that were presented (sections 16.5–16.8), they may not be very helpful in a theoretical or philosophical sense, in terms of immediately delivering a clear-cut formula that finally solves the riddle of national power and whatever it consists of.

If the goal of theory is to provide a reasonable construct and then to test it, the nonarbitrary weights represent the opposite approach. They are rough empirical instruments to exit complete arbitrariness bit by bit and in this way to hint at possible theoretical conceptions of power.

The basis of science is the constant attempt to disprove your own hypotheses in establishing procedures to overcome bias and subjectivity. If a viable theory and method for power measurement ever emerge, then these three nonarbitrary schemes may help in proving or disproving this viability.

Stephen Jones wrote:

> Much of science consists of efforts to narrow the range of guessing. Since there is, inevitably, a large element of guesswork in an estimate of national power, quantitative information is highly desirable […]. (JONES 1953: 426)

Even if the definition of power were clear, it is not clear how resources would relate to it.

The quest for the ultimate power formula requires building a bridge between deductive and inductive approaches. Empiricism should provide new hints for theory and vice versa. Arbitrariness can only be overcome through deduction supported by empirical studies. The question remains to what degree it can be applied in the process of national power measurement.

John Mearsheimer summed things up in an email to me (3 March 2012):

> As I don't have to tell you, measuring power is not easy, but I think we have no choice but to do it, however imperfect the final result.

Appendix A "Capital, Technology and Geopolitics"

The article "Capital, Technology and Geopolitics" written by Max Krahmann in 1927 is translated here. It provides a short but ground-breaking exploration of the relationship of geopolitics (focused on space) to what has become modern geoeconomics (focused on technology). The original German text titled "Kapital, Technologie und Geopolitik" follows the translation. It is taken from the *Journal of Geopolitics* [*Zeitschrift für Geopolitik*], where it was first published (KRAHMANN 1927).

CAPITAL, TECHNOLOGY AND GEOPOLITICS

At a fleeting glance three words that have nothing to do with each other. And yet they are closely related. One affects the other, always in a circular fashion.

C a p i t a l , somehow saved, momentarily unconsumed, impatient in the production or power process, and always seeking investment opportunities, can only find peace when it has somehow adopted the form of technology, when it has become the lever of nature.

T e c h n o l o g y wants to master nature. Technology is the continuation of nature into the intellectual realm, which nonintellectual nature submits to. Technology is new creation or the continuation of creation by man, through ingenuity, through engineers. Technology is shaped capital, is tools, machines, explosives, equipment, disciplined armies, warships. Mechanical presses, routine, in short power resources, new against old, the power of man against the power of nature, dominion over the earth, that is, a strong geopolitical factor.

"P o l i t i c s is not the arbitrary action of individual people, groups, organizations or states," it says somewhere in this magazine, but "is decisively determined by the physical space of the state with its resources, its vegetation, its climate." Politics is the power expansion of stored up capital of any kind in the form of technology over resistant nature, including primitive, capital-scarce humanity without technology; for example, in the form of Columbus' ships versus America, or today's machine-guns against rebellious Incas in Bolivia, or future aircraft over South America completing the idea of the "engineer" Columbus.

Because all politics is conditioned essentially by the already controlled physical territory, and because power wants in the first instance to maintain itself, so it must expand, if it does not want to be surpassed by other power developments. So all politics must strive either for horizontal expansion of its already dominated physical territory, insofar as this is possible in a "colonial era" that is coming to an end, or it must strive to deepen its physical territory vertically.

The tasks of capital and technology are therefore changing in the era of more vertical expansion of power that is now beginning. There is a brake on horizontal expansion, not only because of the division of the earth, but also because the independence of the colonies has put it into reverse: no longer can Venetian merchantmen be "equipped", East India companies be "founded", Woermann shipping lines be "subsidized" and Chinese concessions be "acquired", though huge capital and the most advanced technology are available. Rather, agriculture needs to be more intensively worked, the air above us must be chemically and mechanically conquered, the soil under us must be ever more deeply penetrated and burrowed through, and — one day! — even more thoroughly exploited. Finally the population living in this limited space must be better educated and better taken care of. Herein lie the new geopolitical tasks of capital and technology, as well as the different types of task of the new state, which no longer has to expand horizontally and be directed against other populations, but which has to explore further its own space and educate better its own population. That should be the meaning of the "r i g h t to self-d e t e r m i n a t i o n of nations", which must, of course, be connected to the duty of self-c o n t e m p l a t i o n .

The new national but not nationalistic and imperialistic state is faced with the task of exploring and evaluating economically what lies underground much more precisely than ever before, not because mining is obviously necessary and welcome, but because today's technology and today's capital provide entirely different means than those of former times, and also because they themselves make quite different demands on the acquisition of energy and raw materials, according to quantity, quality and efficiency.

Parallel to the call for the intensification of agriculture in all its multitudinous types and levels of operation — from the science of fertilizers to selective breeding based on the latest theories of genetic inheritance — is the call for improvements in the mining industry. In the ensuing iron and steel economy we are already relatively far advanced scientifically — that is the merit of modern chemistry and metallography. We continue our progress too in the methods for the movement of masses, not only of coal and ores, but also of water and air, thanks to developments in machine technology, but we are still groping in the dark scientifically in the economic calculation of the mineral deposits to be exploited, and we behave like primitive craftsmen.

We must, if we want to develop more intensive economies, draw ever closer to o r i g i n a l nature with our research and evaluations: this must be a general geopolitical demand. Of course, this will become increasingly difficult, because pure nature is so rich and colorful, so manifold and shifting, and therefore so elusive to calculation and value formulas. In agriculture it is the difficult soil-classification, the rating; in the mining industry it is the fluctuating evaluation of underground resources, the inventory of mineral deposits. Significant geopolitical realizations, and hence cultural progress, depend on a little progress in both areas.

KAPITAL, TECHNOLOGIE UND GEOPOLITIK

Für den flüchtigen Blick drei Begriffe, die nichts miteinander zu tun haben. Und doch hängen sie eng zusammen, eines wirkt durch das andere, immer im Kreise herum.

K a p i t a l, das irgendwie Ersparte, das im Augenblicke Nichtverzehrte, ungeduldig im Produktions- oder Machtprozeß wieder Anlagesuchende findet nur Ruhe, wenn es irgendwie die Form der Technik, des Hebels an der Natur angenommen hat.

T e c h n i k will Natur meistern. Technik ist Fortsetzung der Natur ins Geistige, dem sich die ungeistige Natur fügt. Technik ist neue Schöpfung oder Fortsetzung der Schöpfung durch den Menschen, durch das Ingenium, durch den Ingenieur. Technik ist gestaltetes Kapital, ist Handwerkszeug, Maschine, Sprengstoff, Anlage, diszipliniertes Heer, Kriegsschiff. Presse, Routine, kurz Machtmittel, Neues gegen Altes, Menschenmacht gegen Naturmacht, Herrschaft über die Erde, also — ein starker geopolitischer Faktor.

„P o l i t i k ist nicht willkürliches Handeln einzelner Menschen, Gruppen, Verbände oder Staaten“, heißt es schon irgendwo in dieser Zeitschrift, sondern „ist maßgebend bestimmt durch den Erdraum des Staates mit seinen Bodenschätzen, seiner Pflanzendecke, seinem Klima.“ Politik ist Machtentfaltung aufgespeicherten Kapitals irgendwelcher Art in Form der Technik gegenüber widerstrebender Natur, einschließlich natürlicher, kapitalsarmer Menschheit ohne Technik; — z.B. in der Form der Schiffe von Kolumbus gegenüber Amerika oder heutiger Maschinengewehre gegen die aufständischen Inkas in Bolivien oder künftiger Flugzeuge über Südamerika zur Vollendung der Idee des „Ingenieurs“ Kolumbus.

Weil nun jede Politik durch den von ihr bereits beherrschten Erdraum wesentlich bedingt ist, und weil Macht in erster Linie sich erhalten will, also sich erweitern muß, wenn sie nicht von anderen Machtentwicklungen überflügelt werden will, so muß jede Politik entweder nach horizontaler Erweiterung des ihr gefügigen Erdraumes zielen, solange das in dem nun zu Ende gehenden „Kolonialzeitalter“ noch möglich ist, oder sie muß nach vertikaler Vertiefung ihres Erdraumes streben.

Die Aufgaben von Kapital und Technik verändern sich also in dem nun beginnenden Zeitalter der mehr vertikalen Machtausdehnung, nachdem die horizontale Ausdehnung infolge Aufteilung der Erde nicht nur gebremst, sondern infolge der Verselbständigung der Kolonien sogar rückläufig geworden ist: es können nicht mehr venetianische Kauffahrer „ausgerüstet“, ostindische Kompagnien „gegründet“, Wörmannlinien „subventioniert“ und chinesische Konzessionen „erworben“ werden — obwohl größte Kapitalien und höchste Technik zur Verfügung stehen, — sondern es muß die Landwirtschaft intensiver betrieben, die Luft über uns chemisch und mechanisch erobert, der Boden unter uns immer tiefer durchbohrt, durchwühlt und — dereinst! — noch tiefer erschlossen werden und endlich die in diesem begrenzten Raum lebende Bevölkerung geistiger gebildet und sozialer gepflegt werden. Hierin liegen die neuen geopolitischen Aufgaben von Kapital und Technik, auch die anders gearteten Aufgaben des neuen Staates, der sich nicht mehr horizontal auszudehnen und gegen andere Bevölkerungen zu richten hat, sondern seinen eigenem Raum tiefer zu erkunden und seine

eigene Bevölkerung höher zu bilden hat. Das sollte der Sinn des „Selbstbestimmungsrechts der Nationen“ sein, mit dem natürlich eine Selbstbesinnungspflicht verbunden sein muß.

Der neue, national, aber nicht nationalistisch und imperialistisch eingestellte Staat steht vor der Aufgabe, den Untergrund viel genauer als bisher erforschen und wirtschaftlich abwägen zu lassen, nicht weil Bergbau selbstverständlich notwendig und willkommen ist, sondern weil heutige Technik und heutige Kapitalien ganz andere Mittel als früher in die Hand geben und ferner für sich selbst ganz andere Ansprüche an Kraft- und mineralische Rohstoffbeschaffung stellen, nach Menge, Güte und Wirtschaftlichkeit.

Parallel mit dem Ruf nach Intensivierung der Landwirtschaft in allen ihren vielartigen Betriebsarten und Betriebsstufen — von der Düngerlehre bis zur Zuchtwahl auf Grund neuester Vererbungstheorien — geht die Forderung nach Verbesserung der Bergwirtschaft. In der anschließenden Hüttenwirtschaft sind wir wissenschaftlich schon verhältnismäßig weit vorgedrungen, — das ist das Verdienst der modern Chemie und Metallographie —, auch in den Methoden der Massenbewegung, nicht nur der Kohlen und Erze, sondern auch des Wassers und der Luft, schreiten wir dank der entwickelten Maschinentechnik stetig fort, aber in der wirtschaftlichen Erfassung der abzubauenden Lagerstätte tappen wir wissenschaftlich noch arg im Dunkeln und benehmen uns ganz handwerksmäßig.

Wir müssen, wollen wir intensiver wirtschaften, immer näher an die ursprüngliche Natur heran mit unseren Forschungen und Bewertungen: das muß als eine allgemeine geopolitische Forderung aufgestellt werden. Freilich wirds da immer schwieriger, weil eben die reine Natur so reich und bunt, so vielartig und wechselnd und deshalb so schwer in Rechnungen und in Wertformeln zu fassen ist: in der Landwirtschaft ist es die schwierige Bodenklassifikation, die Bonitierung, — in der Bergwirtschaft die schwankende Untergrundsbewertung, die Lagerstätteninventur. Von geringen Fortschritten auf beiden Gebieten hängen wesentliche geopolitische Erkenntnisse und damit kulturelle Fortschritte ab.

Appendix B "A Synthetic Approach to the Measurement of National Power"

Prof. dr hab. Mirosław Sułek from the Institute of International Relations at the University of Warsaw has published several articles and books in Polish relating to the quantification of national power (section 13.30). The following text of his in English has not been published before. It contains a short description of his own theoretical approach as well as a presentation of his model. It is published here with his kind permission:

A SYNTHETIC APPROACH TO THE MEASUREMENT OF NATIONAL POWER

The issue of national power has been of great interest to political scientists, sociologists and historians. But economists, physicists, and information scientists have also contributed to its quantitative expression. Since the Second World War there has been an abundance of scientific literature concerning the measurement of national power, and new ideas are appearing all the time.

The purpose of this article is to present my own model for measuring national power on the basis of the identification and evaluation of the international distribution of power. I have applied a synthetic approach, that is, one that is deductive, proceeding from general principles to particular instances. While not disregarding the advantages of the analytic approach, I attempt to demonstrate that the synthetic measure of power can be useful for both cognitive and decision-making processes. In other words, synthetic measures of national power are the element of the information system utilized by politics. For politicians need brief and synthesized information. My main considerations are complemented by the results of surveys.

1. Assumptions and fundamentals of the model

1.1. Dimensional analysis

Disregard for dimensional analysis has been a noticeable weakness of attempts at measuring the categories of national power. Consequently, it was often unclear what exactly was being measured. A measurement requires knowledge of the dimensions of the values being measured. Without this, not even simple addition or subtraction operations would be possible in the natural sciences. Kilograms are added to kilograms, seconds to seconds, and watts to watts. In social sciences, no such clarity exists. Despite that, some form of dimensional analysis is needed to regulate the process of studying and the drawing of conclusions.

Economics has a lot of experience in dimensional analysis, as it uses two basic dimensions: stocks (S) and flows (F). The stock dimension refers to any stocks available at a given point in time

(for example, the national capital or military potential as of T-day). The dimension can be called a potential (understood as potential energy). The flow dimension refers to stocks flowing in time. With regard to countries (that is, political units), such flows include, for example, a yearly gross domestic product or a quantity of goods transported in a unit of time.

The power of a political unit (as a type of sociological power) is a specific flow – it is a flow of energy in time. The performance of operations permitted on stocks and flows in turn leads to many dimensions of derivatives (e.g. the rate of profit has a dimension 1/T).

In "normal" situations, there is a fairly close connection between potential and power. "Geopolitical shocks" or "tectonic movements" may lead to vast discrepancies. A contemporary example of this is Russia. After the collapse of the Soviet Union, Russia entered into a long period of social, economic and political crisis, as a result of which its power decreased considerably. However, its potential decreased to a lesser degree (in the form of the arms stored or productive capacity).

What is used daily is mainly power. Power stands for what is real and functioning, and potential for what is possible. The competitive nature of the international environment makes political units seek to maximize their power. Therefore, international politics, as such, is always power politics. And it is not about maximizing military power, but about achieving a greater "weight" or national "significance" or (geo) political power or potential.

1.2. Essentials

I consider as valid the reasoning of those authors who sought to recognize solely the power factors that are constant and strictly essential for a complete description.

On the basis of reasoning derived from physics, it can be stated that the assessment of a political unit must take into account what is inherently connected with its existence and functioning, that is, **people** living in a given **area** at a given time, possessing specific **organization and production skills** (or the ability to act collectively; in other words – the ability to process matter, energy and information). All of these factors are necessary for the construction of the model.

Relations between political units are like interpersonal relations – their nature is either cooperative or competitive. For this reason, some people deal with production-service activity oriented towards peacetime, others towards wartime.

The external expression of people's organization and production capacity is the **product value**. The valuable nature of products means that they are also of **information-energetic** nature, even though they are expressed by means of material products. The current value of products is estimated in time, and therefore has a flow nature to it, that is, a given quantity of stocks per unit of time. The value of products is created in the course of processing the material and human resources. A political unit is thus an energy processor.

Every system processing energy can be described in power categories, whose dimensions are expressed as $\left[\frac{kg \cdot m^2}{s^3}\right]$. In the case of a political unit, it should be called sociological power. It is a flow of energy. Several forms of power can be mentioned: total, idle, available, working and coordinative.

Total power is the maximum power that the system is able to process. Idle power is the part of total power necessary to cover energy losses to the environment (in the case of living organisms, idle power is used up for the so-called basal metabolism, which includes breathing, blood circulation, bowel movements and the like). Apart from the energy expended to cover the idle power, part of the energy in the system must be used for obtaining energy from the environment and overcoming the associated difficulties. Thus, additional energy must be obtained, which will enable it to perform the work – *working power*. People use working power to provide sources of food, preparing and having meals, preventing excessive losses of energy by clothing themselves, building houses and the like. *Available power* constitutes the difference between total power and idle power. After deducting idle and working power from total power, there remains a surplus of power – *coordinative power*.

The power scheme is illustrated below:[376]

<table>
<tr><td colspan="3">TOTAL POWER</td></tr>
<tr><td rowspan="2">IDLE POWER</td><td colspan="2">AVAILABLE POWER</td></tr>
<tr><td>WORKING POWER</td><td>COORDINATIVE POWER</td></tr>
</table>

For purposes of analyses in political sciences, two categories of power suffice: available and coordinative. In the following parts of the article, available power will be referred to as general or potential, while coordinative power will be referred to as military or real.

The power of a political unit is a function of the created information-energy flow, together with population and area. Therefore, it can be written down as:

$$P = f\left(\frac{Q}{T}; L; p\right),$$

where:

P – power of a political unit,

f – function,

$\frac{Q}{T}$ – information-energy flow,

L – population,

p – political unit area.

[376]This scheme of power within systems is taken from the work of the distinguished Polish cybernetics specialist Marian Mazur (1909–1983).

The basic information-energy categories of a political unit include: national gross domestic product for general power, and military expenditures for military power. Therefore, it can be said that general power is a function of the national gross domestic product, population and area, and military power is a function of military expenditures, the number of soldiers and area. In a formal notation:

$$P_o = f\left(\frac{D}{T}; L; p\right),$$

$$P_r = f\left(\frac{W}{T}; S; p\right),$$

where:

P_o – general power,
$\frac{D}{T}$ – gross domestic product,
L – population,
p – area of a political unit,
P_r – military power,
$\frac{W}{T}$ – military expenditures,
S – number of soldiers in active service.

In the following parts of the article, the gross domestic product and the military expenditures will be marked in a simplified manner as D and W (where time is set as default).

1.3. The model

I assume that the model of measuring the power of a political unit is presented as a production function, and can be written down as:

$$P = D^a \cdot L^b \cdot p^c,$$

where:

a, b, c – power exponents.

The substantive analysis shows that the capacity for collective action, represented as D, has the greatest impact on the amount of power of a political unit, followed by population and territory (area).

However, the value of power exponents a, b, c – and whether their sum equals 1, is higher than 1, or lower than 1 – is not known. I argue that there are reasonable grounds to believe that the a / b ratio = 3. Three basic reasons support this belief:

1) In a letter to his brother Joseph, advising him how to be a successful king of Spain, Napoleon wrote: "*The moral is to the physical as three is to o*ne"[377];
2) In Wilhelm Fucks' model, the ratio of power exponents of steel and energy to the exponent of the population is 3 to 1;
3) The ratio is supported by empirical studies.

The power exponent c has a value between b and 0. It seems reasonable to assume that c = b / 2. So we have: a : b : c = 3 : 1 : 0.5 or 6 : 2 : 1. We do not know yet the value of the sum of power exponents. From a formal point of view, when it is greater than 1, the returns are increasing, when it equals 1 – fixed; when it is lower than 1 – declining. In my opinion, the sum of power exponents should be lower than 1 (according to the law of decreasing marginal returns). It is not known, however, how much lower it should be.

In the book *The Fundamentals of Powernomics and Powermetrics* (2001), referring to the so-called golden ratio, I determined the following power exponents: a = 0.65239958; b = 0.21746653; c = 0.10873326. Rounded to three decimal places, we get: a = 0.652; b = 0.217; c = 0.109. The sum of exponents (0.97859937) is not much lower than 1, therefore the exponents giving the sum of 1 (i.e. 0.667; 0.222; 0.111) would also give correct results, but the suggested measure is, in my opinion, more accurate.

General power and military power is reflected in the following models:

$$P_o = D^{0.652} \cdot L^{0.217} \cdot p^{0.109} , \quad (1)$$

$$P_r = W^{0.652} \cdot S^{0.217} \cdot p^{0.109} , \quad (2)$$

There are differences between general power and military power – while P_o is of a rather "objective" nature (independent, in the short term, of political power), P_r is of a rather "subjective" nature, since, while being dependent on political decisions (the military factor) – it only encounters "hard" economic and demographic constraints.

As you can see from the above, the model is deductive rather than empirical and inductive. This means that its validity depends on logic rather than empirical data.

[377] Cf. *International Military and Defense Encyclopedia*, Washington-New York 1993, p. 555.

As regards the calculation technique, it should be noted that there are two methods to choose from. The first and recommended method is to convert the output data (D, W, L, S, p) into global shares, which are then substituted into the model. In this way, we eliminate the dimensions of variables, and obtain "ready" results as shares in global power expressed, for example, as a percentage. The other one is used when we do not dispose of the data concerning any of the variables in the model with reference to the whole world. Then, we substitute into formulas the direct data, for example, national gross domestic product or military expenditures expressed in American dollars, population in units, area in km^2. In this case, we need to establish some basis of reference (e.g. the USA), which we assume to be 1, 100, 1000 etc (as calculated by the aforementioned Wilhelm Fucks).

2. Major results

I have presented below the calculations of general power for selected countries. They are included in table 1.

Table 1 Available (general) power of selected political units in the years 1989–2011 (as a percentage of global power)

No.	Political unit	1989	1992	1995	1999	2005	2006	2007	2008	2009	2010	2011
1	EU	–	–	–	–	17.95	17.67	18.11	17.90	17.32	16.23	15.99
3	USA	15.46	15.77	15.90	16.11	16.79	16.49	15.68	14.90	15.20	14.67	13.95
4	CHINA	8.25	9.73	11.42	12.85	7.48	8.10	8.45	9.44	10.92	11.39	11.90
5	JAPAN	6.25	6.58	6.31	5.91	5.05	4.64	4.32	4.31	4.49	4.46	4.35
6	INDIA	2.09	2.04	2.20	2.37	3.27	3.42	3.42	3.58	3.75	4.01	3.96
7	RUSSIA	–	3.87	3.05	2.59	2.45	2.75	3.27	3.23	2.76	2.92	3.16
8	GERMANY	3.00	3.66	3.49	3.29	3.35	3.24	3.24	3.22	3.11	2.91	2.85
9	FRANCE	2.64	2.69	2.66	2.53	2.72	2.66	2.71	2.70	2.70	2.50	2.45
10	UK	2.38	2.35	2.38	2.32	2.56	2.49	2.57	2.35	2.02	2.13	2.11
11	BRAZIL	2.37	2.28	2.11	1.98	2.49	2.92	3.03	3.21	3.29	3.70	3.87
–	POLAND	0.83	0.74	0.75	0.82	0.65	0.67	0.71	0.76	0.68	0.68	0.67

Source: my own calculations. For the years 1989–1999 data referring to the national gross domestic product and population: American Control and Disarmament Agency – ACDA (www.fas.org). For Poland, Russia, and China – estimates of GDP according to the purchasing power of currencies. For the years 2005–2011 – my own calculations on the basis of the data included in *World Development Indicators Database*.

For countries with a market economy, in the whole period considered, the data from both sources are comparable. It is not so in post-communist countries. The stable position of the USA, France and the UK, and the fairly stable position of Germany (with a slight weakening since 1992) is notable. In the years 2005–2011, the positions of China and Brazil increased systematically. Since 1992, a clear downward trend has been recorded by Japan. Russia has restored its "natural" position, which is expected to decrease in the long run.

It must be emphasized that in his book *The Rise and Fall of the Great Powers* (1988), Paul Kennedy justly observed that considering geographical area, population and natural resources, the USA should account for approximately 16–18% of global wealth and power, even though specific

historical circumstances relating to the development of technology enabled it to achieve a lot more. For example, in 1945 at least 40%, which differed significantly from the "natural" level.

Table 2 presents the available (general) and military (real) power indices for the years 2005–2008 for 29 political units. A period of three years is too short for more extensive comparisons, but is sufficient to identify the international distribution of power. More detailed studies could include not only a longer perspective, but also additional political units, such as NATO and other political and military alliances, or political and economic ones.

Table 2 Available (general) and military (real) power of selected political units (as a percentage of global power; ordered according to P_o in 2008)

No.	Political unit	P_o				P_r			
		2005	2006	2007	2008	2005	2006	2007	2008
1	EU	17.95	17.67	18.11	17.90	13.44	14.42	13.31	14.91
2	USA	16.79	16.49	15.68	14.90	21.94	23.01	21.37	23.86
3	China	7.48	8.10	8.45	9.44	5.83	6.79	6.84	7.14
4	Japan	5.05	4.64	4.32	4.31	2.65	2.65	2.39	2.11
5	India	3.27	3.42	3.42	3.58	3.34	3.62	3.35	2.90
6	Russia	2.45	2.75	3.27	3.23	3.37	3.53	3.23	5.08
7	Germany	3.35	3.24	3.24	3.22	2.05	2.15	1.94	2.12
8	Brazil	2.49	2.92	3.03	3.21	1.45	1.88	1.78	2.07
9	France	2.72	2.66	2.71	2.70	2.49	2.67	2.43	2.80
10	UK	2.56	2.49	2.57	2.35	2.34	2.63	2.38	2.37
11	Italy	2.20	2.16	2.21	2.18	1.64	1.70	1.65	1.79
12	Canada	2.14	2.26	2.11	2.04	1.14	1.31	1.28	1.28
13	Mexico	1.84	1.85	1.77	1.87	0.52	0.55	0.55	0.54
14	Spain	1.64	1.63	1.71	1.71	0.83	0.94	0.96	1.11
15	Australia	1.40	1.41	1.36	1.45	1.00	1.17	1.12	1.15
16	Indonesia	1.13	1.25	1.30	1.34	0.58	0.72	0.70	0.62
17	Turkey	0.94	0.95	1.17	1.27	0.92	1.05	0.94	1.33
18	South Korea	1.13	1.16	1.13	1.02	1.00	1.18	1.09	1.50
19	Poland	0.65	0.67	0.71	0.76	0.45	0.57	0.55	0.69
20	Argentina	0.60	0.63	0.67	0.71	0.30	0.32	0.28	0.30
21	Holland	0.68	0.69	0.69	0.70	0.48	0.50	0.46	0.48
22	Nigeria	0.47	0.49	0.58	0.64	0.19	0.21	0.21	0.17
23	South Africa	0.69	0.67	0.66	0.61	0.41	0.48	0.46	0.35
24	Thailand	0.54	0.57	0.59	0.57	0.30	0.32	0.35	0.47
25	Pakistan	0.51	0.54	0.54	0.56	0.56	0.70	0.63	0.63
26	Sweden	0.55	0.55	0.56	0.54	0.38	0.39	0.35	0.36
27	Belgium	0.45	0.43	0.44	0.43	0.27	0.26	0.24	0.23
28	Bangladesh	0.37	0.28	0.35	0.36	0.20	0.16	0.19	0.16
29	Israel	0.24	0.17	0.20	0.21	0.50	0.43	0.41	0.77

Source: my own calculations based on the data provided in *World Development Database*; *The State of World Population*; *The SIPRI Military Expenditure Database*; *The Military Balance*.

Table 2 presents the contemporary international distribution of power, which is characterized by two kinds of indices – available (general) power and military (real) power. The analysis of the data included in the table should cover three fundamental stages: 1) analysis of the relations of power in terms of P_o; 2) analysis of relations of power in terms of P_r; 3) comparative analysis. For the purpose of the estimate of the current distribution of power, P_r indices are more important, but in the long run, it is P_o indices that are more important.

Table 2 allows for isolating three groups of political units: the first one, with a balanced relation P_o – P_r; the second one, with a predominant P_o index; the third one, with a predominant P_r index. The first group includes, inter alia, India, the UK, South Korea and Turkey. The second and most

numerous group includes, inter alia, EU, Japan, Brazil, Italy, Canada, and Mexico, and the third and least numerous one – the USA, Israel and Pakistan.

It should be remembered that the relations of power determined by the size of general power are of a more "natural" and "objective" nature than the relations of power determined by the size of military power. General power demonstrates theoretical limits, to which the military power can become close. Given that the tendency of states and nations to mobilize their stocks for defence and conquest is varied, the same general power can be the basis for different values of military power.

3. Surveys

In addition to the modeling based on "objective" data, it is possible to study the subjective perception of power. It is a kind of sociological study, in which the respondents are asked to answer questions concerning for example the ranking of countries according to the power criterion on the ordinal scale.

A further step can be testing the understanding of power, mainly focusing on the power-promoting factors under consideration. On the basis of the results obtained in this way, one can build econometric models, which would be models of power corresponding to the views of a given group. Obviously, each group would have their "own" model of power.

Various groups can be covered by studies of this type – scientists dealing with international relations, politicians, senior military personnel, student groups or even ordinary people. From the perspective of political decision-making, studies among politicians and senior government officials would be of the greatest importance, but such surveys are difficult for many reasons.

Table 3 presents the results of surveys delivered by a group of students with whom I had classes and who were familiar with the models of measuring national power. The students had a twofold task. The first was to classify a given number of 40 political units according to their power (influence, impact) – from the greatest to the lowest. The second task was to indicate the power profile according to the three given groups of factors: political-and-military, economic, and demographic-and-spatial. The execution of this task helped to determine the political units of a political-and-military nature (USA, Israel, Russia, North Korea), economic (USA, Switzerland, Germany, Japan) and demographic-and-spatial (India, USA, China, Bangladesh). It is remarkable that the power of certain political units is either well-balanced (for example, USA), or unbalanced (Israel, Switzerland, Japan). Most political units are of a medium-balanced nature.

Table 3 Ranking of political units by their power as indicated by students of international relations (2010, the indicated placement in brackets)

No.	Order of political units by their power	Major factors determining the power of a given political unit		
		political-military	economic	demographic-spatial
1	USA	USA (1)	USA (1)	INDIA (1)
2	EU	ISRAEL (2)	SWITZERLAND (1)	USA (2)
3	CHINA	RUSSIA (3)	GERMANY (1)	CHINA (2)
4	RUSSIA	NORTH KOREA (4)	JAPAN (1)	BANGLADESH (2)
5	JAPAN	IRAN (4)	EU (5)	BRAZIL (5)
6	GERMANY	UK (6)	HOLLAND (5)	RUSSIA (6)
7	UK	PAKISTAN (6)	CHINA (5)	VIETNAM (7)
8	INDIA	EU (8)	SWEDEN (8)	EU (8)
9	FRANCE	FRANCE (8)	SAUDI ARABIA (8)	CANADA (8)
10	CANADA	SOUTH KOREA (10)	UK (10)	INDONESIA (8)
11	BRAZIL	UKRAINE (11)	SPAIN (10)	EGYPT (8)
12	ITALY	BELGIUM (11)	BELGIUM (10)	AUSTRALIA (8)
13	SPAIN	ITALY (13)	ITALY (13)	UKRAINE (13)
14	SWITZERLAND	TURKEY (13)	FRANCE (13)	NIGERIA (13)
15	SWEDEN	GERMANY (13)	**POLAND** (15)	MEXICO (13)
16	SOUTH KOREA	TAIWAN (16)	BRAZIL (16)	SOUTH AFRICA (16)
17	ISRAEL	JAPAN (16)	AUSTRALIA (16)	PAKISTAN (16)
18	AUSTRALIA	CHINA (16)	ARGENTINA (16)	CHILE (16)
19	SAUDI ARABIA	**POLAND** (19)	TAIWAN (19)	TURKEY (19)
20	IRAN	CANADA (19)	SOUTH AFRICA (19)	THAILAND (19)
21	TURKEY	INDIA (19)	CANADA (19)	COLOMBIA (19)
22	HOLLAND	SPAIN (19)	THAILAND (22)	IRAN (19)
23	BELGIUM	SWEDEN (23)	SOUTH KOREA (22)	VENEZUELA (23)
24	**POLAND**	VENEZUELA (24)	EGYPT (24)	TAIWAN (24)
25	SOUTH AFRICA	COLOMBIA (24)	VENEZUELA (25)	**POLAND** (24)
26	PAKISTAN	HOLLAND (24)	INDIE (25)	NORTH KOREA (26)
27	NORTH KOREA	BRAZIL (24)	CHILE (27)	ISRAEL (26)
28	ARGENTINA	VIETNAM (28)	VIETNAM (28)	SAUDI ARABIA (26)
29	MEXICO	SWITZERLAND (28)	TURKEY (28)	ARGENTINA (29)
30	UKRAINE	INDONESIA (28)	RUSSIA (28)	ITALY (30)
31	TAIWAN	EGYPT (28)	NIGERIA (28)	SPAIN (30)
32	THAILAND	ARGENTYNA (28)	COLOMBIA (28)	FRANCE (32)
33	INDONESIA	SAUDI ARABIA (28)	MEXICO (33)	UK (33)
34	EGYPT	THAILAND (34)	NORTH KOREA (34)	SZWEDEN(34)
35	CHILE	SOUTH AFRICA (34)	ISRAEL (34)	SWITZERLAND (34)
36	COLOMBIA	AUSTRALIA (34)	INDONESIA (34)	SOUTH KOREA (36)
37	VENEZUELA	MEXICO (37)	UKRAINE (37)	HOLLAND (36)
38	VIETNAM	CHILE (37)	IRAN (37)	BELGIUM (38)
39	NIGERIA	NIGERIA (39)	PAKISTAN (39)	GERMANY (39)
40	BANGLADESH	BANGLADESH (39)	BANGLADESH (40)	JAPAN (39)

Source: my own list based on a survey on 22 first year students of complementary studies of international relations at the University of Warsaw UW (evening studies) – Warsaw 18.01.2010 (in brackets – placement in classification by groups of factors).

The studies mentioned above allow for the modeling of the nature of political units' power, and the specific "composition" or simple proportion of factors making up that power. Action taken by political units in the international environment is affected not only by their general position in the hierarchy, but also by their power profile. This is why studies of this kind are needed. They can be crucial for forecasting. The model I have developed allows for an even more accurate study of the power profile of individual political units. After presenting the model in a linear form by the logarithm, the proportions of each variable can be calculated, determining in this way the power profile. I demonstrated this in the book *The Fundamentals of Powernomics and Powermetrics*. Compiling the profiles obtained in studies based on this model and the surveys would provide valuable insights.

Final remarks

The modeling and measurement of national power is an important technique in the study of international relations. It facilitates criticism and allows us to discipline our thinking and, most importantly, to conduct "painless", "non-invasive" experiments.

Modeling can also serve didactic purposes. There has been significant progress in this field in recent years. Further progress requires the introduction of dimensional analysis, which will make it possible to calculate derivative values.

I am convinced that the study of national power (through formal modeling or sociological study) can result in several benefits, including:

- a better knowledge of international relations (and the underlying distribution of power);
- an improvement in the chances for better governmental decision-making, which in turn may reduce the unnecessary waste of resources;
- a better understanding of "objective" and "subjective" power.

The processes occurring in the international arena – globalization, structural changes, changes in the distribution of power between countries and continents – increase the need for reliable measures of power. The countries which are particularly interested in such measures are those which have either lost their status and are eager to recover it (e.g. Russia), those which expect a significant improvement of their position (e.g. China, India), or those whose position is threatened by rising rivals (e.g. the USA). It can therefore be assumed that the study of national power and power relations has good prospects for the future.

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Karl Hermann Höhn
Rheingaustraße 160
65203 Wiesbaden
Germany

+49 611–61432
conducator@gmail.com

CURRICULUM VITAE

Date of Birth	30 September 1976
Place of Birth	Wiesbaden
Nationality	German

EDUCATION

1999–2001	Master of International Studies, International Cooperation, (distribution minor in Chinese Studies); Yonsei University, Seoul, Korea.
1997–1999	Bachelor of Arts (cum laude), International Affairs; American University of Paris, France.
1995–1996	Associate of Applied Science, Management / Marketing; Certificate, Accounting Clerk; Latter-day Saints Business College, Salt Lake City, United States.

ACTIVITIES

2005–2006	Survey Conductor: Socio-Economic Survey of the Various Districts of Northern Tajikistan; NGO Deutsche Welthungerhilfe (German Agro Action);
	Instructor: Introduction to International Relations, Chinese Politics, Basic Methodology; Tajik State University, NGO Social Institute "Youth & Civilization";
	Program Assistant: Monitoring of Illegal Child Labor in Sughd Region; NGO Social Institute "Youth & Civilization";
	Khujand, Tajikistan.
2001	Research Assistant: Economic Reform in Mongolia; Yonsei University, Seoul, Korea.

PUBLICATIONS / CONFERENCE PAPERS

2011	"Power in Alexander Supan's Guidelines to General Political Geography (1918/1920)." *Przegląd Geopolityczny* 3, 23–44.
2010	"Measuring Geopolitical Power in India: A Review of the National Security Index (NSI)." In *Working Paper Series* 136. Hamburg: German Institute of Global and Area Studies (GIGA).
2009	"Navigare Necesse Est! Maritimity and the Prospect of a Korean Blue Water Navy." *Geopolitics Quarterly* 3 (4), 99–113.
2008	"Navigare Necesse Est! Maritimity and the Prospect of a Korean Blue Water Navy." Paper presented at the 5th East Asian Regional Conference in Alternative Geography (EARCAG) at Seoul National University, December 13–16, in Seoul, Korea.
2008	"New Thinking in Measuring National Power." Paper presented at the 2nd Global International Studies Conference by the World International Studies Committee (WISC) at the University of Ljubljana, July 23–26, in Ljubljana, Slovenia.
2002	«L'armée s'oppose à la protection de l'environnement en Asie du Sud-Est.» *Forum* N° 1, 6.