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Market Discipline and Media Influence in the German Banking Industry

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Preface

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Summary

This dissertation is the first analysis dealing with the examination of market discipline in the German banking sector and the role that daily newspapers play in the behavior of private bank depositors and banks.

German savers are renowned for preferring safe, long-term investments, thus providing patient capital, with bank deposits playing an important role. Based on a unique data set for the period 2003–2012, thus covering the financial crisis, our empirical findings do not confirm this hypothesis but reveal instead that market discipline is prevalent throughout the entire period of observation. Hence, the financial crisis did not provoke major behavioral changes. Moreover, the government announcing a guarantee for the safety of all deposits after the Lehman collapse did not diminish depositors' alertness. However, the strength and type of market discipline vary across governance structures, with savings and cooperative banks' depositors being significantly more active than commercial banks.

The following findings are of particular interest: First, commercial banks experience less market discipline throughout the observation period than savings and cooperative banks. Second, market discipline follows a similar pattern for savings and cooperative banks. Third, the "Merkel-Steinbrück guarantee" apparently did little to soothe depositors' nerves. Concerning cooperative banks, the high degree of market discipline signals that depositors used market discipline as a substitute for exercising their ownership rights in the general assembly. Savings banks experienced significant organizational and behavioral changes during the observation period relating to the loss of guarantor liability and the relaxation of constraints on risk-taking by the Landesbanken, which might explain depositors' high sensitivity to the aggravation of risk indicators. In particular, the observed low market discipline in the commercial bank sector compared to savings and cooperative banks merits further research.

Chapter 3 contributes to our understanding of the media's role as a watchdog and the third pillar in banking supervision. We argue that the general public, at least partially, perceives information on bank risk from newspapers' coverage. This is the first study evaluating whether depositors and supervisors should be concerned about media bias in banks' coverage. Especially in times of (financial) crises, depositors need to be informed about their bank and the banking system's safety. For this purpose, we collect a unique data set containing almost 700,000 statements on more than 1,500 banks in 51 regional and 6 national German newspapers over 2007-2013. First, we use text analysis techniques to assess bank (-type) coverage and sentiment. While regional and national outlets cover approximately the same number of banks and publish about the same amount of articles, we find that articles in national newspapers require a higher literacy level. The main difference becomes apparent through sentiment

analysis: On average, savings and cooperative banks are pictured more negatively in national than regional newspapers. However, all news outlets assess commercial banks most negatively, on average. Second, we describe the connectivity of newspapers and banks through geographical and network-driven distance measures. We thus provide a network perspective on banks throughout the crisis. Finally, we detect significant differences between regional and national newspapers using a difference-in-difference regression model, pointing to biases in coverage and sentiment. Additionally to bias through omission, we find newspapers slanting towards readers' beliefs. Regional newspapers' sentiment towards savings and cooperative banks is significantly more positive (or less negative) than toward their national counterparts. The same finding holds for national newspapers with respect to commercial banks.

In Chapter 4, we examine daily newspapers' contribution to market discipline in the German banking industry. The media must provide correct information about bank risk-taking in a timely manner to enable depositors to monitor banks effectively. Using a unique data set of 111,869 bank news observations covering 2007-2012 in Germany, our results reveal that media sentiment meaningfully and timely captures bank risks across bank types. In particular, the media respond negatively to increased risk exposures. Moreover, newspapers provide new information beyond fundamentals influencing depositor and bank behavior. Indeed, declining bank-related sentiment leads to disciplinary actions across all bank types.

In summary, our results confirm that German depositors exert disciplinary behavior if they perceive banks to engage in risks for which they have not been compensated. The media substitute partially for the low frequency of risk disclosures by banks, although newspapers do not cover individual banks at a specific frequency. Additionally, we find news outlets to be prone to omission bias and slanting toward readers' beliefs. Regional newspapers' sentiment toward savings and cooperative banks is significantly more positive (or less negative) than concerning their national counterparts. The same finding holds for national newspapers for commercial banks.

Nevertheless, media sentiment in regional and national newspapers alike captures bank risks correctly, even though they react differently to quantitative risk measures in the respective bank type. However, bank-related media sentiment spills across all bank types, thus potentially leading to overreaction to public information. When a wide range of newspapers is used, media sentiment is a valuable early indicator of bank distress.

Zusammenfassung

Die vorliegende Dissertation ist die erste Analyse, die sich mit der Untersuchung der Marktdisziplin im deutschen Bankensektor und der Rolle von Tageszeitungen für das Verhalten von privaten Bankeinlegern und Banken beschäftigt.

Deutsche Bankeinleger sind dafür bekannt, dass sie sichere, langfristige Anlagen bevorzugen und somit geduldiges Kapital bereitstellen. Auf der Grundlage eines einzigartigen Datensatzes für den Zeitraum 2003-2012, zeigen unsere empirischen Ergebnisse, dass Anleger während des gesamten Beobachtungszeitraums Marktdisziplin ausüben. Die Finanzkrise hat also keine größeren Verhaltensänderungen ausgelöst. Auch die Ankündigung einer staatlichen Garantie für die Sicherheit aller Einlagen nach der Lehman-Pleite hat die Wachsamkeit der Einleger kaum beeinträchtigt. Allerdings variieren Stärke und Art der Marktdisziplin zwischen den verschiedenen Governance-Strukturen, wobei die Einleger von Sparkassen und Genossenschaftsbanken deutlich aktiver sind als die von Geschäftsbanken.

Die folgenden Ergebnisse sind von besonderem Interesse: Erstens fällt Marktdisziplin bei Geschäftsbanken während des gesamten Beobachtungszeitraums geringer aus als bei Sparkassen und Genossenschaftsbanken. Zweitens sind Marktdisziplin bei Sparkassen und Genossenschaftsbanken vergleichbar und drittens hat die "Merkel-Steinbrück-Garantie" offenbar wenig zur Beruhigung der Nerven der Einleger beigetragen. Bei den Genossenschaftsbanken deutet der hohe Grad der Marktdisziplin darauf hin, dass die Einleger die Marktdisziplin als Ersatz für die Ausübung ihrer Eigentumsrechte in der Generalversammlung nutzten. Bei den Sparkassen kam es im Beobachtungszeitraum zu erheblichen organisatorischen und verhaltensmäßigen Veränderungen im Zusammenhang mit dem Wegfall der Gewährträgerhaftung sowie durch Lockerung von Risikobeschränkungen durch die Landesbanken, was die hohe Sensibilität der Einleger gegenüber einer Verschärfung der Risikoindikatoren erklären könnte. Insbesondere die beobachtete geringe Marktdisziplin im Geschäftsbankensektor im Vergleich zu Sparkassen und Genossenschaftsbanken verdient weitere Untersuchungen.

Kapitel 3 trägt zu unserem Verständnis der Rolle der Medien als Wächter und dritte Säule der Bankenaufsicht bei. Wir argumentieren, dass die breite Öffentlichkeit zumindest teilweise Informationen über Bankrisiken aus der Berichterstattung der Zeitungen wahrnimmt. Unseres Wissens nach ist dies die erste Studie, in der untersucht wird, ob Einleger und Aufsichtsbehörden sich Sorgen über eine einseitige Berichterstattung über Banken in den Medien machen sollten. Insbesondere in Zeiten von (Finanz-)Krisen müssen Einleger über die Sicherheit ihrer Bank und des Bankensystems informiert werden. Zu diesem Zweck erheben wir einen einzigartigen Datensatz mit fast 700.000 Aussagen über mehr als 1.500 Banken in 51 regionalen und 6 überregionalen deutschen Zeitungen im Zeitraum 2007-2013. Zunächst wenden

wir Textanalysetechniken an, um die Berichterstattung über Banken (-typen) und die Stimmung zu bewerten. Während regionale und überregionale Zeitungen ungefähr die gleiche Anzahl von Banken abdecken und eine vergleichbare Anzahl von Artikeln veröffentlichen, stellen wir fest, dass Artikel in überregionalen Zeitungen ein höheres Leseniveau erfordern. Der Hauptunterschied wird jedoch bei der Stimmungsanalyse deutlich: Im Durchschnitt werden Sparkassen und Genossenschaftsbanken in überregionalen Zeitungen negativer dargestellt als in regionalen. Allerdings werden Geschäftsbanken in allen Zeitungen im Durchschnitt am negativsten bewertet. Weiterhin beschreiben wir die Konnektivität von Zeitungen und Banken durch geografische und netzwerkbasierte Distanzmaße. Damit erzeugen wir eine Netzwerkperspektive auf die Banken während der Finanzkrise. Und schließlich stellen wir mithilfe eines Difference-in-Difference-Regressionsmodells signifikante Unterschiede zwischen regionalen und überregionalen Zeitungen fest, die auf Verzerrungen in Berichterstattung und Stimmung hindeuten. Zusätzlich zu Verzerrungen durch Auslassungen stellen wir fest, dass die Zeitungen den Überzeugungen der Leser entgegenkommen. Die Meinung der regionalen Zeitungen gegenüber Sparkassen und Genossenschaftsbanken ist deutlich positiver (bzw. weniger negativ) als die von nationalen. Dies gilt auch für überregionale Zeitungen bezüglich Geschäftsbanken.

In Kapitel 4 untersuchen wir den Beitrag der Tageszeitungen zur Marktdisziplin im deutschen Bankensektor. Medien müssen zeitnah korrekte Informationen zur Risikobereitschaft von Banken liefern, damit Einleger diese wirksam überwachen können. Unter Verwendung eines Datensatzes von 111.869 Beobachtungen von Banknachrichten aus den Jahren 2007-2012 in Deutschland zeigen unsere Ergebnisse, dass die Stimmung in den Medien Bankrisiken über alle Banktypen hinweg sinnvoll und zeitnah abbildet. Insbesondere reagieren die Medien negativ auf erhöhte Risikopositionen. Darüber hinaus liefern die Zeitungen neue Informationen, die über Fundamentaldaten hinausgehen und das Verhalten von Einlegern und Banken beeinflussen. Tatsächlich führt eine sinkende Stimmung in Bezug auf Banken zu Disziplinarmaßnahmen gegenüber allen Banktypen.

Zusammenfassend bestätigen unsere Ergebnisse, dass deutsche Einleger disziplinarische Maßnahmen ergreifen, wenn sie der Meinung sind, dass Banken Risiken eingehen, für die sie nicht entschädigt wurden. Die Medien kompensieren teilweise die geringe Häufigkeit der Offenlegung von Risiken durch Banken, obwohl Zeitungen nicht in einer bestimmten Häufigkeit über einzelne Banken berichten. Darüber hinaus stellen wir fest, dass die Zeitungen anfällig sind für Auslassungen und eine Ausrichtung an den Überzeugungen der Leser. Regionale Zeitungen sind in Bezug auf Sparkassen und Genossenschaftsbanken deutlich positiver (bzw. weniger negativ) eingestellt als ihre überregionalen Pendants. Das gleiche Ergebnis gilt für nationale Zeitungen in Bezug auf Geschäftsbanken.

Nichtsdestotrotz erfasst die Medienstimmung in regionalen und überregionalen Zeitungen gleichermaßen die Risiken von Banken korrekt, auch wenn sie auf quantitative Risikomessungen

für den jeweiligen Banktyp unterschiedlich reagieren. Die Medienstimmung in Bezug auf Banken erstreckt sich jedoch auf alle Banktypen, was zu einer Überreaktion auf öffentliche Informationen führen kann. Wenn ein breites Spektrum von Zeitungen verwendet wird, ist die Medienstimmung ein wertvoller Frühindikator für die Notlage einer Bank.

Chapter 1

Introduction

Market discipline (Pillar 3) constitutes, besides minimal capital requirement (Pillar 1) and supervisory review (Pillar 2), a set of measures aiming to strengthen the regulation, supervision, and risk management of the banking sector. The role of market discipline has been receiving increasing attention from researchers and policymakers alike in light of the great financial crisis. Market discipline exercised by depositors constitutes a form of self-regulation to punish banks for imposing a cost on depositors for which they have not been compensated (Berger, 1991). Empirical studies confirm market discipline irrespective of existing deposit insurance schemes for many countries. However, to the best of our knowledge, no such study exists for Germany.

In Germany, depositors and their main bank traditionally form stable relationships, with depositors being regarded as "lazy" managers of their wealth (Größl et al., 2013). It is difficult to tell if the outbreak of the financial crisis in 2008 put a limit to this supposed patience because the German government reacted promptly to the Lehman Brothers' failure by proclaiming an unlimited government guarantee for all deposits ("Merkel-Steinbrück guarantee"). On the whole, it must be recognized that German depositors' sensitivity to bank risk-taking remains to be tested empirically. In the face of the financial crisis a comprehensive study of German depositors' behavior appears overdue. Above all, we aim to assess whether German depositors contribute to the banking system's self-regulation – and if they are indeed "lazy" or have become more sensitive in the financial crisis.

In our empirical investigation of depositor-induced market discipline, we account for the existence of three pillars that reflect different bank governance models based on divergent ownership structures. In particular large banks belonging to the group of credit banks[1] are organized as stock-holding companies. Cooperative banks are owned by their members and hence by their depositors. Savings banks and Landesbanken have multiple obligations: they operate under public law, giving priority to the economic well-being of the region in which

[1]We use the terms "credit banks", "private banks", and "commercial banks" interchangeably.

they are based, and are also fully liable for their debt.

The purpose of Chapter 2 is to investigate empirically to what extent German depositors exercise market discipline in the first place and, if so, whether the specific governance structures in the banking groups impact depositors' behavior differently. We are particularly interested in the role of the financial crisis. Therefore, we examine if depositors switch to deposits with shorter maturities or claim higher interest rates due to their bank's increased risk-taking. We conduct an empirical analysis by applying panel regression techniques to empirically examine the German banking system. Here, we use a unique data set for the period 2003-2012 from the Deutsche Bundesbank, which combines interest rate statistics, balance sheet statistics, and the supervisory database.

Our empirical findings reveal that market depositor-induced discipline is prevalent throughout the entire period of observation. Hence, the financial crisis did not provoke significant behavioral changes. Moreover, depositors' alertness was not silenced by a government guarantee of all deposits issued after the Lehman collapse by the German government. However, the strength and type of market discipline vary across governance structures, with significantly more active depositors in savings and cooperative banks than in commercial banks.

Similar to our investigation, previous empirical analyses in the literature primarily relied on bank-specific variables from financial reports, balance sheets, and ratings. However, several considerations suggest a prominent role of daily newspapers in depositors' decision-making. News media are essential for spreading ideas and reducing market participants' costs to get informed (Dyck et al., 2008; Shiller, 2016). To private depositors, media may arguably be the primary source of information. On the one hand, decision-makers use easily accessible information more frequently, even if it were a less qualified source (O'Reilly, 1982). On the other hand, depositors lack the training to monitor banks' risk exposures based on their public disclosures (Basle Committee on Banking Supervision, 1998).

The Basle Committee on Banking Supervision (1998) points out the role of secondary information sources like the media for market discipline as the third pillar of banking supervision. Chapter 3 provides systematic evidence on bank coverage in daily newspapers. Especially in times of financial crises, depositors need to be informed about their bank and the safety of the banking system. Text analysis techniques provide an excellent tool for quantitative assessments of textual data that can complement accounting and other market data. For this paper, we collect a unique data set on German banks and bank types based on a wide range of daily newspapers from LexisNexis, Frankfurter Allgemeine Zeitung, and Handelsblatt. Thus, 640,384 statements on 1,483 German banks and all bank types from 49 regional and 6 German newspapers from 2007-2013 are available. First, we investigate bank (type) coverage and sentiment, applying dictionary-based text analysis techniques. While regional and national outlets cover approximately the same number of banks and publish about the same amount of articles,

we find that articles in national newspapers require a higher literacy level. The main difference, however, becomes apparent through sentiment analysis. On average, savings and cooperative banks are pictured more negatively in national than regional newspapers. However, on average, most negative sentiments are found for commercial banks, with no significant differences between regional and national papers. Second, we describe the connectivity of newspapers and banks through geographical and network-driven distance measures. Finally, a difference-in-difference regression model is specified to test for biases in media coverage and sentiment to answer whether depositors and supervisors should be concerned about bias in the coverage of banks.

We detect significant differences between regional and national newspapers, suggesting implications for the media's role in the information process. By closely observing bank-related information in the media, depositors and supervisors gain a secondary source of timely available and highly market-relevant information that can serve as an early risk indicator. However, based on descriptive analyses, we expect that an observation of a "media portfolio" of multiple media sources for event counts (volume of media attention) is indicated to balance out possible biases.

Chapter 4 is dedicated to researching the informational role of the media in the market for deposits. Combining our measures of bank-related media sentiment with bank-specific balance sheet and interest rate data for the period 2007-2012, we conduct the first investigation of the extent of bank risk information in daily newspapers and the impact of bank-related media sentiment on the behavior of depositors and banks. To monitor banks effectively, depositors need to be correctly informed about bank risk-taking in a timely manner. Nevertheless, banks usually disclose financial statements at a low frequency. Using 111,869 bank news observations covering 2007-2012 in Germany, we investigate whether the media fulfill their role as watchdogs in the German banking industry. Our results show that media sentiment indeed meaningfully and timely captures bank risks across all bank types such that sentiment falls with increasing bank risks. Moreover, the media provides new information beyond fundamentals influencing depositors and banks. Declining bank-related sentiment in daily newspapers leads to disciplinary actions across all bank types.

Chapter 2

Market Discipline Across Bank Governance Models

2.1 Introduction

The role of market discipline has been receiving increasing attention from researchers and policymakers alike in the light of the recent financial crisis. Market discipline constitutes a form of self-regulation exercised by purchasers of financial services in order to punish the behavior of sellers that impose a cost on the buyers for which they have not been compensated (Berger, 1991). Following Rochet, 2008, Flannery, 2001, and Kwast et al., 1999, the value of market discipline exercised by banks' creditors results from its disciplining management decisions toward choosing lower-risk projects. Notably, current research on the role of and outlook for market discipline focuses on well-informed financial investors rather ignoring small savers among which depositors are an important group. One possible explanation points to existing deposit insurance schemes which might be taken by depositors as a welcome relief from performing otherwise necessary but cumbersome monitoring tasks (Dewatripont & Tirole, 1994). As has also been shown, however, deposit insurance schemes may incentivize bank managers to take excessive risks, which if exercised on a large scale might pose a serious threat to the stability of the entire banking system (Kim & Santomero, 1988). Deposit insurance schemes, however, are not prepared to provide sufficient protection from losses once systemic risks have materialized. As will be described in more detail in Section 2.2, empirical studies exist which confirm market discipline irrespective of existing deposit insurance schemes for a considerable number of countries. However, to the best of our knowledge no such study exists for Germany. The German financial system has a tradition of bank orientation characterized by stable relationships between depositors and their "housebanks".[1]

[1] In Germany, a bank with which a depositor has a close relationship (for instance it transacts with this bank) is called housebank.

Prior transportation of the European directive[2] into German law in 1998, deposit insurance in Germany rested by and large on informal guarantees given by the banks themselves but leaving a depositor without any formal and judicially enforceable claim in the event of a bank failure. This lack of legal entitlements notwithstanding, German depositors have come to be regarded as "lazy" managers of their wealth (Größl et al., 2013), providing large amounts of patient capital to their housebanks. Whether the outbreak of the financial crisis in 2008 put a limit to this patience is difficult to tell because German Chancellor Angela Merkel and her then-Finance Minister Peer Steinbrück reacted promptly to the Lehman Brothers failure by proclaiming an unlimited government guarantee of all deposits ("Merkel-Steinbrück guarantee"). On the whole, however, it must be recognized that the concept of German depositors as lazy managers of their wealth remains a hypothesis which still has to be proved empirically. Not only in the face of the financial crisis but also amid ongoing changes within the German banking system in a globalizing financial world, a comprehensive study of the behavior of German depositors appears overdue. Evidence on this point is important above all because, inasmuch as German savers have never been that lazy or have become more sensitive at least in the aftermath of the financial crisis, they too would contribute to the self-regulation of the banking system.

Before we embark on an empirical investigation into the existence of market discipline among German depositors, we need to take into account a key feature of the German banking system, namely the parallel existence of different bank governance models based on different ownership structures which, in turn, are closely related to the existence of three pillars. Whereas in particular large banks belonging to the group of credit banks[3] are organized as stockholding companies, cooperative banks are owned by their members and hence by their depositors. Savings banks and Landesbanken have multiple obligations: they operate under public law, giving priority to the economic well-being of the region in which they are based, and are also fully liable for their debt. [4]

The fact that ownership structures have a significant impact on a firm's governance model has been confirmed by a large body of literature,[5] with firms' risk tolerance and risk management receiving the most attention. Hence we would expect that the existence as well as the type of market discipline will depend on the governance model of the chosen housebank. Furthermore, it is likely that deposit insurance would translate into different risk attitudes and risk management strategies depending on the specific governance structure. We would also, for example, expect depositors of banks with a higher risk tolerance to also display greater willingness to punish their banks for bad behavior. It is noteworthy in this respect that the

[2](94/19/EC: CELEX No. 394L0019; 97/9EC: CELEX No. 397L0009; 2009/14/EC: CELEX No. 309L0014)

[3]We use the terms "credit banks" and "commercial banks" interchangeably.

[4]Full liability is a direct consequence of the Brussels Concordance of 2002 which restricts public ownership in these banks to the binding of their objectives to public interests.

[5]For basic contributions see Jensen and Meckling, 1976 and Shleifer and Vishny, 1997. A more recent survey is provided by Singh and Davidson III, 2003.

three banking groups briefly introduced above differ in their activities to ensure the safety of deposits beyond risk management on the individual bank level. For the group of credit banks, what stands out is that deposit insurance is organized as a cooperative institutional arrangement among otherwise competing banks. By contrast, both the group of savings banks as well as cooperative banks represent risk-sharing networks among non-competing credit institutions with the aim to ensure the existence of each member bank as well as the sustainability of the network as a whole. Hence deposit insurance here constitutes only one element of ensuring the safety of deposits alongside a complex net of measures meant to avoid member banks' failures while avoiding moral hazard. Concerning the group of savings banks public ownership adds a further safeguard, and the prompt rescue of failing Landesbanken by their respective owners might have blurred the abandonment of a state liability in the eyes of depositors. Taking all this together, we would expect to find that market discipline is more pronounced for the group of depositors of credit banks than of cooperative and savings banks. We would furthermore expect greater market discipline among depositors of cooperative banks than among depositors of savings banks.

The purpose of this paper is to investigate, using an empirical study, to what extent German depositors exercise market discipline in the first place, and if so, whether the specific governance structures have a visible impact which explains differences between banking groups in terms of depositors' behavior. Our particular interest lies in the role of the financial crisis. As examples of disciplining measures exercised by depositors intended to incentivize managers to switch to lower-risk projects, we examine whether depositors switch to deposits with shorter maturities and/or claim higher interest rates as a consequence of their bank's increased risk-taking. In order to answer these questions, we conduct an empirical analysis by applying panel regression techniques to empirically examine the German banking system; here, we use a unique data set provided by the Deutsche Bundesbank which combines MFI interest rate statistics, balance sheet statistics, and the supervisory database.

Our paper aims to contribute to the literature on market discipline by depositors and on the relationship between banks' risk-taking behavior and governance structures. By and large, the existing literature concentrates on the role of deposit insurance for market discipline while broadly ignoring the impact of governance models. On the other hand, papers dealing with the impact of governance on risk-taking largely disregard market discipline by depositors.[6] The main contribution of our paper relates to examining the interaction between market discipline, regulation, and bank governance conducting an empirical analysis of the German banking sector which appears as particularly suitable to study a variety of bank governance models.

The remainder of the paper is organized as follows. Section 2.2 reviews the theoretical and empirical literature. Section 2.3 presents the major characteristics of the German banking

[6] Hughes and Mester, 2012 discuss market discipline in the context of the market for corporate control.

system relating to depositors' safety and Section 2.4 describes the applied data set. Section 2.5 is dedicated to the presentation of the empirical analysis. Section 2.6 concludes the paper.

2.2 Literature Review

Though representing a debtor-creditor relationship, a standard deposit contract differs from what we define as a standard debt contract (Diamond, 1984; Williamson, 1986). Firstly, depositors have the right to exit at negligible or no cost. Secondly, prevailing deposit insurance schemes signal that the safety of the depositor's claim is at least partly separated from the respective bank's risk behavior. Whether depositors consider these features as a relief of any obligation to monitor and punish their banks for bad behavior, has been the topic of numerous empirical investigations.

Concerning the behavior of US depositors market discipline was found for uninsured deposits (Baer & Brewer, 1986; Calomiris & Wilson, 1998; Ellis & Flannery, 1992; Goldberg & Hudgins, 1986; Hannan & Hanweck, 1988; Hosono, 2004) as well as for insured deposits (Baer & Brewer, 1986; Cook & Spellman, 1994; Maechler & McDill, 2006; Park & Peristiani, 1998). Crabbe and Post (1994) show that the intensity of punishments turns out to be less severe if deposits are insured. Sanctioning mechanisms encompassed higher interest rates, deposit withdrawals, restructurings towards insured deposits as well as distressed banks' difficulties in attracting new uninsured deposits. In a comparison between the US, EU and Switzerland, Berger and Turk-Ariss, 2015 examine market discipline exercised by uninsured as well as insured depositors. Their findings indicate higher market discipline in the US than in Europe, both pre- and post-financial crisis and in the aftermath. Their analysis also reveals that government interventions during the financial crisis had a dampening impact on depositors' reactions to higher bank risk. A weakening effect of government intervention measures in support of the safety of deposits on market discipline is also found by Demirgüç-Kunt et al. (2005) and Balasubramnian and Cyree (2011). Market discipline for deposits, irrespective of their insurance, is confirmed for Latin American countries like Argentina, Chile, and Mexico, where depositors reacted by both deposit withdrawals and the demanding of higher interest rates to higher bank risk (Martinez Pería & Schmukler, 2001). Murata and Hori (2006) focus on Japanese cooperative banks and identify market discipline especially in anticipation of regulatory changes towards a lower degree of deposit protection. On the other hand, Pop and Pop (2009) suggest that market discipline may no longer be present after the bailout of *Resona Holdings* in 2003.

The empirical findings thus point to skepticism on the part of depositors concerning the safety of their deposits even if deposit insurance schemes exist. This skepticism is confirmed by research results finding a positive correlation between a bank's risk tolerance and deposit insurance schemes (Keeley, 1990; Kim & Santomero, 1988). As is emphasized in Santomero,

1997, banks have an incentive to take higher risks if, due to deposit insurance, the cost of financing risky assets is unrelated to the probability of debtors' default. This, however, raises the question as to whether such a reaction on the part of banks is an automatism of sorts or dependent on the ruling governance structure. Santomero's conclusion draws on principal agency theory which has a dominating focus on stockholding companies marked by conflicting interests between owners and their creditors (Jensen & Meckling, 1976).

Limited liability on the part of risk-neutral owners fuels their risk appetite given that creditors participate in realized losses, and this attitude should even be more pronounced in the existence of deposit insurance schemes which shield the cost of debt from the riskiness of the firm's decisions. Under highly concentrated corporate ownership and thus a low degree of separation from management decisions, we should expect stockholding banks to prefer high-risk projects and this tendency to be positively correlated with prevailing deposit insurance schemes. Empirical studies for US banks organized as stockholding companies indeed reveal that stockholder-controlled banks, and thus institutions with a low degree of separation between ownership and management, are more inclined to take greater risks than managerially controlled banks. They confirm that the concentration of ownership matters for a bank's risk-taking (Saunders et al., 1990). This evidence is supported in an international comparison (Laeven & Levine, 2009) which reveals that stricter capital regulations only dampen the risk-taking of a stockholding bank if ownership is widely dispersed and that deposit insurance schemes increase bank risk only in institutions with concentrated ownership. These empirical results are confirmed by Koehn and Santomero (1980), Buser et al. (1981), and Haw et al. (2010). Sullivan and Spong (2007) find that bank risk rises in line with the ownership stake of the manager(s). Barry et al., 2011 find that in Europe the type of owners who have the say in a stockholding bank matters. In particular, a higher equity stake of individuals, families or even banking institutions is correlated with lower bank risk compared to institutions with financial investors and non-financial corporations as principal owners.

Of further importance are cooperative structures (credit unions and mutuals in the US, mutual building societies in the UK, Genossenschaftsbanken in Germany) as well as banks publicly owned banks. Much unlike shareholding companies, the owners of credit unions and mutuals belong to the group of depositors, thus removing conflicts between debtholders and owners. Since each member is given one vote in the general assembly, ownership is widely dispersed. By consequence, the separation between ownership and control might even be more pronounced than in shareholding companies (Rasmusen, 1988) thus endowing the incumbent managers with a high degree of discretion. This leaves open the crucial question of whether the incumbent management is less risk-averse than management at shareholding companies. Typically, managers of credit unions receive a fixed salary and therefore cannot benefit from higher profits; hence they should have an interest in low-risk strategies (Valnek, 1999). We

may therefore conclude that cooperative banks should have a preference for strategies which are less risky compared to stockholding banks. Empirical studies on the risk-taking behavior of credit unions and mutuals confirm that they engage in lower risk-taking behavior than stockholding companies (Cordell et al., 1993; Esty, 1997; Lamm-Tennant & Starks, 1993; Saunders et al., 1990; Verbrugge & Goldstein, 1981). Karels and McClatchey (1998) even find that the introduction of deposit insurance for US credit unions did not lead to higher risk taking but, on the contrary, increased their capitalization. Valnek (1999) finds that UK mutual building societies outperformed stock retail banks in the period 1983-1993 and were less affected by the negative outcomes of higher risk.

Research on public versus private ownership is centered on efficiency and profitability and, in this respect, does not have a particular focus on banks (Shirley & Walsh, 2001). A common conclusion here is that a lack of corporate control through capital markets aggravates conflicts of interest between the maximization of social welfare and the maximization of politicians' private utility function, thus leading to inefficiencies and lower profitability than in privately owned firms. For public banks in Europe, Iannotta et al. (2007) find a lower loan quality and higher insolvency risk than for mutuals and private banks. In an empirical investigation into the significance of ownership in the Indian banking industry, Sarkar et al. (1998) confirm the proposition that, in the absence of well-functioning capital markets, differences between public and private ownership of banks concerning both their performance and risk vanish. There also exists a study on the German banking system, though with an exclusive focus on profitability (Altunbas et al., 2001). In particular, empirical studies examining market discipline exercised by German depositors across the variety of German bank governance structures are lacking. Our paper seeks to fill this gap. In doing so, we will begin by introducing the specifities of the German banking system.

2.3 Bank Governance Models in Germany

Excessive risk-taking by banks is to a large degree associated with the possibility of externalizing realized losses to third parties. The degree to which this occurs very much depends on the existence of disciplinary forces. In this respect, the Anglo-Saxon countries share a tradition of placing a great deal of emphasis on the disciplinary role of competitive markets. This also explains their preference for shareholding companies, which find themselves continuously re-evaluated by a functioning market of corporate control. It explains why in the US credit unions and savings banks organized as mutuals have remained small in terms of market share.[7]

[7] In December 2010, mutual banks (credit unions) had total assets of $209 billion ($914.5 billion) compared to $12,094.4 billion for commercial banks (America's Mutual Banks, 2015; Federal Reserve System, 2015; National Credit Union Administration, 2015).

Indeed, cooperative banks are not permitted to raise capital by issuing shares, and typically they are barred from access to ample liquidity at decent interest rates. Hence, the only way for cooperative banks to grow would be to give them permission to cooperate with other banks, thus forming strategic networks. This, however, conflicts with the Anglo-Saxon market paradigm.

Germany has followed a different path by attaching much greater importance to cooperative solutions aimed at avoiding excessive risk-taking by individual institutions or at internalizing possible detrimental effects to depositors. The German banking sector is composed of three banking groups which differ not only in terms of their ownership structures but also in their internal organization and – not unrelated to this – in their deposit insurance schemes. *Commercial banks* are privately owned and, especially in the case of large banks, operate as stockholding companies. The sector of commercial banks is quite heterogeneous regarding the size as well as the range of business models. The class of large banks (Großbanken) experienced mergers in the aftermath of the financial crisis as well as nationalization and is now represented by Deutsche Bank, Commerzbank (partly in public ownership), Deutsche Postbank[8] and UniCredit Bank. Further classes of commercial banks are regional banks (under private law) and branches of foreign banks. The German *savings banks* see themselves as independent institutions governed by public law. Prior to the Brussels Concordance (2002), they were owned by public municipalities (cities, districts, federal states) which were also fully liable for their savings banks' liabilities. Working under public law now implies that savings banks have to gear their objectives and strategies to promoting the economic welfare of the region in which they are based. By contrast, the owners of *cooperative banks* belong to the group of depositors. The objective pursued by cooperative banks is not primarily the maximization of expected profits but the promotion of their members' well-being. The market shares of both savings banks and cooperative banks are significantly larger than in the US.[9]

Each banking group has its own umbrella association and the public representation of group interests is a function that is common to all three banking groups.[10] Furthermore, all three banking groups locate their deposit insurance schemes at the level of their umbrella associations. Beyond that, the umbrella associations of both savings banks and cooperative banks assume further tasks which include the provision of management training programmes.

The fact that savings banks and cooperative banks have a significantly larger market

[8] Deutsche Postbank is treated as an individual large bank throughout the considered period.

[9] In December 2010, savings banks (cooperative banks) had total assets of 1,082,870 € (705,044 €) billion compared to 5,839,659 € billion for commercial banks including credit banks, large banks, and regional banks (Deutsche Bundesbank, 2011).

[10] For commercial banks, this is the "Bundesverband deutscher Banken" (Association of German Banks, BdB), for the group of savings banks and Landesbanken, the "Deutscher Sparkassen- und Giroverband" (German Savings Bank Association, DSGV), for the cooperative banks, the "Bundesverband der Volks- und Raiffeisenbanken" (Association of Cooperative Banks, BVR).

share than their US counterparts can be explained by their internal organization. Unlike commercial banks, savings banks and cooperative banks alike are embedded in their own financial association networks. These networks support individual member banks in enhancing their supply of financial services beyond what their often small size and regional constraints would allow. They also act as clearing houses and, by coordinating liquidity surpluses and shortages among members, assume the role of an internal capital market. Furthermore, and importantly, the network acts as lender of last resort and, in doing so, protects individual members from illiquidity and insolvency (Joint Liability Scheme). In order to minimize moral hazard, each financial network has its own auditing associations. Notably, competition within either financial network is prohibited (DSGV, 2012; Theurl & Kring, 2002).

Savings banks are organized in the "Savings Banks Finance Group". The members of this group cooperate in national and international market activities. Further members are the Landesbanken, which are owned by the federal states as well as by the savings banks themselves. They combine central bank functions with commercial bank activities and are the main lenders to the states in which they are located. The Joint Liability Scheme is based on funds provided by the network itself and provides extensive monitoring mechanisms. These monitoring mechanisms have the primary purpose of preventing savings banks from getting into trouble. To achieve this aim, quantitative indicators as well as qualitative analyses are applied on a regular basis. Upon detecting first signs of economic problems at a savings bank, the regional funds can use their information and intervention rights accordingly. Moreover, as the contributions to the Joint Liability Scheme depend on the riskiness of bank assets, savings banks should not favor high-risk strategies (DSGV, 2012, p. 20). Close similarities to the financial networks of cooperative banks exist, except that their central bank functions are concentrated in two "head institutions" only, which are wholly owned by cooperative banks.[11]

A further special feature of the German banking system is its deposit insurance system. Up to 1998, the safety of deposits was considered to be a matter of self-regulation by the banking sector itself. Whereas the financial networks of savings and cooperative banks guarantee the safety of deposits by granting institutional protection, which is a consequence of the Joint Liability Scheme, commercial banks established their own deposit insurance fund after the failure of a private bank in 1974. The deposit protection scheme is located at the umbrella association of the commercial banks, so membership of the banking association is a necessary precondition for access to the scheme. Furthermore, commercial banks are required to meet specific criteria in order to gain access to the deposit protection funds, including liable capital as defined by BaFin and a rating which is at least BBB^{+}. The deposit protection funds are generated by one-shot as well as annual contributions made by member banks depending

[11] The DZ bank is responsible for 80% of all German cooperatives except for cooperative banks based in North Rhine-Westphalia. Their central bank is the WGZ bank (see Theurl & Kring, 2002).

on their riskiness. There is also an auditing association which has special access rights to information as well as the right to impose conditions on a bank that has been downgraded or may even have run into difficulties. The private deposit insurance fund guarantees a bank's deposits up to 30% of the bank's liable capital until December 2014. From then on this ratio will decline to 8.75% in 2025 (BDB, 2012). Notably, these self-help guarantee funds did not endow depositors with a legally enforceable claim. Initiated by a European directive (94/19/EC: CELEX No. 394L0019; 97/9EG: CELEX No. 397L0009; 2009/14/EC: CELEX No. 309L0014), a special law enacted in 1998 and amended in 2009 now gives German depositors this formal right and protects deposits up to 100,000 €. This formal law has left the Joint Liability Scheme of savings and cooperative banks untouched, however. Looking at the three groups' deposit protection schemes, the institutional protection provided by the savings and cooperative banks gives those banks special incentives for mutual monitoring and control. The absence of competition between the members of each financial network association additionally facilitates the disclosure of relevant information. This would suggest a higher degree of stability compared to commercial banks.

The financial networks described above constitute cooperative solutions for internalizing externalities: Protecting institutions through the Joint Liability Scheme is a precautionary measure to prevent bank runs. The auditing and monitoring system coupled with risk-adjusted contributions to the guarantee funds seeks to prevent excessive risk-taking. Notably, the financial network of cooperative banks has not been affected by the severe financial distress experienced by, at least, the larger cooperative banks. The same holds true for savings banks, though not for all Landesbanken. In particular, compared to commercial banks, the cooperative banks' financial network appears to have been minimally involved in the financial crisis. Empirical studies reveal that commercial banks are indeed less stable than either cooperative banks or savings banks (Gropp et al., 2011).

Our look at the German banking system suggests that the existing risk-sharing networks characterizing each banking group might act as a substitute for depositors' market discipline, thus making punishments by depositors for their banks' high-risk behavior redundant. We will investigate below whether this assessment is borne out by the data and whether differences in governance structures both on the firm-specific as well as network-specific level lead to different degrees of market discipline among depositors. In this respect we will distinguish between the period prior to the financial crisis, the financial crisis, and the period following the financial crisis. Special attention will be given to the introduction of the "Merkel-Steinbrück guarantee."

2.4 Data and Descriptive Statistics

We use panel data for 142 German banks representing the three pillars of the German banking sector. For our analysis, we combine different data sets provided by the Bundesbank. More precisely, bank balance sheet statistics and data from supervisory reporting are merged with bank-specific and asset-specific interest rates from the MFI interest rate statistics[12] for the period 2003-2012 on a monthly basis. Furthermore, information on income statements which is available annually is also taken into account.

The final data set consists of 72 savings banks, 41 cooperative banks, and 29 commercial banks (including the large banks). The key variables of our empirical study, namely the endogenous variables, are the following: *(i)* the growth rate in private households' deposits ($\Delta DEPOSITS$), *(ii)* the corresponding interest rate (IR), *(iii)* the ratio between time and sight deposits (TD/SD), and *(iv)* the spread between interest rates on time and sight deposits ($IRSPREAD$).

We measure bank risk by bank-specific variables that indicate banks' individual asset quality, their capital adequacy, and their liquidity risk. Banks' financial strength is measured by the ratio of Tier 1 capital to risk-weighted assets ($Tier1 - Ratio$). The ratio of liquid assets to total assets (LR, see Murata and Hori, 2006) indicates banks' capacity to meet unexpected liquidity requirements without having to sell off any assets.[13] A liquidity transformation gap is taken into account by the difference between liquid liabilities (sight and time deposits) and liquid assets held by a bank, scaled by its total assets (LTG). The extent to which banks are involved in traditional lending activities is captured by total loans to total assets ($CREDIT$, see Altunbas et al., 2011). Thus, higher bank risk is associated with lower $Tier1 - Ratio$ and LR, as well as higher $CREDIT$ and LTG.

Table 2.1 summarizes the descriptive statistics of the data for the entire period 2003-2012. We present summary statistics for all German banks and for each bank type. With respect to differences between the banking groups, it is not surprising that commercial banks are, on average, larger than savings and cooperative banks ($SIZE$, TA) and have more deposits ($DEPOSITS$). With respect to the balance structure we find that savings banks have the largest loans-to-total assets ratio ($CREDIT$), whereas the share of households' deposits in total assets ($DEPOSITS/TA$) is highest among cooperative banks (31.43%), on average, compared with savings banks (25.65%) and commercial banks (8.67%), respectively. The banking groups differ only slightly on average regarding the liquidity ratio (LR), the liquidity transformation gap (LTG) and the Tier 1 Ratio. Savings banks offer the lowest volume-

[12] Interest rates are collected on a sample basis from domestic monetary financial institutions (MFIs) with the exception of money market funds.

[13] We use a narrow concept and measure liquid assets as banks'cash holdings + deposits held with the central bank + bills + treasury bills.

weighted interest rate on time deposits (IR_TD) and sight deposits (IR_SD)[14], on average amounting to 2.90% and 0.84%, respectively.

e to the very low interest rate on sight deposits, savings banks have the highest interest rate spread between time deposits and sight deposits (IR_SPREAD). Furthermore, the ratio of time deposits to sight deposits (TD/SD) is, on average, lower for savings banks than among cooperative and commercial banks; in particular, the ratio of time deposits to sight deposits is 45%, whereas this ratio is, on average, 63% and 55% for cooperative and commercial banks, respectively. In addition, savings banks are characterized by stable balance sheets and interest rates; this is reflected in low volatility of the loans-to-total assets ratio ($CREDIT$), the ratio of time deposits to sight deposits (TD/SD) and that of the corresponding interest rates (IR_TD and IR_SD).

As macroeconomic control variables, we use the monthly growth rate of the harmonized consumer price index ($HICP_{gr}$), the unemployment rate (UR_{gr}, as monthly growth rate), the real exchange rate ($RealEx$), and the annual GDP growth rate (GDP_{gr}). Furthermore, we include the interest rate term structure ($TERMSTRUC$) approximated by the difference between the 10-year government bond yield and the 3 month Euribor rate. Table 2.1 illustrates that the economic environment in the considered time period was relatively good, measured by high GDP growth rates, decreasing unemployment and moderate inflation.

We construct a dummy variable ($Crisis$) indicating the recent financial crisis. Following the Bundesbank definition (Deutsche Bundesbank, 2011, p. 56), we mark the beginning of the crisis by the outbreak of the financial market turmoil on August 9, 2007 and the end by the beginning of the exit from the non-standard measures taken by the European Central Bank (ECB) on December 3, 2009. Thus, the dummy variable $Postcrisis$ covers the period 12/2009-12/2012. This breakdown is also justified by the summary statistics for the macroeconomic variables (see Table A.1). Before and after the crisis the German economy is characterized by growing GDP, shrinking unemployment rates and a reasonable inflation rate. However, during the crisis this situation was completely reversed. Moreover, we control for the introduction of the "Merkel-Steinbrück guarantee" by specifying a second dummy variable (MS), which takes on the value of one starting in October 2008.

Table A.1 presents summary statistics for the pre-crisis (01/2003-07/2007), crisis (08/2007-11/2009) and post-crisis period (12/2009-12/2012). Total deposits ($DEPOSITS$) increased across all bank types during the observed period. In each of the sub-periods we find that, on average, commercial banks offer the highest volume-weighted interest rate (IR). In all sub-periods, interest rates on sight deposits are highest in the commercial banks sector, whereas savings banks offer the lowest interest rates on sight deposits. This is also true of time de-

[14]Sight deposits ("overnight deposits" in the MFI interest rate statistics) are defined as deposits which are immediately convertible into cash on demand or which are transferable at any time.

Table 2.1: Descriptive Statistics, 2003-2012

	All Banks				Savings Banks			
Bank-specific Variables	N	Mean	Std.dev	Median	N	Mean	Std.dev	Median
$DEPOSITS$	15,459	3.143	6.931	1.328	8,233	1.798	1.470	1.351
$\Delta Deposits$	15,309	0.005	0.039	0.003	8,161	0.004	0.025	0.003
IR	15,453	1.547	0.746	1.450	8,233	1.436	0.643	1.379
IR_TD	15,453	2.913	0.811	2.904	8,233	2.897	0.760	2.934
IR_SD	15,453	0.958	0.619	0.827	8,233	0.837	0.478	0.762
$IRSPREAD$	15,453	1.955	0.685	1.951	8,233	2.060	0.614	2.037
TD	15,453	0.798	1.799	0.354	8,233	0.460	0.385	0.362
SD	15,453	2.344	5.491	0.901	8,233	1.338	1.288	0.954
TD/SD	15,453	0.520	0.498	0.364	8,233	0.450	0.365	0.336
TA	15,453	25.50	113,0	4.968	8,233	7.010	5.629	5.358
$SIZE$	15,453	1.848	1.126	1.603	8,233	1.755	0.566	1.679
LTG	15,381	0.255	0.111	0.244	8,233	0.236	0.069	0.228
LR	15,453	0.019	0.010	0.018	8,233	0.019	0.007	0.017
$CREDIT$	15,321	0.544	0.173	0.571	8,233	0.572	0.125	0.586
$Tier1\_Ratio$	15,268	0.093	0.030	0.087	8,227	0.093	0.028	0.088
	Cooperative Banks				Commercial Banks			
$DEPOSITS$	4,632	1.384	1.327	0.969	2,588	10.57	14.51	4.428
$\Delta Deposits$	4,592	0.006	0.040	0.004	2,556	0.007	0.066	0.002
IR	4,632	1.605	0.738	1.506	2,588	1.797	0.962	1.691
IR_TD	4,632	2.934	0.798	2.916	2,588	2.924	0.975	2.756
IR_SD	4,632	1.006	0.544	0.893	2,588	1.255	0.943	1.080
$IRSPREAD$	4,632	1.928	0.627	1.894	2,588	1.669	0.882	1.577
TD	4,632	0.375	0.448	0.233	2,588	2.632	3.801	0.944
SD	4,632	1.009	1.113	0.591	2,588	7.937	11.62	3.426
TD/SD	4,632	0.625	0.638	0.423	2,588	0.554	0.543	0.396
TA	4,632	4.404	5.474	3.186	2,588	121.8	254.8	22.11
$SIZE$	4,632	1.168	0.706	1.159	2,588	3.363	1.585	3.096
LTG	4,585	0.303	0.090	0.298	2,563	0.232	0.195	0.165
LR	4,632	0.021	0.011	0.020	2,588	0.017	0.014	0.013
$CREDIT$	4,564	0.545	0.146	0.552	2,524	0.448	0.283	0.399
$Tier1\_Ratio$	4,629	0.090	0.023	0.087	2,412	0.100	0.043	0.084

Macroeconomic variables	N	Mean	Std.dev	Median
$HICP_{gr}$	15,313	0.152	0.389	0.104
UR_{gr}	15,313	-0.354	3.728	-1.149
$RealEx$	15,453	103.66	4.297	104.06
GDP_{gr}	15,453	2.205	2.798	2.236
$TERMSTRUC$	15,453	1.285	0.984	1.320

$DEPOSITS$ display households' deposits in billion euros. $\Delta DEPOSITS$ is the growth rate of deposits. The interest rates IR are given in percent. IR_TD (IR_SD) represents the volume-weighted interest rates for time (sight) deposits in percent and IR_SPREAD the difference between IR_TD and IR_SD. Time (sight) deposits in billion euros are denoted by TD (SD) and their ratio is displayed as TD/SD. $SIZE$ is defined as the natural logarithm of total assets TA. LTG is difference between liquid liabilities (sight and time deposits) and liquid assets held by a bank, scaled by its total assets. LR represents the ratio of liquid assets to total assets. $CREDIT$ represents the total credit volume relative to total assets. The $Tier1\_Ratio$ is the ratio of Tier 1 capital and risk-weighted assets. $HICP$ is the monthly growth rate of the Harmonized Consumer Price Index in percent, UR is the monthly unemployment rate in percent, $REALEX$ is the real exchange rate (euro vs. EER-20) based on consumer price indices (base year 1999Q1) and GDP is the yearly growth rate of GDP. $TERMSTRUC$ is the interest rate term structure approximated by the difference betwenn the 10-year governmentbond yield and the 3-month Euribor rate

posits, except for the pre-crisis period where commercial banks offered lower interest rates on time deposits compared to savings banks and cooperative banks. We observe the highest interest rate spread ($IRSPREAD$, measured as the difference between interest rates on time and sight deposits) in the savings banks sector. Prior to the outbreak of the crisis, the smallest ratio between time deposits and sight deposits is found in the commercial banks sector. However, afterwards commercial banks have the highest TD/SD.

All interest rates (IR, IR_TD, IR_SD) rise on average during the crisis period and subsequently go back down. This holds for the interest rate spread as well. During the crisis, we find higher ratios between time deposits and sight deposits (TD/SD) across all bank types. This ratio drops after the crisis and even falls below the pre-crisis period in the savings banks and cooperative banks sector.

2.5 Empirical Analysis of Market Discipline in Germany

The following empirical study provides a comprehensive picture of whether and in which form market discipline was applied in Germany, with a special focus on the role of governance. In this regard, we pay particular attention to the financial crisis and, in doing so, to the state guarantee of all deposits announced shortly after the Lehman Brothers failure ("Merkel-Steinbrück guarantee"). We consider the effects of each risk parameter in isolation, taking the possibility into account that depositors might have a partial perception of risk. Thus, for each banking group we distinguish between effects of increasing bank risks before, during, and after the financial crisis.

2.5.1 Estimation Methodology

We estimate reduced form equations in line with Park, 1995 and Martinez Pería and Schmukler, 2001. Our analysis is subdivided into two parts. First, we investigate whether households slowed down deposit growth and/or demanded higher interest rates due to increased bank risk. We call this *market discipline of Type 1*. Second, we introduce a more subtle measure of market discipline by addressing the question of whether households restructured their deposits in favor of sight deposits and/or demanded a higher interest rate spread from riskier banks. We refer to this as *market discipline of Type 2*.

Using reduced forms implies that we estimate how equilibrium combinations of the interest rate and interest rate spread, and household deposit growth and the time-to-sight-deposit ratio, respond to bank risk. Market discipline exists in either of the following cases. First, a higher bank risk is combined with higher interest rates on deposits paired with a lower growth rate of deposits (Type 1). Second, a higher bank risk is associated with a higher interest rate

spread between time and sight deposits paired with a lower time-to-deposit ratio (Type 2). Of course, in order to obtain results, we need to distinguish between shifts in the supply and demand curves.

In this regard, we draw on Park, 1995 who suggests rules of thumb based on the following arguments: Market equilibrium is characterized by the intersection of a demand and a supply function. Shifts of either function lead to a new equilibrium characterized by new combinations of the equilibrium values of the relevant variables. Given a positively sloped supply curve reflecting the behavior of depositors and a negatively sloped demand curve characterizing bank behavior[15], we can state that both types of market discipline require a leftward shift of the supply curve, signaling depositors' behavior designed to punish their banks for taking higher risks.

Empirically, we face the problem that we are unable to observe these shifts and hence have to draw appropriate conclusions from observed changes in prices and quantities. In this respect, we have to take simultaneous shifts of the supply and the demand curve into account. Hence, any leftward shift of the supply curve may be coupled with both a leftward and a rightward shift of the demand curve. In all these cases, however, we may conclude that, whenever we observe a simultaneous increase in the interest rate or interest rate spread, and a decrease in deposit growth or in the time-to-sight-deposit ratio, we face market discipline in its purest form. There might have occurred a leftward shift of the demand curve, too, though to a significantly less degree. The impact of a leftward shift of the demand curve still does not dominate if we observe constant prices paired with lower quantities (deposit growth or time-to-sight-deposit ratio). Hence this case, too, signals market discipline. If, on the other hand, we observe unchanged quantities (deposit growth or time-to-sight-deposit ratio) but higher prices (interest rate or interest rate spread), then this still indicates a leftward shift of the supply curve, though paired with a rightward shift of the demand curve. In all these cases, we may say that depositors' reactions outweigh the effects of a change in bank behavior, either with respect to quantities or prices, which in accordance with Park, 1995 we interpret as a clear signal of market discipline.

The empirical analysis below uses Park's methodology and thus examines the prevalence of the two types of market discipline as defined above. Our argument here assumes a positively sloped deposit supply curve, where deposits are measured by their growth rates. Taking the financial crisis and, in particular, the failure of Lehman Brothers into account, this view could be considered overly optimistic. In such a situation, it might well be possible that depositors withdraw their deposits at any interest rate. However, even prior to the "Merkel-Steinbrück

[15] A rightward shift of the supply curve leads to a higher equilibrium quantity and to a lower equilibrium price. By contrast, a leftward shift of the supply curve leads to a lower equilibrium quantity coupled with a higher equilibrium price. A rightward shift of the demand curve is followed by a higher quantity and a higher price, and a leftward shift of the demand curve implies a lower quantity and a lower price.

guarantee", it was not possible to observe significant signs of panic, which supports our decision to measure deposits by their growth rates and to assume a positive correlation with the interest rate.

Therefore, following Park, 1995 we first estimate two reduced-form equations, the first representing the impact of bank risk on the equilibrium value of households deposit growth and the second representing the impact of bank risk on the equilibrium interest rate (market discipline of *Type 1*). For each bank type $k \in \{COMMERCIAL, COOPERATIVE, SAVINGS\}$, we estimate fixed effects models:

$$\begin{aligned}\Delta DEPOSITS^k_{i,t} = \alpha + \sum_j \Big[&\beta^j_1 RISK^j_{i,t-1} + \beta^j_2 RISK^j_{i,t-1} * Crisis_{i,t} + \\ &+\beta^j_3 RISK^j_{i,t-1} * Crisis_{i,t} * MS_{i,t} + \\ &+\beta^j_4 RISK^j_{i,t-1} * Postcrisis_{i,t}\Big] + \\ &+\beta_5 SIZE_{i,t} + \beta_6 Crisis_t + \beta_7 Postcrisis_t + \\ &+\sum_m \beta^m_8 MACRO^m_t + \epsilon_{i,t}\end{aligned} \tag{2.1}$$

$$\begin{aligned}IR^k_{i,t} = \alpha + \sum_j \Big[&\beta^j_1 RISK^j_{i,t-1} + \beta^j_2 RISK^j_{i,t-1} * Crisis_{i,t} + \\ &+\beta^j_3 RISK^j_{i,t-1} * Crisis_{i,t} * MS_{i,t} + \\ &+\beta^j_4 RISK^j_{i,t-1} * Postcrisis_{i,t}\Big] + \\ &+\beta_5 SIZE_{i,t} + \beta_6 Crisis_t + \beta_7 Postcrisis_t + \\ &+\sum_m \beta^m_8 MACRO^m_t + \omega_{i,t}\end{aligned} \tag{2.2}$$

where $\Delta DEPOSITS$ is the growth rate of household deposits and IR is the corresponding interest rate, with IR being calculated as a bank-specific volume-weighted average interest rate on time deposits and sight deposits. $RISK^j$ denotes one of the following j variables that are associated with banks' riskiness: LR is the ratio of liquid assets (cash + central bank deposits + bills + treasury bills) to total assets. A lower LR reduces banks' ability to meet sudden liquidity demands. LTG is the difference between a bank's liquid liabilities (sight deposits and time deposits) and liquid assets scaled by its total assets. A higher LTG indicates a larger liquidity transformation gap, which is mirrored in an increased dependence on illiquid assets. The $Tier1 - Ratio$ (the ratio of Tier 1 capital to risk-weighted assets) represents the degree of capitalization; the lower a bank's Tier 1 ratio, the more fragile it is financially. $CREDIT$ (total loans-to-total assets ratio) represents banks' involvement in traditional lending activities.

$SIZE$ is the natural logarithm of total assets and is a proxy for the size of the bank. We

include a dummy variable for the recent financial crisis to assess the impact of the crisis itself. $Crisis$ takes on the value of one between 8/2007 and 11/2009, and zero otherwise. Moreover, we include a dummy variable MS to control for the announcement of the "Merkel-Steinbrück guarantee" in 2008/10. Finally, the post-crisis period (12/2009-12/2012) is indicated using the dummy variable $Postcrisis$. In order to capture differences in the impact of risk measures during the sub-periods, we construct interaction terms between risk variables and the crisis dummy, the crisis dummy interacted with MS, and the post-crisis dummy. $MACRO^m$ denotes the following m macro control variables: $HICP_{gr}$ and UR_{gr} are the monthly growth rates of the Harmonized Consumer Price Index and the unemployment rate, respectively. $RealEx$ is the real exchange rate (euro vs EWK-20) based on Consumer Price Indices. GDP_{gr} is the yearly GDP growth rate. $TERMSTRUC$ is the interest rate term structure approximated by the difference between the 10-year government bond yield and the 3 month Euribor rate. Finally, ϵ and ω are the error terms.

We then turn to examining the market discipline of *Type 2* in an analogous manner using the following two reduced-form equations. The first equation represents the impact of bank risk on the equilibrium value of the time-to-sight-deposit ratio and the second represents the impact of bank risk on the equilibrium interest rate spread:

$$\begin{aligned} TD/SD^k_{i,t} = \alpha + \sum_j \Big[& \beta^j_1 RISK^j_{i,t-1} + \beta^j_2 RISK^j_{i,t-1} * Crisis_{i,t} + \\ & + \beta^j_3 RISK^j_{i,t-1} * Crisis_{i,t} * MS_{i,t} + \\ & + \beta^j_4 RISK^j_{i,t-1} * Postcrisis_{i,t} \Big] + \\ & + \beta_5 SIZE_{i,t} + \beta_6 Crisis_t + \beta_7 Postcrisis_t + \\ & + \sum_m \beta^m_8 MACRO^m_t + \epsilon_{i,t} \end{aligned} \tag{2.3}$$

$$\begin{aligned} IRSPREAD^k_{i,t} = \alpha + \sum_j \Big[& \beta^j_1 RISK^j_{i,t-1} + \beta^j_2 RISK^j_{i,t-1} * Crisis_{i,t} + \\ & + \beta^j_3 RISK^j_{i,t-1} * Crisis_{i,t} * MS_{i,t} + \\ & + \beta^j_4 RISK^j_{i,t-1} * Postcrisis_{i,t} \Big] + \\ & + \beta_5 SIZE_{i,t} + \beta_6 Crisis_t + \beta_7 Postcrisis_{i,t} + \\ & + \sum_m \beta^m_8 MACRO^m_t + \omega_{i,t} \end{aligned} \tag{2.4}$$

where TD/SD is the ratio between time deposits and sight deposits for bank i at time t. $IRSPREAD$ is the interest rate spread between time deposits and sight deposits.

Using Park's rules of thumb implies that if *bank risk increases* – expressed as a lower LR and $Tier1 - Ratio$, and a higher LTG and $CREDIT$, respectively, we have to distinguish between the following cases:

1. A *negative* correlation with $\Delta DEPOSITS$ (TD/SD) and a *positive* correlation with IR ($IRSPREAD$) indicates that the major effect is a leftward shift of the supply curve and thus depositors are exercising market discipline of Type 1 (Type 2).

2. The *absence* of a correlation with $\Delta DEPOSITS$ (TD/SD) and a *positive* correlation with IR ($IRSPREAD$) indicates that a rightward shift of the demand curve has been outweighed by the leftward shift of the supply curve, hence signaling market discipline of Type 1 (Type 2).

3. A *negative* correlation with $\Delta DEPOSITS$ (TD/SD) and the *absence* of a correlation with IR ($IRSPREAD$), suggests a simultaneous leftward shift of the supply and demand curve with a predominating effect of the supply curve. This will be interpreted as a signal of market discipline of Type 1 (Type 2).

4. A *positive* correlation with $\Delta DEPOSITS$ (TD/SD) and a *negative* correlation with IR ($IRSPREAD$), indicates a rightward shift of the supply curve and hence the absence of market discipline of Type 1 (Type 2).

5. A *positive* correlation with $\Delta DEPOSITS$ (TD/SD) and a *positive* correlation with IR ($IRSPREAD$) signals a rightward shift of the demand curve. A leftward shift of the supply curve cannot be ruled out in this case but it does not dominate effects. Hence, we will not discuss market discipline of Type 1 (Type 2) here.

6. A *negative* correlation with $\Delta DEPOSITS$ (TD/SD) and a *negative* correlation with IR ($IRSPREAD$), suggests a leftward shift of the demand curve. Again, a leftward shift of the supply curve cannot be excluded but it does not dominate effects. So, again, market discipline of Type 1 (Type 2) will be ruled out.

2.5.2 Estimation Results

Estimation Results for Commercial Banks

Table A.2[16] presents the estimation results for commercial banks. Prior to the crisis we find market discipline of Type 2 only: Depositors demand a higher interest rate spread from banks with a lower liquidity ratio (LR) and Tier 1 ratio ($Tier1-Ratio$). During the crisis we observe market discipline of Type 1 as well as of Type 2: The deposit growth declines following an increase in the liquidity transformation gap (LTG) and banks with a lower liquidity ratio (LR) have to pay both higher interest rates and a larger interest rate spread. After the announcement of the "Merkel-Steinbrück guarantee" we find market discipline of Type 1 in its

[16]All presented estimation results show the marginal effects of risk variables in the pre-crisis, crisis, and post-crisis period, instead of the fixed effects.

purest form. Depositors reduce their supply with deposits and demand higher interest rates from banks with a higher liquidity transformation gap (LTG). Additionally, a lower Tier 1 ratio ($Tier1 - Ratio$) is also associated with higher interest rates. In the post-crisis period almost all signs of market discipline disappear. We only observe an increase in the interest rate spread for less capitalized banks ($Tier1 - Ratio$).

Summarizing our findings, we may state that, both pre- and post-crisis, depositors exercise market discipline only by shortening maturities or demanding higher interest spreads. Equally notable is the finding that market discipline only follows from aggravated liquidity and equity ratios, whereas no such reaction can be observed upon higher loan-to-assets ratios. Also, the "Merkel-Steinbrück guarantee" obviously did not calm depositors the manner which might have been expected.

Estimation Results for Cooperative Banks

Estimation results for cooperative banks are presented in Table A.3. In the pre-crisis period depositors of cooperative banks are found to exercise market discipline of Type 1 and of Type 2: Banks with a larger liquidity transformation gap (LTG) experience market discipline of Type 1 in its pure sense (reduction in $\Delta DEPOSITS$ and increase in IR). Moreover, depositors demand higher interest rates from less capitalized banks ($Tier1 - Ratio$). The time-to-sight-deposit ratio (TD/SD) decreases following an increase in the loans-to-assets ratio ($CREDIT$). For the crisis period we do not find market discipline of Type 2. Instead, depositors exercise market discipline of Type 1 in its pure sense as a reaction to an increase in the liquidity transformation gap (LTG) as well as to a reduction in banks' capitalization ($Tier1 - Ratio$). A lower liquidity ratio (LR) is associated with an increase of the interest rates. The introduction of the "Merkel-Steinbrück guarantee" seems to have a slightly mitigating effect on market discipline of Type 1: We find a reduction in the growth of deposits and increased interest rates for banks with a higher LTG. A lower Tier 1 ratio is also associated with higher interest rates. Additionally, depositors reduce their supply with time deposits relative to sight deposits (TD/SD) for banks with a lower liquidity ratio. The post-crisis period differs only little from the pre-crisis period. We find market discipline of Type 1: Depositors punish banks for a larger liquidity transformation gap by demanding higher interest rates and reducing the deposit growth. A lower Tier 1 capital ratio is followed by an increase in interest rates. Market discipline of Type 2 is observed for banks with a lower liquidity ratio (LR) in terms of a reduction of the time-to-sight deposit ratio.

In summary, cooperative banks are faced with market discipline of Type 1 in its purest form throughout the whole observation period. Riskier banks are punished by a reduction in the growth of deposits coupled with higher interest rates. Depositors also seem to restructure their deposits in favor of sight deposits following an increase in bank risk. However, the

demand for a larger interest rate spread is not found in the cooperative banks sector and depositors discipline banks with higher $CREDIT$ in the pre-crisis period only. Contrary to the depositors of commercial banks, the "Merkel-Steinbrück guarantee" appears to have dampened the magnitude of market discipline of depositors of cooperative banks.

Estimation Results for Savings Banks

The results for savings banks are summarized in Table A.4. For the pre-crisis period we find evidence for market discipline of Type 1: Interest rates increase following a reduction in the Tier 1 ratio. Furthermore, depositors punish banks by reducing their deposit growth and demanding higher interest rates from banks with a higher liquidity transformation gap (LTG). During the crisis depositors react to an increase in all risk measures by demanding higher interest rates (Type 1). Savings banks with a higher loans-to-assets ratio ($CREDIT$) also have to pay a larger interest rate spread (Type 2). However, neither the deposit growth nor the time-to-sight-deposit ratio are affected during the crisis. After the "Merkel-Steinbrück guarantee" we find market discipline of Type 1 and Type 2: Depositors discipline banks with a higher liquidity transformation gap (LTG) by reducing their deposit supply (demanding higher interest rates and reducing their deposit growth). Banks with a lower Tier 1 ratio are also punished through higher interest rates. We also find an increase in the interest rate spread following a reduction of the liquidity ratio (LR). After the crisis, we still observe market discipline of Type 1 in its purest form for banks with a higher liquidity transformation gap (LTG). Less capitalized banks have also still to pay higher interest rates. Moreover, depositors reduce the time-to-sight-deposit ratio for banks with a lower liquidity ratio.

Summarizing findings, we observe that depositors of savings banks are by no means passive. Rather, they exercise market discipline throughout the entire observation period, and contrary to cooperative banks, the "Merkel-Steinbrück guarantee" had no comparable dampening effect. Instead, at the beginning of the crisis we find depositors exercising both types of market discipline.

2.5.3 Interpretation of Estimation Results

Overall our empirical investigation does not lend support to the frequent characterization of German depositors as lazy managers of their wealth. Rather, we find market discipline in all banking groups, and this suggests that neither the safety umbrella association of savings banks nor that of cooperative banks is capable of assuaging depositors' sensitivity to their banks' risks. Our analysis, too, reveals an increased sensitiveness of depositors to their banks' risky actions during the financial crisis which could not be mollified by the "Merkel-Steinbrück guarantee". The most surprising result, however, concerns the role of ownership structures.

Following theory, stockholding banks are inclined to take greater risks than cooperative banks. We would therefore expect more market discipline among the depositors of commercial banks than of cooperative banks, especially since typically depositors of cooperative banks could seek to influence the risk-taking of their banks through ownership rights. However, we find that cooperative banks experience a significantly higher degree of market discipline than commercial banks, and this applies for all periods under investigation. We may conclude that obviously depositors of cooperative banks do not take their ownership rights as being effective or they might see the impact of the general assembly on management decisions as rather restricted. In both cases market discipline remains the only effective instrument to change the bank's risk-taking decisions. Our study therefore reveals signs that depositors of cooperative banks are rather passive concerning their direct ownership rights but active regarding their rights as debtors. In this regard, the umbrella association into which cooperative banks are embedded obviously did not dampen depositors' fears about the safety of their investments sufficiently. At least prior to the crisis we furthermore observe a conflict of interest between "borrower-members" and "depositor-members" of cooperative banks giving them reason to exercise market discipline in response to an increase in their banks' lending. Throughout the entire period of observation depositors of cooperative banks punish their banks for a lower equity ratio, which, too, confirms that they see themselves more as debtors than as owners. As described in our literature review, theory on savings banks' risk-taking is sparse. Empirical evidence has been found that savings banks in Europe might be exposed to higher risks, which has been explained by their focus on the public interest. For many years German savings banks therefore enjoyed a guarantee on their liabilities by their public owners. In order to avoid moral hazard, savings banks had to comply with severe restrictions concerning the riskiness of their assets. Furthermore the umbrella association of mutual guaranteeing and monitoring was intended to keep risks low. However, amidst ongoing financial deregulation, restrictions on the riskiness of assets were gradually eased, and above all the Landesbanken increasingly added investment banking to their portfolios. This change in orientation might have spurred the abolishment of guarantors' liability with the result that to day the ownership structure of the savings bank sector has remained rather blurred. The implications of this uncertainty are clearly visible in the results of our estimation: Already prior to the financial crisis market discipline was more severe for savings banks than for commercial banks, though less so compared to cooperative banks. Market discipline increased during the financial crisis, which is hardly surprising considering that two Landesbanken went bully-up. Prior to the "Merkel-Steinbrück guarantee" savings banks' depositors punished their banks for an increase in liquidity risk as well as credit and solvency risk. In this regard, credit risk received most attention, which is hardly surprising considering the large volumes of bad loans in the balance sheets of Landesbanken. The "Merkel-Steinbrück guarantee" did little to soothe depositors'

nerves, and a higher sensitivity to savings banks' liquidity position has remained during the post-crisis period.

As a further interesting result, we observe close similarities in the pattern of market discipline between savings and cooperative banks. During the entire observation period, depositors of both banking groups exercise market discipline whenever both refinancing risk and solvency risk increase. Similarities become even more pronounced during and after the crisis. One possible explanation might be that both banking groups display organizational similarities, especially with respect to their umbrella associations. Furthermore, it might be possible that for depositors of both banking groups the role of ownership has remained unclear.

Our interpretations so far have provided explanations for market discipline in the group of cooperative and savings banks but have remained silent on the observed comparative passiveness by depositors of commercial banks. Indeed, the sector of commercial banks was severely hit by the financial crisis, so why should depositors have remained calmer than in the savings or cooperative bank sector? At this point it is worth mentioning that savers are free to choose their bank and will do so in accordance with their risk appetite as well as their wealth and income. It is the group of smaller savers with less potential and also less willingness to diversify wealth that hold their bank deposits with savings and cooperative banks. For these bank customers, deposit losses and wealth losses are closely correlated, which might make them excessively sensitive to their banks' behavior. By contrast, wealthier households have a larger potential to diversify their wealth with deposits forming only a small proportion. In other words, this group of households is in a better position to diversify away any increase in risk taken by their bank, thus rendering them less sensitive to their banks' changing risk positions. That commercial banks experience less market discipline thus could also indicate a higher proportion of customers with well-diversified portfolios in this banking group than in the cooperative and savings bank group.

2.6 Conclusions

German savers are renowned for preferring safe, long-term investments, thus providing patient capital, with bank deposits playing an important role (Größl et al., 2013). Patience, in this regard, indicates not only the absence of deposit withdrawals at the first sign of banks getting into trouble; at a more subtle level, it means that depositors are not quick to reduce that part of their savings invested in deposits and to demand higher interests or shorter maturities and charge higher risk premia, but instead wait and see, signaling trust in their housebanks. Patience thus defined implies an absence of market discipline.

Using a unique data set for German banks, we examine whether German depositors are really that patient and how the financial crisis might have changed a well-established habit.

Our empirical analysis does not confirm the supposed passiveness of German depositors but rather reveals the existence of market discipline and, in this regard, signals a high degree of heterogeneity among German depositors. Notably, this heterogeneity confirms the impact of the governance structure. This evidence continues to hold even after the "Merkel-Steinbrück guarantee", which helped to calm depositors of each banking group but obviously did not entirely stifle market disciplinary reactions.

Of particular interest are the following findings. First, throughout the entire observation period, commercial banks experience less market discipline than savings banks and cooperative banks. Second, market discipline follows a similar pattern for savings and cooperative banks. Third, the "Merkel-Steinbrück guarantee" apparently did little to soothe depositors' nerves. Concerning cooperative banks, the high degree of market discipline signals that depositors apperently used market discipline as a substitute for exercising their ownership rights in the general assembly. Savings banks experienced major organizational and behavioral changes during the observation period relating to the loss of guarantor liability and the relaxation of constraints on risk-taking by the Landesbanken, which might explain depositors' high sensitiveness to the aggravation of risk indicators. In particular, the observed low market discipline in the commercial bank sector compared to savings and cooperative banks merits further research, taking households' choice of housebank into account.

Chapter 3

Banks through the Lens of the Media

3.1 Introduction

"In general, bad news is news and the rest is publicity." (Baker, 1994, p. 293)

Studies of risk perception have shown that most laypeople have a comprehensive idea of risk. In addition to quantitative risk measures, the public's perception of risks rests on subjective probabilities arising from social norms, personal risk preferences, and feelings (Boholm, 1998; Loewenstein et al., 2001; Markowitz, 1952). Following Loewenstein et al. (2001), emotional reactions to risky situations often drive behavior and lead to outcomes that diverge from the cognitive evaluation of those risks. What an individual perceives as risk depends on his direct and personal experiences, and changes in perceived risks may lead to changes in trust (Siegrist, 2001; van der Cruijsen et al., 2016). According to Siegrist (2001), trust in involved industries and institutions significantly decreases with rising perceived risks. Of even greater significance to policymakers and supervisors are those risks that agents experience indirectly through communication (Boholm, 1998; Kasperson et al., 1988). The reason is that, according to Kasperson et al. (1988), public responses to risks flow through a social amplification channel. In this concept, agents' behavioral changes–in response to (realized) risks–generate secondary social or economic consequences. These arise from the repercussions of behavioral changes from an individual to companies and industries. These, in turn, may dampen or increase the risk itself–possibly culminating in (financial) crises. These indirect (adverse) effects excel narrow technical measures of risk often employed by experts. Therefore, gauging these secondary effects is of great importance to policymakers and supervisors since they may require additional institutional responses and protective actions (Kasperson et al., 1988).

In this regard, Slovic (1986) highlights the media's great significance for informing and educating the general public about risk. Slovic's rationale is confirmed by several studies explicitly evaluating sources of information to the general public. Based on a U.S. survey,

Blinder and Krüger (2004) find that laypeople learn about economic issues first and foremost through television and newspapers, where local newspapers are a more important source of information than national newspapers. Van der Cruijsen et al. (2015) apply the methodology in Blinder and Krüger (2004) to evaluate the degree and determinants of the general public's knowledge about ECB monetary policy in the Netherlands. As main sources of information, they also identify television, closely followed by newspapers. When asked which source of information is relevant regarding banking supervision, newspapers are named even more often than television (van der Cruijsen et al., 2013).

Pyle et al. (2012) provide evidence for Russian depositors' media environment driving their deposit withdrawal activities. Similar studies are not available for Germany so far. However, a very recent survey by Jackob et al. (2019) focuses on trust in news coverage in general. The picture, though, is very similar to previous findings for other countries: The majority of the German population trusts daily newspapers that are ranked second after public service broadcasting authorities (65%), where regional outlets (63%) are trusted even more than national newspapers (49%). These recent studies show the overwhelming role of the media in the transmission of financial information. However, they neither analyze the content nor the sentiment that the news spread.

Especially during financial crises, information on banks is crucial in preventing undesirable events as bank runs. In this respect, the Basle Committee on Banking Supervision (1998) considers media as a secondary source of information, on which market participants may rely as a replacement of credible and comprehensible public disclosure of bank risks. The Basel Committee also acknowledges that even if banks disclose their condition publicly, depositors cannot monitor banks effectively due to a lack of training. Given households' low level of financial literacy, as documented in many studies (Calcagno & Monticone, 2015; Lusardi & Mitchell, 2011, see, e.g.), the media's role in informing depositors concerning banks' risk gains even more relevance.

The media's role as an intermediary in affecting the public's perception of bank risks has mainly been ignored in the literature.[1] However, we know that the media can impact risk perception by influencing different attributes of information. According to the "quantity of coverage theory" (QCT), news media affect public opinion by more or less intensely covering topics and thus setting people's agenda (Mazur, 2006). Especially repetitions of the factual statement in different sources, let information appear to be more accurate (Kasperson et al., 1988).

[1] In their very recent work, Bluwstein and Yung (2019) model the effect of risk perception shocks through bank lending in a DSGE framework. In particular, they point out that sometimes, risk perceptions drive market participants' decisions instead of any fundamental changes. Within their framework, changes in risk perception can lead to a mispricing of risk, leading to real effects on the economy. As a measure for risk perception, Bluwstein and Yung (2019) draw on the implied volatility index of U.S. treasury bills provided by Merrill Lynch.

On the other hand, the media channel feelings through the tone (or sentiment) in their reports. From a large body of literature, we know that feelings substantially impact cognitive processes, such that agents base their judgments on affective responses (MacGregor et al., 1999; Schwarz, 2000) and remember events that evoke feelings (Dolan, 2002). Modern text analysis techniques allow the extraction and analysis of public mood and views through sentiment analysis, also known as opinion mining, based on daily press articles. [2]

None of the above studies consider the level of readability, although several readability measures are readily available (for the English language, at least). The question of newspaper readability has, in fact, been subject to very few studies. Razik (1969) assesses American newspaper readability and finds significant differences between sections and between metropolitan versus non-metropolitan newspapers, with the latter being harder to read. Only one readability measure has been adapted to the German language by Amstad (1978). In his analysis of German-speaking newspapers, Amstad (1978) finds sections and newspapers to be unequally sophisticated. In particular, economic articles are significantly harder to understand compared to other sections.

The Basel Committee on Banking Supervision (2001) emphasizes the role of market discipline as the third pillar of supervisory efforts to strengthen the banking and financial system's safety and soundness. For market discipline to be effective, the Committee admonishes banks to disclose their financial situation frequently. Banks' transparency is thereby crucial for their credibility. In 1998, the Basle Committee on Banking Supervision (1998) pointed out that if banks lack to inform depositors themselves, it enhances the role of secondary information sources like the media.

To what extent households base their financial decisions on media sources is not part of this paper. However, to provide some anecdotal evidence, in 2015, we conducted a representative study for one of the major German cities (Hamburg), asking households to rank the importance of different factors when choosing a bank or a financial investment. The respondents evaluated the media as slightly less important than banks' information material and counseling by a bank or financial advisor. In contrast, recommendations from family and friends have been ranked highest. Additionally, a recent survey by Jackob et al. (2019), shows that the majority of the German population trusts daily newspapers that are ranked second after public service broadcasting authorities (65%), where regional outlets (63%) are trusted even more than national newspapers (49%). These findings indicate the media's potentially outstanding role as a transmitter of financial information.

To the best of our knowledge, *bank-related news coverage* has not been previously analyzed in-depth.[3] Although, a few studies do focus on the coverage of the banking crisis. In particular,

[2] Online sources and social media platforms, such as Twitter, are also often analyzed. These sources of information are, however, not considered in the present paper.

[3] Instead, several studies address the question of why financial journalists failed to inform adequately and

Berry (2012) is questioning the choice of sources used for the reporting on the banking crisis by English public broadcasting (BBC Radio 4's *Today* programme). For this analysis, he manually coded cited sources and their comments on the British banking bailout. Moreover, for the latter, he conducted a qualitative thematic analysis. The main finding is that only very few elite financial sources have been used, which had quite similar (non-critical) thoughts on the bailout, too. Berry (2012), therefore, concludes that the BBC Radio 4's *Today* programme did not equip their listeners with the necessary information they would need to make informed decisions.

The literature on media bias also emphasizes the significance of using a wide range of news sources. In their seminal paper, Mullainathan and Shleifer (2002) propose two different types of media bias. "Ideology" refers to news outlet's incentive to influence readers' opinions in a certain way, and newspapers' spinning stories by aiming to publish a "memorable story." Ideological bias originates in newspapers' desire to confirm readers' beliefs. If the latter diverged in different directions, news outlets split the market and slant toward opposing reader beliefs. Mullainathan and Shleifer's (2002) model emphasizes that competition between media outlets compensates biases from ideology. Without ideology, however, competition fuels bias through spin. A reader can acquire an unbiased perspective by accessing many different news sources. In this respect, Mullainathan and Shleifer (2005) find reader heterogeneity to be more critical for accurate information in the media than competition in the market for news.

Nevertheless, most of the literature uses only one or very few news media sources for their empirical analyses. However, some scholars address implications arising from a limited news selection. On the one hand, Fogarty (2005) does not expect general patterns to differ across outlets. Besides, he states that primarily smaller newspapers use news agencies as a source for national-level news. In contrast, major outlets provide the content for news agencies and act as agenda-setter for other newspapers. On the other hand, Goidel et al. (2010) infer from finding that regional newspapers cover the economy differently compared to national outlets that it is essential to take both sources into account. Although a national perspective is not absent in local newspapers, they predominantly focus on local businesses in the community. Therefore, they expect local newspapers to be superior in predicting economic expectations compared to national newspapers. Woolley (2000) strongly recommends including a "media portfolio" to avoid biased analyses. In support of his argument, he presents empirical evidence for differences in coverage, even between national newspapers. One potential source of conflicting findings in the literature is the inter-researcher divergence. Indeed, by just counting singular events, different scholars yield different results, despite using similar or even identical data sources. Finally, Woolley (2000, p. 160) points out that regional and national presses represent "two separate worlds," being independent and distinct from one another.

warn the general public about the emerging banking crisis (Fahy et al., 2009; Schechter, 2009; Tambini, 2010).

This work at hand contributes to the literature in several aspects. As indicated above, a comprehensive news source is necessary for a meaningful interpretation of the media. Instead of turning to experts or banks' information, we are interested in easily available information and understandable to the average bank customer. According to a recent survey, the German population trusts in German news coverage in general (Jackob et al., 2019). Therein, daily newspapers are ranked second after public service broadcasting authorities, with the general public trusting regional outlets even more than national newspapers. Hence, the primarily relevant information source to depositors is daily newspapers, which target audiences with different financial literacy levels. Hence, to represent information available to readers from the whole range of the banking sector and the level of financial literacy, national and regional newspapers are used in the analysis. Thus, the first focus is on gauging bank-related content and sentiment of German daily newspapers during the global crisis 2007-2012. The emphasis, thereby, is on the distinction of bank types and the evolution of their evaluation throughout the crisis. Moreover, the analysis of individual banks' coverage is also included. Second, taking the readability of bank-related articles into account provides additional information to sentiment measures. Third, the examination of media biases regarding banks completes the study and provides further insight into policy implications. Finally, to assess possible differences between newspapers, national and regional outlets are analyzed separately.

In a nutshell, how the media are covering bank risks may attenuate or amplify the transmission of these risks. This paper aims to provide systematic evidence of whether depositors and supervisors should be concerned about bias in banks' coverage. Especially in times of financial crises, depositors need to be informed about their bank and the banking system's safety. Monitoring transmitted risks is a fortiori because risk evaluations of laypeople may substantially differ from narrow (model-based) experts' assessments (af Wåhlberg & Sjöberg, 2000; Gooding, 1975). Hence, in consideration of the media's special importance in times of crisis, the work at hand will be analyzing daily newspaper coverage and evaluation of German banks during the period 2007-2012. Special attention is drawn to potential sources of media bias. In particular, we evaluate whether ideology and advertising incentives, respectively, bias newspapers' evaluations of banks. To retrieve an extensive impression of bank coverage, a unique and comprehensive selection of newspapers will be analyzed, applying quantitative text analyses. The study will be focusing on coverage and bank-related sentiment that identifies positive and negative opinions, evaluations, and emotions. To the best of our knowledge, this paper is the first to investigate how banks' sentiment has emerged in the course of the crisis. In particular, we answer the following research questions: (i) How understandable is information regarding banks in the daily press? (ii) Which banks and bank types are covered? (iii) How does the media evaluate banks and bank types? (iv) Do we find systematic differences between local and national outlets?

The paper is structured as follows: The following Section 3.2 introduces the applied text mining techniques. Section 3.3 is devoted to an in-depth analysis of bank-related newspaper articles. In particular, we present how readability (subsection 3.3.1), content (subsection 3.3.2), and sentiment of texts (subsection 3.3.3) are quantified. In Section 3.4 we derive a bank network based on articles before turning to the analysis of news bias in Section 3.5. Finally, Section 3.6 summarizes main findings and concludes.

3.2 Text Mining Procedure

Economic research increasingly incorporates the rich information that is encoded in texts. Besides structural data that empirical studies use, new technologies make much wider data sources available and open up new research possibilities. However, with these new opportunities, new challenges arise too, and in many respects, the possibilities of text mining techniques are limited (yet).

Text mining refers to the process of automatically extracting information from unstructured text data.[4] Depending on the research questions, different techniques can be combined–the work at hand resorts to information retrieval (IR) and natural language processing (NLP). Information retrieval deals with identifying complex contents in text going beyond the sheer finding of single words.

The most prominent and widespread tasks are the measurement of *volume* and *tone*. Measuring volume implies counting the mentioning of any specific event, topic, institution, or person (see Section 3.3.2). A further computer-based content analysis that would identify the evolution of different topics can be conducted based on different approaches. It can rely on word frequencies, co-occurrences, and categorization via hypothesis-driven buzzwords.[5] One increasingly prominent application of NLP is sentiment analysis (Delmonte & Pallotta, 2011, see Section 3.3.3).[6]

In contrast to structured data, text data contain multi-layered information that ranges from different topics, over opinions and sentiment, to sarcasm. However, sarcasm is a different kettle of fish, as it requires a profound understanding of natural language processing (NLP). As also do tasks that involve the detection of the semantic structure underlying a text. These make NLP very difficult as they aim at answering the question of "Who did what to whom?" (Manning et al., 2014, p. 17) We leave this challenge to future research.[7] While all these tasks

[4] Whereas data mining subsumes big data in general, text mining comprises the extraction of information from texts only.

[5] For quantitative text analyses using topic models see Jacobi et al. (2016).

[6] I follow Liu (2012) and Wilson et al. (2005) by using the terms sentiment analysis and opinion mining interchangeably.

[7] For the English language, up-and-coming tools are being developed and provided by the Stanford NLP Group. For further reading, please visit https://nlp.stanford.edu/.

can be performed manually, over the past years, the emergence of automated textual analysis techniques allows to process and analyze large amounts of data. Common text mining tasks involve content analysis, document classification and clustering of similar documents (topic modeling), and sentiment analysis.

Assigning a sentiment score to a text or statement can result in subjective differences when accomplishing this task manually. As even for "simple" event counts, like elections, significant divergences emerge between coders (Woolley, 2000). One substantial benefit of automated text analyses is human coders' independence, thus ensuring objectivity and traceability. However, the main advantage comes with the computing power to conduct many different analyses (as event counts, sentiment analysis, readability, topic modeling) on large data sets in a short time. An additional strength of automated analysis of big text data lies in detecting large shifts that otherwise remain undiscovered to the human eye (Nyman et al., 2018).

For this paper, we carry out a content analysis regarding banks and bank types. Therefore, we identify individual bank names as well as bank types and extract meaningful statements. However, any concepts that would require a comprehensive dictionary with distinct definitions of thematic categories or annotated and labeled texts cannot be conducted in this work as annotated and labeled text data is not available for German media reports on banks. Accordingly, this work applies techniques that do not depend on annotated data sets allowing analyses based on dictionaries.[8]

3.2.1 Selecting and Collecting Relevant Text Sources

Several analytical problems arise when choosing news sources. In the first place, any newspaper, broadcast station, or analyst report we include, represents only an excerpt from reality. Besides, this choice is always imperfect and may lead to biased conclusions. Additional distortions may occur through the selection process itself if we do not "draw" a representative sample of information. A second important constraint is that by measuring media content, we measure media focus, at best. Some scholars interpret this as a measure of public concern or public awareness (Woolley, 2000).

Depending on the research agenda, different sources of information seem to be well suited to a greater or lesser extent when it comes to the target audience. From Doyle (2006) we know that journalists are very conscious of the readership they are targeting. For instance, a *Financial Times* journalist stated: "We're writing for investors such as City fund managers. Our role is to inform educated, professional investors." (Doyle, 2006, p. 4) However, in general, the mainstream media usually target non-specialist audiences of a lay readership. Thus, journalists' goals range from providing in-depth analyses "intended to inform and perhaps shape investor

[8] Machine learning approaches to sentiment analysis are described in Schrauwen, 2010.

sentiment and behaviour" to "'infotainment' centered around actors, events, and intrigues that happen to be situated in the realm of business and finance." (Doyle, 2006, p. 5) Hence, the primary information source used by the target audience needs to be identified in the first place. Furthermore, the target audience's level of education (and financial literacy in the context of financial studies) determines selected news appropriateness.

For example, for a study of the Fed's monetary policy reactions to signals from the Administration[9], the *Wall Street Journal* seems to be the right choice, because we may expect monetary policy makers as well as financial market participants to pay a considerable amount of attention to this newspaper. The same argument holds if we are interested in investor reactions, though other major outlets (*New York Times*, *Washington Post*) are also often used in this strand of literature. In both cases, one can expect a relatively homogeneous education level, so that these newspapers seem to be the right choice. In contrast, studies that address reactions from or effects on a broader audience (as citizens and households) may want to consider a broader news sample reflecting their sources of information.

However, following another line of argument, one or two "leading" outlets would suffice to represent newspaper coverage: From a theoretical point of view as a social scientist, Cook (2005, p. 166) expects a high similarity across news outlets. He argues that journalists' interpretations of the real world are homogeneous, as they rely on a minimal number of underlying assumptions about the real world. Additionally, some authors argue that "leading" outlets serve as agenda-setter for other media outlets, making the latter's inclusion in news analyses obsolete (Fogarty, 2005).

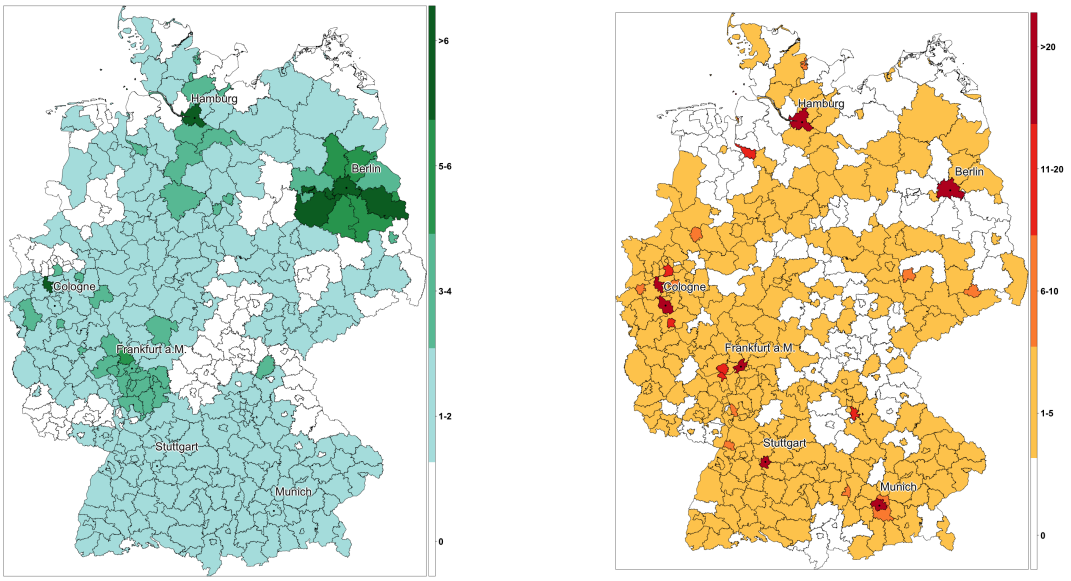
Woolley (2000) disagrees with these arguments and states that focusing on a limited number of news outlets results in considerable biases. He finds that even rare and vital events are not covered reliably by most media. As the most critical identified reasons in the literature, Woolley (2000) summarizes that "most media exhibit significant regional biases, disproportionately cover large urban areas or areas with wire service offices, and report events with large numbers rather than small." (Woolley, 2000, p. 158) From this, it follows that specialized media may enhance biased event counts. Moreover, the more intensive an event is covered, the more journalists will cover this event. The resulting concentrated coverage, however, can be independent of the underlying real frequency. To balance out possible biases, Woolley (2000), consequently recommends using a "media portfolio" of multiple media sources for event counts (volume of media attention).

In other words, several aspects need to be accounted for to define adequate news sources for the analysis of bank-related coverage. As this work focuses on private depositors, the primarily relevant source of information is daily newspapers. To represent information available to readers from the whole range of financial literacy, national and regional newspapers should be

[9]For the initial study studies on this topic see Havrilesky (1988).

considered. Even more crucial are the eligibility criteria that target individual banks and bank types–and their unique features. On the one hand, German savings banks and cooperative banks usually operate in local markets (Arnold et al., 2016; Goedde-Menke et al., 2014). Therefore, information regarding these banks may be relevant predominantly for the particular region, which may only be covered by a regional outlet. On the other hand, each journalist or newspapers lays stress on different topics, thus altering incoming information (Kasperson et al., 1988). From this point of view follows the necessity of including regional and national newspapers. Besides, only gathering as much regional information as possible can detect potential regional distinctions. After all, relying on accordingly comprehensive news sources reduces the probability of getting a biased, not representative picture, concerning the readership and covered banks (Kearney & Liu, 2014).

Figure 3.1: Regional newspapers and covered banks



(a) Location and number of regional newspapers (b) Location and number of covered banks

Source: Geographical data is from http://gadm.org/. Data on newspaper coverage is from ZMG-Verbreitungsanalyse (2015). Bank names and their postal codes are kindly provided by the Deutsche Bundesbank. Own visualization.

We collect a uniquely comprehensive and extensive set of newspaper articles covering regional and national daily print media in Germany. Most newspapers are collected via *LexisNexis*. Specialized newspapers or German-speaking outlets from Austria or Switzerland do not enter our sample because the main target audience is German private depositors. Additionally, the two national newspapers often used in the text mining literature (Baker et al., 2016, e.g.) are added to the news sample, namely Handelsblatt and Frankfurter Allgemeine Zeitung (FAZ). In total, 51 regional and 6 national newspapers are available for the analysis.

In contrast to national-wide newspapers with their sole publisher, many regional outlets share a publishing house. Thus, the 51 regional newspapers can be assigned to 17 publishers. Figure 3.1 highlights all regions covered by the sample of regional newspapers (nation-wide newspapers are not included in this figure). More than six papers belong to the region around Berlin and Hamburg. Around Frankfurt and Cologne, the sample contains between three and six newspapers. To find as many relevant articles as possible, we search for the appearance of the word "Bank" or "Sparkasse" (savings bank) within articles or titles of newspapers' economic sections. These terms capture all types of banks and bank names, including central banks.[10]

Figure 3.1a shows the total number of banks which not only report to the Bundesbank and are included in the bank list but appear in at least one article during 2007-2012.[11] Dark red regions indicate that more than 20 banks are registered and covered in these areas, which applies to large cities Berlin, Hamburg, Bremen, the region around Stuttgart and Cologne, Frankfurt (Main), Munich, and Dresden. For most parts of the country, our data set includes between one and five banks, notwithstanding their branches.

3.2.2 From Text to Data

First, one needs to bring together all the different layouts and data formats that identify precisely article texts and the corresponding meta-information. At this point, the harmonization of newspaper names avoids multi-metering.

In contrast to human readers, machines neither interpret words nor extract meaning from the text as a whole. In contrast, machines have to recognize words in the first place. Therefore, language needs a formal, machine-readable representation. The simplest possible approach is "text processing" that does not involve any linguistic knowledge for "parsing"–such as grammar, syntax, or semantics (Ahlswede & Evens, 1988; Reghizzi et al., 2019).

Word form recognition requires the tokenization of article texts.[12] This allows the identification (and therefore countability) of every single word, which is also called "type". The text is then transformed into a word corpus for subsequent statistical analyses, the raw data format for text analysis.[13]

A corpus structure is comparable to a table with rows representing each document and

[10]For subsequent text analyses, we will be using an extensive list with bank names that are bound to reporting their balance sheets to the Deutsche Bundesbank.

[11]We manually enrich the bank list with different spellings to increase the number of entities identified by text mining.

[12]The appearance of a word type within a text is called "token".

[13]Although natural language processing (NLP) makes considerable progress in taking account of complex grammatical and semantical structures, dealing with this complexity is in its infancy–especially for the German language. For now, we consider a text as a sequence of linguistic elements consisting of words, punctuation marks, and space characters (Gentzkow et al., 2019). Additionally, each document provides meta-information such as author, date, the section within a newspaper, page number, and others. The goal is a quantitative representation of the underlying text that allows conducting statistical analyses and meaningful visualizations.

columns containing the whole text, and meta-information respectively. Based on the corpus, different algorithms can identify sentences, words, and syllables. With this information, further analyses can be conducted, like the calculation of readability measures (see Section 3.3.1) or the extraction of sentiment (Section 3.3.3).

For statistical analysis, the text needs to be transformed into a document-term matrix (DTM) $\underset{i\times j}{\boldsymbol{M}}$. The DTM is a matrix whose rows correspond to i text documents and whose columns represent the various words w_j used in the documents drawn from a set of possible words $\sum^*$ over the alphabet $\sum$ of the German language L. Each line, thus, contains a vector $\boldsymbol{w}$ of all words w^i used in this text i, where

$$L^i = \{w^i \mid w \in L\}.$$

In contrast to the corpus, the DTM is independent of the word order in the raw text. Rather, the word vector has the same structure for every document: the column names reflect appearing unique words w_j (tokens). After that, we can determine the frequency of each word form within a text. Hence, elements of $\underset{i\times j}{\boldsymbol{M}}$ are the number n of observations of word w_j in document i. Please note that the matrix can be extremely sparse as words are distributed very unequally over articles.

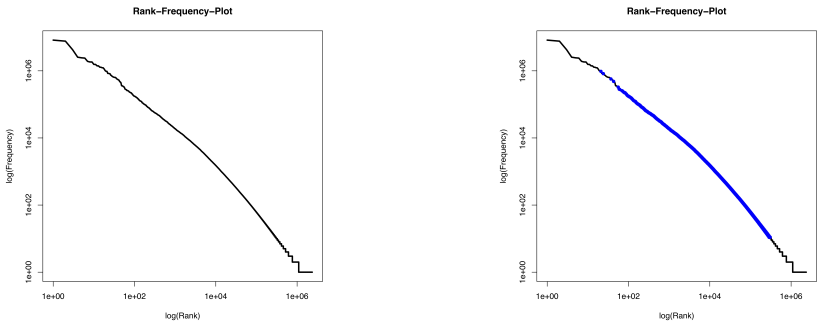
$$\underset{i\times j}{\boldsymbol{M}} = \begin{array}{c} \\ doc_1 \\ doc_2 \\ \vdots \\ doc_i \end{array} \begin{array}{c} \begin{array}{cccc} word_1 & word_2 & \dots & word_j \end{array} \\ \begin{pmatrix} n_{11} & 0 & \dots & n_{1j} \\ 0 & n_{22} & \dots & n_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ n_{i1} & 0 & \dots & n_{ij} \end{pmatrix} \end{array} \tag{3.1}$$

The only difference between the lines is the number of times a word appears. For a meaningful and computing time-efficient text analysis, some fundamental transformations of the textual data are necessary. We remove punctuation and transform all capital letters to lower cases. [14] Then, all numbers and special characters are removed as they are semantically irrelevant.

The nature of text data implies an extraordinary high dimension compared to quantitative data otherwise used in empirical economics. A document's i dimension is determined by the

[14] A computer distinguishes between capitalized and lower case letters. The machine will wrongly identify the same word as two different words if it appears at the beginning and in the middle of the sentence. Moreover, in the German language, the same term can enter a sentence as a noun and a verb, respectively. Only that in the first case, it is capitalized.

Figure 3.2: Rank-Frequency-Plot



(a) Rank-Frequency (b) Rank-Frequency-Plot with Stop Words

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations. Both figures are in log-log coordinates. The x-axis shows the rank of a word in the frequency table. The total number of the word's occurrences is displayed on the y-axis. Blue area in Panel (b) marks stop-words.

number j of words w. Thus, each document i has a unique representation with dimension w^j (Gentzkow et al., 2019).

After identifying all words and sentences, we can calculate word frequencies and then sort the resulting word list starting with the most frequent words. Each word receives a rank depending on its position, assigning low ranks to often appearing words. As is common to most languages, German word frequencies follow a power law, following approximately a Zipfian distribution, i.e., there is a linear relationship between the logarithms of a word's frequency and its rank. Panel (a) of Figure 3.2 visualizes this relationship.

There are several ways of reducing the high dimension of the DTM: Applying a "stemming"-procedure, different words can be unified based on their word stems. As a result of this, all grammatical cases and plural forms vanish such that they do not represent different words anymore. The corresponding columns in the DTM drop out, leaving only the column for the stem. Furthermore, semantically irrelevant words ("stop-words") can be removed, eliminating columns in the DTM accordingly (Feinerer et al., 2008). In Panel (b) of Figure 3.2 such stop-words are dyed blue.[15] For the analyses in this work, however, neither stemming nor removing stop-words is appropriate and is mentioned here only for the sake of completeness. Especially for the German language, stemming may lead to unwanted misperceptions due to unrecognized nouns and composited words, respectively. Instead, we will be using dictionaries that include flexions and different spellings to grasp as many word forms and entities as possible. Moreover, a word's reduction to its stem is not appropriate for calculating readability

[15]For this example, "stop-words" have been removed using the integrated German lists in the *tm* package in R (Feinerer et al., 2008). Obviously, our text data contains many words that one should include in such a list, as otherwise the line would have been dyed blue starting in the upper left corner of Panel (b) in Figure 3.2).

measures that depend crucially on word lengths. Stemming would thus alter the readability measure result (see Section 3.3.1). As for our sentiment analysis in Section 3.3.3, we will rely on dictionaries containing sentiment bearing words, including their flexions.

Finally, some pre-processing procedures are necessary to ensure good data quality. The disadvantage of broad search criteria is that they catch unrelated articles, despite the imposed restriction to economic sections. Therefore, we impose some filtering to remove sports and cultural sections, local events, and further selected terms like "sperm bank". Thus, we gather $511,582$ articles. However, some articles contain only lists of (bank) names with corresponding interest rates or stock prices but no text. Other "articles" are essentially only short statements. Such articles are not suitable for our analyses. To gather feasible articles automatically, we remove outliers below the 1st and above the 99th percentiles regarding five categories: number of words, number of sentences, average word length, average sentence length, and readability score (see section 3.3.1), respectively. This procedure ensures that only articles of reasonable length and kind remain, reducing the number of articles to $457,398$. However, this leaves us with articles that cover banks but do not necessarily refer to German banks. Thus, to ensure that only relevant articles enter our study, we identify German banks within the texts. To do so, we use a list of all German banks provided by the Deutsche Bundesbank, which is extended by possible spellings and flections. The final bank list B contains 22,434 bank names w_b representing 6,873 German banks b, where

$$B = \{w^b \mid w \in L\}.$$

For each of these banks, an individual bank ID allows mapping banks to bank types $b_{m,k}$ according to the Bundesbank's classification, such that $k \in \{\text{commercial, cooperative, savings}\}$. Additionally, we search for explicit references to bank groups b_g, where $g \in \{\text{German banks, savings banks, cooperative banks, commercial banks}\}$ and assign them explicit IDs. For further analyses, all articles i with identified banks b_m or bank types b_g are used, which are given by the intersection of the bank list B with L^i:

$$B \cap L^i = \{w \mid w \in B \wedge w \in L^i\}$$

The final data set on German banks and bank groups, respectively, contains $224,446$ articles, of which $52.75\,\%$ are from regional newspapers (see Table 3.1). Although the total number of articles is quite equal between regional and national outlets, the composition reveals significant variation: at least 17 articles in regional newspapers refer to German banks during the considered period. In contrast, a national newspaper has published at least 780 articles mentioning a German bank or bank group. Although the maximum number of articles is much closer, this makes an impact on the average number of articles that is considerably higher in

national $(17,674)$ compared to regional newspapers $(2,322)$.

Table 3.1: Number of bank-related articles per newspaper in regional and national outlets

	Number of Articles	Min	Mean	Max	Std
Regional Outlets	118,403	17	2,321.63	22,755	4,143.90
National Outlets	106,043	780	17,673.83	39,649	17,399.79
All Outlets	224,446	17	3,937.65	39,649	8,059.65

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.

3.3 Quantitative Textual Analysis of National and Regional Newspapers

3.3.1 Readability of German Daily Newspapers

Adequately informing and educating the public implies that complex information is understandable. As has been shown above, journalists adapt their presentation of information to their target audience. The other side of the story is that a highly educated person will rather read different newspapers than someone with a low education level. However, whether newspapers differ in the level of difficulty–especially within an economic context–is relatively unexplored. Although the language is hard to measure, we can apply readability measures to classify how easy or hard the text is.

Since this work focuses on private households' perceptions, we need to take at least account of the difficulty of understanding newspaper articles. Amstad (1978) describes that the used language is sometimes inappropriate, especially in daily newspapers' economic sections. In particular, the already complicated subject is unadapted to the reader, which results in either misunderstood texts or readers quitting reading altogether. One of the challenges journalists face when writing about economic issues is that they address a more or less heterogeneous audience, leading to a high uncertainty regarding the appropriate level of linguistic and content difficulty. The more, however, content difficulty exceeds the recipient's capacity, the more he will fail to decode the information.

In principle, there are two ways of evaluating a text's difficulty. First, several procedures exist where test persons (often fourth graders) read and evaluate texts. However, this is only an option if aiming to assess relatively few texts. Second, formal readability measures can be applied manually (for a reasonable number of texts) or automatically using text mining

techniques. In both cases, readability measures are derived from regression models based on empirical evaluations of text readability, allowing to estimate the degree of comprehension difficulty for new texts (Amstad, 1978). In general, readability measures can be applied to all kinds of text, as long as they are not too short and are composed of complete sentences. An additional benefit of readability formulas is their independence of content analysis.

More than 50 readability measures are available so far. The two best-known readability formulas are the Flesch Readability Ease (RE) measure, which has been developed in 1943 and revised in 1948, and the Dale-Chall formula (Dale & Chall, 1948; Flesch, 1948). Dale and Chall (1948) directly measure the degree of familiarity with any given word. They use the Dale Vocabulary list, which comprises 3,000 English words known to 80 percent of surveyed fourth graders. For a given text, they then calculate the ratio of words not contained in this list. However, such a list of familiar words is not available for the German language and cannot be simply translated due to linguistic differences (Amstad, 1978).

Therefore, Amstad (1978) identifies the Flesch's reading ease measure to be the best suited and the most efficient formula for German newspaper articles.[16] In Flesch's RE measure, several factors determine how easily a text can be understood. These factors are irrespective of sociocultural and psychological factors related to receivers of information (readers of newspapers). Instead, the focus is on formal factors that depend on the senders (journalists) only. Following Amstad (1978), most important formal factors include word-, sentence-, and text-factors: A text is harder to comprehend if it contains infrequently used words (that are not necessarily unknown words), long terms, and nested sentences, which increase the semantic and syntactic information. Particularly challenging to understand are words representing complex situations and processes.

Hence, several approaches to determining the readability of texts are possible. Though, for newspaper articles, only formal indicators based on statistical measures are manageable due to long text lengths (applying even more to enormous numbers of articles). Statistical readability measures are constructed based on factors which influence has been validated experimentally. In general, such factors measure the level of either word or sentence difficulty. They comprise word occurrence, sentence length, sentence nesting, the appearance of different words, word length, number of simple sentences, and number of propositional expressions. For computational reasons, not all established measures can be applied simultaneously. Besides, many measures are highly correlated and not independent of each other. For example, sentence length strongly correlates with sentence nesting. Hence, most readability measures rely on just two factors that gauge all relevant information (Amstad, 1978).

According to Flesch (1948) and Amstad (1978) the validity of Flesch's reading ease measure to assessing the readability of a text has been shown in different independent studies. The

[16] An excellent and extensive discussion of readability measures is provided in Amstad (1978).

revised version of the formula is based on four factors and calculated for 100 words-samples of each targeted text: The average number of words per sentence (sl), the number of syllables per 100 words (wl), the average percentage of references to 'Personal Words' (including *people* and *folks*), and the average percentage of 'Personal Sentences' that are marked by quotation marks or otherwise directly addressed to the reader (Flesch, 1948, p. 223). The regression model for estimating a text's i reading ease uses the average word length wl_i (being also an indirect measure of word complexity) and average sentence length sl_i (an indirect measure of sentence complexity) only and yields the following coefficients:

$$RE_i = 206.835 - \underbrace{0.846wl_i}_{\text{word factor}} - \underbrace{1.015sl_i}_{\text{sentence factor}} \tag{3.1}$$

For a given text, the formula estimates a score between 0 and 100, the highest score indicating that the text is understandable for a barely "functionally literate" person who has completed four years of schooling (Flesch, 1948, p. 225).

Amstad (1978) argues that the formula needs a further adjustment due to two reasons: First, even for the English language, the impact of the word factor (wf) is overrated relative to the sentence factor (sf). Moreover, German words are longer, with an estimated 1.85 syllables per word on average, whereas sentences are similarly long compared to English sentences (Amstad, 1978, p. 79). Thus, using the original formula with a higher average number of syllables would increase the word factor's overvaluation even further. Taking into account these two arguments Amstad (1978) adjusts the formula to:

$$RE_i^{FA} = 180 - 58.5wl_i - sl_i \tag{3.2}$$

This version of the Flesch formula yields values near 100 for elementary texts and close to 0 for challenging texts. For a text with average-long words and sentences, the adopted Flesch formula (RE_i^{FA}) would result in about 50 points, whereby Amstad (1978) considers a text to be of an average difficulty if it reaches between 40 and 60 points.

Now, the studies mentioned above were conducted decades ago, when no automatic text mining was possible yet. Back then, researchers had to count words and syllables manually. To reduce the workload, they used samples of 100 words per text. This limitation is not necessary nowadays. Instead, whole texts are comfortably manageable to calculate the RE_i^{FA} measure. The implementation is provided in the *koRpus R* package (Michalke, 2019) and is conducted for the whole corpus (as all available information on the raw text is needed). The procedure runs a so-called tagger first, which identifies sentences within each text. After that, an algorithm implements word hyphenation that fragments words into syllables (Liang, 1983). The calculation of the following text properties f per document (text) is then straightforward: number of sentences ns, words nw, characters nc, and letters nl; sentence to word ratio s/w,

punctuation count np, number of syllables per word $nsyl$, number of mono-syllable words $nmono$, etc. However, the RE_i^{FA} measure is based only on:

$$sl_i = \frac{nw_i}{ns_i}, \tag{3.3}$$

where sl is the average sentence length in document i that is determined by the ratio of the number of words nw_i to the number of sentences ns_i. The average word length is, therefore,

$$wl_i = \frac{nsyl_i}{nw_i}, \tag{3.4}$$

where the number of syllables $nsyl$ is divided by the number of words nw_i. Then, for each document i the RE^{FA} measure is calculated is stored as an additional meta-information that can be used for further statistical examinations.

In his analysis of German-speaking Swiss daily newspapers, Amstad (1978) finds an extensive readability spectrum, which is slightly higher for newspapers with a low print run. Nonetheless, on average, he did not find significant differences in the readability of high print run papers than those with a low print run. In a related work for American newspapers, Razik (1969) chose the Dale-Chall formula to assess differences between metropolitan and non-metropolitan newspapers' readability and found metropolitan newspapers easier readable. Both studies compare different sections' readability and find economic news consistently among the most difficult to comprehend. According to Amstad (1978), articles within this category are either challenging or even difficult to understand, reaching 35 points on average.

We apply the adjusted and adapted Flesch readability measure (RE^{FA}) to our data set. Table 3.2 presents summary statistics for general article properties as well as the RE^{FA} score. For each of the considered formal measures, the last column in Table 3.2 reports p-values of a two-sample t-test with unequal variances for the null hypothesis of no difference between the means of national compared to regional newspapers:

$$H_0 : \mu_{nat}^f = \mu_{reg}^f,$$

where μ_{nat}^f is the average of the formal article property $f \in \{$number of words, average word length, number of sentences, average sentence length, $RE^{FA}\}$ within national newspapers and μ_{reg}^f are the corresponding averages for regional papers.

With at least 51 words per article in all news sources, the requirement for sufficiently long texts is fulfilled. The minimal average sentence length of 7.68 in local and 7.67 in national newspapers, respectively, indicates reasonably long sentences as well. Compared to previous studies, bank-related articles in German newspapers are comparatively easy to understand with an average readability score of 50.35 in regional and 48.99 in national papers, respectively. However, the null is rejected at the 1% significance level, implicating that national

Table 3.2: Descriptive statistics for bank-related article properties and readability score

	Min	Median	Mean	Max	SD	p-value
Panel A: Regional outlets						
# Words	51.00	305.00	339.80	2,245.00	214.86	0.00
Average word length	5.02	5.99	6.00	7.02	0.34	0.44
# Sentences	5.00	21.00	24.09	137.00	15.72	0.00
Average sentence length	7.68	14.27	14.33	22.28	2.66	0.00
Readability RE^{FA}	31.39	50.47	50.35	66.33	7.17	0.00
Panel B: National outlets						
# Words	51.00	408.00	462.10	2,299.00	315.90	
Average word length	5.02	6.00	6.00	7.02	0.34	
# Sentences	5.00	28.00	31.62	137.00	22.04	
Average sentence length	7.67	14.70	14.79	22.28	2.62	
Readability RE^{FA}	31.39	49.02	48.99	66.33	7.13	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations. For each of the considered formal properties, the last column reports p-values of a two-sample t-test with unequal variances for the null hypothesis of no difference between the means of national compared to regional newspapers.

outlets are slightly more challenging. The reason is that they contain longer sentences on average, whereas the average word length is statistically not distinguishable between regional and national newspapers. Articles in national newspapers are also significantly longer, which does not affect the readability score, however.

3.3.2 Coverage of the Banking Industry in the Media

Media coverage refers to counts of individual events or entities. For quantitative automatic text analyses, the identification rests upon predetermined lists that contain relevant selection words (also called targets). These can include combinations of words, different spellings, and proper names. The total frequency of identified targets can then be summarized per media item (article, statement, newspaper outlet), thus measuring the degree of attention dedicated to these entities. Within an article, a bank's name may occur because it is being covered but also if the bank's analyst serves as an expert to the journalist on economic issues. The dictionary-based approach does yield a distinction between the two cases. However, we follow the argumentation in Reuter and Zitzewitz (2006, p. 201) stating that a bank's mentioning "can be viewed as proxies for the news coverage of specific funds", at least.

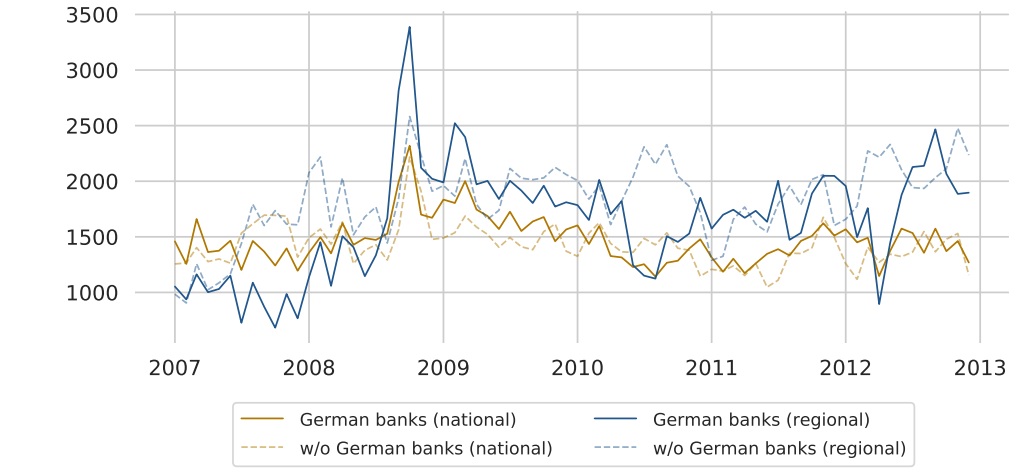
Number of articles on banks

The importance of identifying specific bank names and bank groups is demonstrated in Figure 3.3a that shows the monthly number of bank-related articles (solid lines) compared to the number of articles containing just the search terms "Bank" and "Sparkasse" (dashed lines), respectively. An article is defined as bank-related if a specific bank name or mentioning a bank type occurs. We can assign about half of the captured articles to specific banks and bank types, respectively, across all newspapers. We also see that among national media outlets, both lines are very close to each other. However, the discrepancy among regional newspapers is larger. A further and partly manual investigation into article texts reveals that the two series' detachment in regional outlets arises from totally unrelated topics. Predominantly, these address sports activities with sports players sitting on the bench ("Bank" in German) and are thus irrelevant to our analysis. We therefore conduct all further analyses using bank-related articles only. The displayed distinction between regional and national papers' coverage of German banks and bank groups (solid lines) shows that the two time series are positively correlated, with Pearson's correlation coefficient being $r = 0.72$.

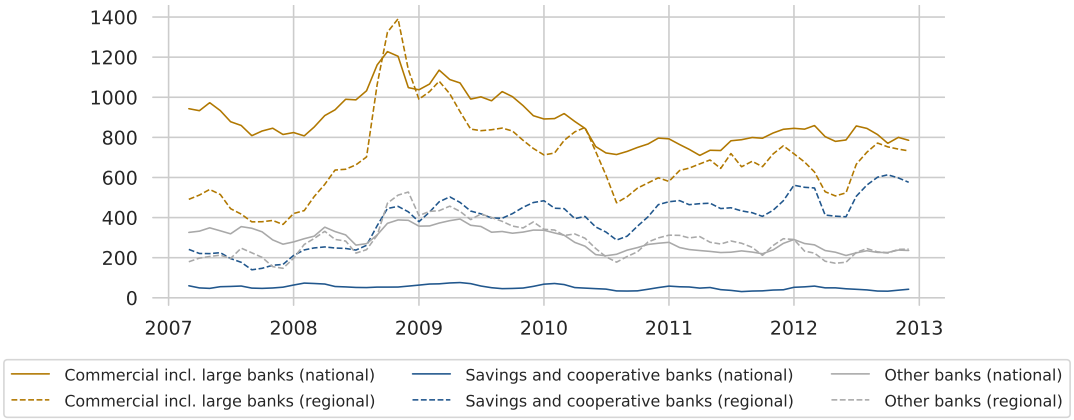
On average, national-wide newspapers dedicate around 1,500 articles per month to banks throughout the considered period. A significant increase in coverage across all newspapers can be observed in summer 2008, coinciding with Lehman Brothers' insolvency. We can see a sharp increase in coverage, starting slightly after the financial crisis outbreak in December 2007. After the announcement of the "Merkel-Steinbrück guarantee" in August 2008, protecting deposits up to 100,000 EUR by a state guarantee, coverage drops rapidly and reaches a pre-crisis level in mid-2010. However, right after that, German banks' coverage bounces back up because of the Greek government-debt crisis and the following European debt crisis. Since 2007, regional newspapers roughly doubled their bank coverage from about 750 articles per month to over 1,500 articles throughout the crisis. After mid-2010, the considered regional papers even jointly surpass national outlets on average. The similar run of the curves in different news outlets indicates that all are reporting the same external events. Nevertheless, the first impression also points to characteristic differences between regional and national newspapers. Through quantitative text analysis, we aim at revealing possible sources of differentiation. Therefore, the following section is devoted to a close analysis of the underlying structure behind bank-related articles.

The initially broad search criteria allow to capture and observe coverage of individual banks and bank types in the media. First, we investigate which bank types newspapers represent. Figure 3.3b displays the monthly number of articles that can be assigned to the three pillars of the German banking sector: commercial banks, savings banks, and cooperative banks. The similar orientation on region-promoting businesses of savings and cooperative banks (Arnold et al., 2016) becomes apparent in the media's very similar attention toward these two bank types.

Figure 3.3: Monthly coverage in regional and national media outlets (2007-2012)



(a) Bank-related coverage



(b) Coverage by bank type

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Figure 3.3 displays the number of articles captured by using a list with bank names along with their different spellings (solid lines) as compared to the number of articles captured with the broad search criteria "Bank" or "Sparkasse" only (dashed lines).

Whenever this seems appropriate, we, therefore, refrain from differentiating between these two bank types. However, the distinction between bank type coverage in regional and national newspapers points to different importance given to them. The highest number of articles in both news sources (regional and national) targets commercial banks. Whereas national papers publish monthly around 800 articles in the second half of 2007, regional outlets devote half that many articles to banks representing commercial banks during the same period. However, the financial crisis outbreak boosts the number of articles on commercial banks, peaking around November 2008 in 1,200 articles in national and 1,400 articles in regional outlets.

In contrast to commercial bank coverage, savings and cooperative banks receive signifi-

cantly less attention in regional newspapers. National media outlets, however, hardly address these two bank types at all. Concerning other bank types, we find no noticeable differences between coverage in national and regional papers, respectively.

So far, we have seen how many articles contain information on individual banks and bank types, respectively. From this, however, we cannot derive the variety of individual banks covered by the news media. The following section thus seeks to close this gap and provide insight into the number of banks we were able to identify.

Number of banks

Table 3.3 lists the number of identified banks during the considered period (2007-2012). In total, $1,514$ banks have been mentioned, with $1,129$ different banks being covered by regional and $1,129$ by national newspapers. 686 banks occur at least once in both news sources. Table 3.3 also reveals substantial differences between bank types covered by regional and national newspapers. Regional outlets focus on savings and cooperative banks, predominantly, whereas national outlets cover a significantly higher number of commercial banks. This finding is even more relevant considering that 828 banks are covered only by regional and national newspapers, respectively.

Table 3.3: Number of unique covered banks by bank type

	All Banks	Commercial	Savings	Cooperative
Total number of covered banks	1,514	218	316	403
# banks covered by regional outlets	1,129	168	259	340
# banks covered by national outlets	1,071	212	205	160
# banks in regional AND national outlets	686	162	148	97
# banks in regional outlets only	443	6	111	243
# banks in national outlets only	385	50	57	63

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.
Note: Commercial banks include large banks.

Although the total number of banks covered in either news source splits almost equally between them, the covered bank types do not. For instance, just 6 commercial banks are only covered by regional outlets. However, this is also the case for 111 savings and 243 cooperative banks, respectively. In contrast, national newspapers consider 50 commercial banks that are not covered by regional outlets. This also applies to 57 savings and 57 cooperative banks, respectively.

While the total number of banks does not differ significantly between regional and national newspapers, considerable differences come to the fore by looking at the average number of covered banks by each newspaper in Table 3.4. Among regional outlets, a newspaper mentions

103 banks, whereas 398 different banks are covered per national newspaper, on average. However, the variation is also noteworthy, with a standard deviation of 266 among national against 96 between regional newspapers. This difference reflects that national newspapers also mention more banks within an article (1.48 on average) than regional outlets (1.26 on average).

Table 3.4: Number of unique covered banks per publisher, newspaper, and article

	# Banks	per publisher	per outlet	per article
Regional outlets	1,129			
Min		8	2	1
Max		400	393	11
Mean		187.53	102.78	1.26
Std		139.49	95.81	0.61
National outlets	1,071			
Min		83	83	1
Max		660	660	11
Mean		397.83	397.83	1.48
Std		265.65	265.65	0.86
Total covered banks	1,514			
Regional AND national outlets	686			

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.

Bank-Related Statements

Compared to tweets, analyst reports, or event speeches, one of the biggest challenges when dealing with newspaper articles is that texts are relatively long and often contain multilayered information. Even if the whole article deals with one topic, it may contain many different statements regarding sources, aspects, and information evaluations. In dealing with this, we follow Rössler (2010, p. 80) by assuming that content belonging together also is located semantically close to each other. Depending on the research question, the extraction of "relevant" topics or entities can be reasonable or necessary. Balahur et al. (2010) conduct experiments on appropriate window sizes around target words that maximize sentiment analyses' accuracy. They show that computing sentiment regarding entities increases accuracy if calculated on small word windows around the respective entity instead of the whole text. This procedure has an additional advantage of focusing on specific information within the text while leaving other information unconsidered, thus reducing the DTM's high dimension. For calculations based on relevant statements, the document-term matrix contains a statement in each row instead of the whole article text.

Following this intuition, information on banks should occur in the neighborhood of bank names. We regard this neighborhood as the sentence in which the bank name or a reference to a bank group occurs, together with one preceding and one succeeding sentence. We thus extract three sentences for each bank's or bank group's occurrence that creates the bank-related statement. As each article can contain multiple statements (see Table 3.4), this procedure yields a total of $699,789$ statements, with $402,807$ statements referring to individual bank names of which $53\,\%$ are found in national newspapers.

Table 3.5 provides further insight into bank coverage by looking at the number of statements per bank. Whereas the total number of statements $(442,911)$ splits relatively equally into regional $(47\,\%)$ and national $(53\,\%)$ newspapers, the weight given to bank types differs partly substantially between the two. For instance, national newspapers dedicate $75\,\%$ of their articles to commercial banks, including large banks. In contrast, this bank type accounts for $57\,\%$ of articles in the regional media. On the other hand, savings banks are covered in only $2\,\%$ of national outlets, whereas regional papers mention savings banks in $14\,\%$ of their articles. Although cooperative banks play a minor role, they are not entirely insignificant in regional newspapers compared to their role in national bank coverage. This finding, however, needs to be put into perspective. As Table 3.5 shows, the median number of statements per bank is very low for savings, cooperative, and other banks, respectively. Overall, insights presented so far indicate that both sources of information are of equal importance.

Table 3.5: Number of statements per bank by bank group in regional and national newspapers

	N	Min	Median	Mean	Max	SD
Panel A: Regional outlets						
Commercial banks	47,716	1	13	289	8,919	992.46
Large banks	71,720	6,568	24,997	23,907	40,155	16,820.03
Savings banks	30,093	1	7	116	2,993	344.50
Cooperative banks	13,224	1	6	39	533	82.82
Other banks	46,715	1	4	129	14,446	949.56
Panel B: National outlets						
Commercial banks	96,026	1	12	459	14,714	1,723.32
Large banks	79,532	6,294	29,516	26,511	43,722	18,894.12
Savings banks	4,348	1	3	21	998	88.18
Cooperative banks	2,574	1	2	16	623	56.19
Other banks	50,963	1	4	103	11,342	729.43

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.

In the following Section 3.3.3 we will be looking at the sentiment associated with newspapers' bank coverage. Since each article can contain information on different banks and topics, as has been discussed above, all calculations are conducted on bank-related statements. Con-

sidering just statements can, however, have an impact on the evaluation of the overall texts. Dunwoody and Peters (1992) invoke significant differences in the evaluation of Chernobyl stories, depending on whether statements or whole articles are used. Evaluations, thus, diverge because semantic meta-structures[17] contained in stories are missing when content is reduced to statements. On the other hand, Balahur et al. (2010) conduct experiments for sentiment analysis in newspaper articles based on different sentiment lexicons for the English language. They emphasize the importance of identifying opinion targets for improving the accuracy of automated sentiment detection. Hence, when choosing the semantic level for the analysis, one is faced with a trade-off between statements that may influence readers' beliefs and behaviors and meta-information that may alter perceptions through the composition of the many pieces of information. These meta-structures are difficult to capture, though, and their impact is quite unexplored yet (Dunwoody & Peters, 1992, p. 204).

3.3.3 Bank-related Sentiment Analysis

In general, sentiment analysis seeks to identify positive and negative opinions, evaluations, and emotions in text (Liu, 2012; Wilson et al., 2005). Our goal is to measure bank-related sentiment in press articles.[18] The presence of highly negative sentiment may indicate current or future problems. In contrast, overly positive sentiment could point to overconfidence, especially if banks themselves communicate such evaluations (Nopp & Hanbury, 2015).

In order to extract a text's tone (alternatively labeled as sentiment, slant, and opinion, respectively), the text needs to be labeled manually, or researchers can apply automated text analysis techniques based on dictionaries that contain sentiment bearing words.[19] A list of such words comprises a sentiment lexicon or sentiment dictionary. For many languages, such dictionaries are publicly available. However, when using sentiment words, several limitations should be kept in mind.

First, the orientation of a sentiment word can be domain-specific. Loughran and McDonald (2011, 2015, 2016) discuss implications of text analysis based on dictionaries for applications in financial texts. Kearney and Liu (2014) survey methods and models of sentiment analysis in finance-related texts. Second, negation within sentences may invert the contained sentiment. For the English language, Taboada et al. (2011) present a dictionary-based approach for sentiment analysis that includes negation. Unfortunately, there is no such algorithm for the German language yet. However, Nyman et al. (2018) show that even including negation words does not significantly affect their sentiment series. The correlation between the original series

[17] With meta-structures Dunwoody and Peters (1992) describe that journalists–and news networks in general–frame risk stories differently. For a definition of the term "frame" and a discussion of how journalists frame risk stories, see Dunwoody (1992).

[18] For a comparison of different methods for opinion mining in newspaper articles see Scholz et al. (2012).

[19] Scholz and Conrad (2013) compare different dictionary-based sentiment analysis approaches.

and sentiment subject to negation is 0.99. Third, question sentences and conditional sentences that contain sentiment words do not necessarily express any sentiment. Fourth, the detection of sarcastic statements is very challenging. Fifth, sentences can contain a positive or negative sentiment or opinion without actually using sentiment bearing words (Liu, 2012).[20] Sixth, Nyman et al. (2018) point out that the identification of sentiment alone may be too vague as to allow for the deduction of behavioral reactions. They, therefore, use a dictionary that accounts for narratives bearing implications for action. Such narratives capture excitement and anxiety about potential gains and losses. Nyman et al. (2018) then focus on relative differences between the two measures and their shifts (Relative Sentiment Shift or RSS), respectively. However, their analysis bases on English texts. For the German language, such a dictionary is missing yet.

Finally, by identifying our main target (a bank or a bank type), we still do not know the context around it. This problem could be dealt with by conducting a content analysis, which, however, is not within the scope of this work. A further limitation of our approach is that it cannot differentiate between present, past, and future references (in contrast to Fogarty (2005)). For instance, if a negative opinion regarding a bank type is established, we cannot determine whether this evaluation refers to the present state, the past, or an outlook on the future. Such differentiation can only be achieved by manually coding each article and statement, respectively. Such a procedure may be feasible for a relatively small amount of stories (1,056 in (Fogarty, 2005)) but is not realizable for big data. However, we assume that the inclusion of various newspapers throughout the considered period levels out this lack of information.[21]

Given all these limitations and keeping potential implications for behavioral changes in mind, we will be focussing on differences between positive and negative sentiment. Thus, we capture the degree of emotions in German newspaper articles and shifts in the balance between positive and negative sentiment. In contrast to the dictionary in Nyman et al. (2018), we use polarity weights that provide a finer grinding and therefore a potentially more robust sentiment measure (Loughran & McDonald, 2016) provided in the publicly available German-language dictionary for sentiment analysis (*SentiWS*) (Remus et al., 2010). This lexicon contains positive and negative sentiment-bearing words and, if applicable, their inflections. We use this additional information and refrain from stemming (i.e., using only the words' stems). To distinguish between banks and bank types, respectively, we conduct our sentiment analyses based on individual bank statements, according to the assumption in the agenda-

[20] For a comprehensive discussion of many issues of dictionary-based sentiment analysis and possible solutions see Liu (2012).

[21] An extensive survey of tasks, approaches and applications for quantitative opinion mining and sentiment analysis is given in Ravi and Ravi (2015). For a survey of challenges in sentiment analyses see Hussein, 2018 and Delmonte and Pallotta, 2011.

setting literature that topic-specific terms, as well as their evaluation, occur close to each other (Fan & Tims, 1989).

Sentiment analysis thus rests upon a statement-term matrix $\boldsymbol{S}$, with rows corresponding to s statements and each statement including an individual bank ID $m \in \{1, \dots m\}$. We use a dictionary D^{sws} containing sentiment-bearing words w^{sws} from Remus et al. (2010), where

$$D^{sws} = \{w^{sws} \mid w \in L\}.$$

Calculating the sentiment for any given statement requires identifying all sentiment-bearing words within the statement and assigning the corresponding weights. Hence, we determine the intersection of $\boldsymbol{S}$ and D^{sws}. Furthermore, each sentiment word w^{sws} is assigned a polarity score $c^{sws} \in \{1, \dots c\}$:

$$c^{sws} = \begin{cases} \{c^{sws} \mid -1 \leq c^{sws} < 0\} & \text{negative tone} \\ \{c^{sws} \mid 0 > c^{sws} \leq 1\} & \text{positive tone} \end{cases}$$

Statement sentiment for bank m in outlet o is then calculated as the row sum of all polarity scores therein:

$$sent^{sws}_{m,o} = \sum_{1}^{c} c^{sws}, \quad \forall s \in \{1, \dots s\}$$

The linear combination of polarity weights yields a relative sentiment measure since positive and negative weights are included. We depart from sentiment measures used in many other studies that insert the number of terms or documents for normalization (Nyman et al., 2018, see, e.g.). We argue that normalization eliminates stronger sentiment values that result from longer texts. It seems unreasonable to do so as the length of an article and its sentiment should be positively correlated and, consequently, relevant to the reader. However, this effect diminishes if considering only statements, since they comprise three sentences per definition. Nevertheless, these sentences may differ in the number of words and hence sentiment.

Loughran and McDonald (2011) argue that finance-related dictionaries improve finance-related text analysis (e.g., earnings announcements and analyst reports). Although most of the newspaper selected for this study are not finance-oriented and do not address finance experts in the first place, we include one more dictionary D^{bpw} to our analysis. The lexicon provided by Bannier et al. (2019) aims to capture polarity in finance-related German text (in particular earning announcements and analyst reports). This dictionary has the additional advantage of containing words with a positive and negative connotation and listing terms that identify uncertainty.

$$D^{sws} = \begin{cases} \{w_s^{bpw} \mid w \in L\} & \text{tonality terms} \\ \{w_u^{bpw} \mid w \in L\} & \text{untertainty terms} \end{cases}$$

Thus, this measure may provide additional information on banks as uncertainty relates directly to risk resulting from detrimental volatility, as emphasized by Nopp and Hanbury (2015). For our analysis, however, we assume that the *SentiWS* dictionary is more appropriate due to the provided term weights and the generally non-technical language in daily newspapers (Jegadeesh & Wu, 2013). This intuition is also supported by Nyman et al. (2018), who demonstrate that their results (based on ordinary English words) are robust to excluding potentially economic terms that may have no emotional connotation. Nevertheless, the dictionary in Bannier et al. (2019) provides a precious extension to our analysis. Unfortunately, weights are not available in this dictionary. Each polarity word w_s^{bpw} is therefore assigned a weight c_s^{bpw} and uncertainty terms w_u^{bpw} a weight c_u^{bpw}, respectively:

$$c^{bpw} = \begin{cases} \{c_s^{bpw} \mid c_s^{bpw} = -1\} & \text{negative tone} \\ \{c_s^{bpw} \mid c_s^{bpw} = 1\} & \text{positive tone} \\ \{c_u^{bpw} \mid c_u^{bpw} = 1\} & \text{uncertainty term,} \end{cases}$$

where $c^{bpw} \in \{c_s^{bpw}, c_u^{bpw}\}$. Sentiment and uncertainty scores are used analogously to $sent_{m,o}^{sws}$ to calculate sentiment ($sent_{m,o}^{bpw}$) and uncertainty ($uncert_{m,o}^{bpw}$) measures, respectively, for each statement s in outlet o on bank m:

$$sent_{m,o}^{bpw} = \sum_1^c c_s^{bpw} \quad \text{and} \quad uncert_{m,o}^{bpw} = \sum_1^c c_u^{bpw}, \quad \text{respectively.}$$

The inclusion of different dictionaries in analyzing emotions and uncertainty in German newspapers adds value if they do not provide the same terms. In the case of financial texts, it may even occur that terms receive conflicting tonalities (Loughran & McDonald, 2011). The two considered dictionaries have some intersecting terms (see Figure B.1 in the Appendix); however, this applies only to a relatively small number of words. With 30,975 polarity terms, *SentiWS* provides the highest number of sentiment-bearing words, 3,354 of which are also listed as sentiment- and 306 as uncertainty-bearing words, respectively, in the *BPW*-dictionary. Surprisingly, Bannier et al. (2019) assign 334 terms to sentiment as well as uncertainty.

Panel A (Panel B) in Table 3.6 lists summary statics for sentiment (based on the *SentiWS*- and *BPW*-dictionaries) and uncertainty, respectively, calculated for whole articles and statements only in regional (national) outlets. We find that banks are evaluated more negatively in national newspapers, on average. This finding applies to both dictionaries. In contrast, the median statement-sentiment is neutral. National newspapers also associate a higher un-

certainty with banks. However, the variation of sentiment and uncertainty is higher among national outlets, too. We investigate these differences in more detail by considering monthly sentiment in Figure 3.4.

Table 3.6: Summary statistics for sentiment and uncertainty in articles and statements by news source

	Min	Median	Mean	Max	SD
Panel A: Regional outlets					
Article Sentiment (SentiWS)	-20.04	-0.47	-0.76	13.23	2.25
Statement Sentiment (SentiWS)	-4.24	0.00	-0.08	3.60	0.50
Article Sentiment (BPW)	-60.00	-2.00	-3.51	28.00	7.03
Statement Sentiment (BPW)	-10.00	0.00	-0.39	8.00	1.54
Article Uncertainty (BPW)	0.00	3.00	3.48	43.00	3.43
Statement Uncertainty (BPW)	0.00	0.00	0.41	8.00	0.69
Panel B: National outlets					
Article Sentiment (SentiWS)	-32.08	-0.84	-1.34	14.76	2.55
Statement Sentiment (SentiWS)	-4.38	0.00	-0.12	3.22	0.49
Article Sentiment (BPW)	-86.00	-3.00	-4.69	45.00	8.69
Statement Sentiment (BPW)	-12.00	0.00	-0.41	16.00	1.50
Article Uncertainty (BPW)	0.00	4.00	5.42	55.00	4.71
Statement Uncertainty (BPW)	0.00	0.00	0.50	8.00	0.76

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.

Figure 3.4 displays average *SentiWS*-sentiment contained in German newspapers on all banks operating in Germany over the period 2007-2012. Shaded arias indicate 95%-confidence intervals. On the left-hand side all calculations are conducted on whole article texts. The right-hand side presents results of the same measure, conducted on statements only. Both sub-graphs differentiate between regional (blue lines) and national (orange lines) media outlets. In Figure B.2a we find significant differences between regional and national newspapers based on sentiment-bearing terms from *SentiWS*. Throughout the whole period of observation sentiment in regional news outlets is significantly less negative than in national newspapers. This finding largely remains if we use sentiment measures based on the *BPW*-dictionary (see Figure B.2a in the Appendix). However, we can hardly distinguish between both news sources if sentiment is calculated for bank-statements (please compare Figure 3.4b and B.2b, respectively). In contrast, as shown in Figure B.2c and B.2d in the Appendix, uncertainty contained in newspapers is significantly higher in national papers' articles as well as statements. These findings suggest that on the one hand, it is indeed important to choose statements as semantic unit if we aim at comparing newspapers' reporting on banks. On the other hand, distinguishing between national and regional outlets provides meaningful additional information.

Although the sentiment and uncertainty time series seem very similar, the correlation between articles and statements is not particularly high between the two dictionaries (see Table B.1 in the Appendix). The only exception being article sentiment, where Pearson's correlation coefficient is $r = 0.74$. However, on the statement-level, it drops to $r = 0.53$, indicating that both dictionaries capture different pieces of information. Obviously, positive sentiment is associated with less uncertainty. Although, the correlation coefficients are significantly higher on measures calculated for whole articles compared to statements only. Please note that the uncertainty measure is only slightly stronger correlated with the *SentiWS*-sentiment measure ($r = -0.39$ for articles and $r = -0.09$ for statements) than with *BPW*-sentiment ($r = -0.36$ for articles and $r = -0.06$ for statements). In the following, we will therefore conduct all analyses based on the *SentiWS* dictionary. Robustness checks will include the *BPW* dictionary, though.

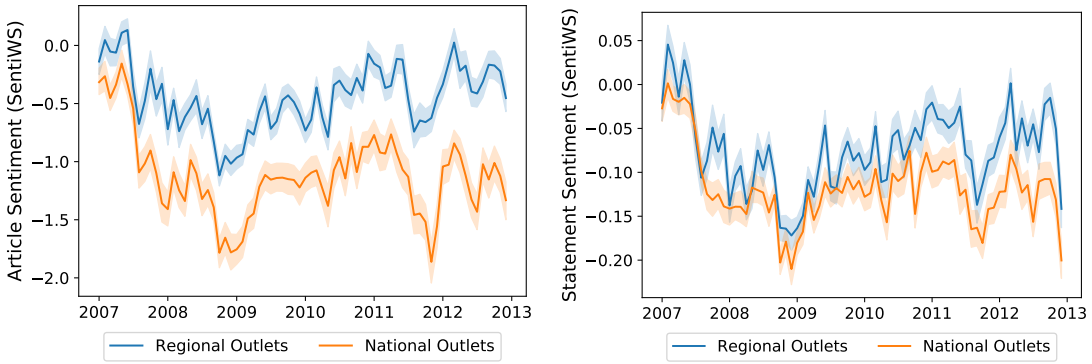
From Figure 3.4 we cannot refer whether news media outlets evaluate banks differently. Hence, Figure 3.5 presents average sentiment and uncertainty, respectively, for the three bank types that correspond to the three pillars of the German banking system. We calculate sentiment and uncertainty for statements, thus ensuring to capture information on individual banks. Here, sub-graphs on the left-hand side show statement averages with 95%-confidence intervals for regional outlets. Savings and cooperative banks are evaluated significantly more positively and are also associated with less uncertainty than commercial banks. Savings and commercial banks' sentiment even increases slightly since 2010. In contrast, newspapers view commercial banks increasingly negatively, especially around the announcement of the "Merkel-Steinbrück-guarantee" in October 2008 and other rescue measures, the implementation of a German stimulus program, and the ECB cutting interest rates. Overall we observe that statements on commercial banks drive the evolution of the sentiment and uncertainty series, respectively.[22] These, in turn, seem to be reflecting global events driving the financial system during the period of consideration quite well. Among national outlets (right-hand side of Figure 3.5) sentiment and uncertainty seem not to be significantly different across bank types. Although the overall pattern is very similar to regional newspapers.

3.4 Bank Network through the Lens of Regional and National newspapers

So far we have shown that regional and national outlets, respectively, differ in their attention and assessment of banks and bank types. This section will be focusing on the banking network we can identify through articles.

[22] Figure B.2 in the Appendix displays sentiment and uncertainty using the *BPW* dictionary.

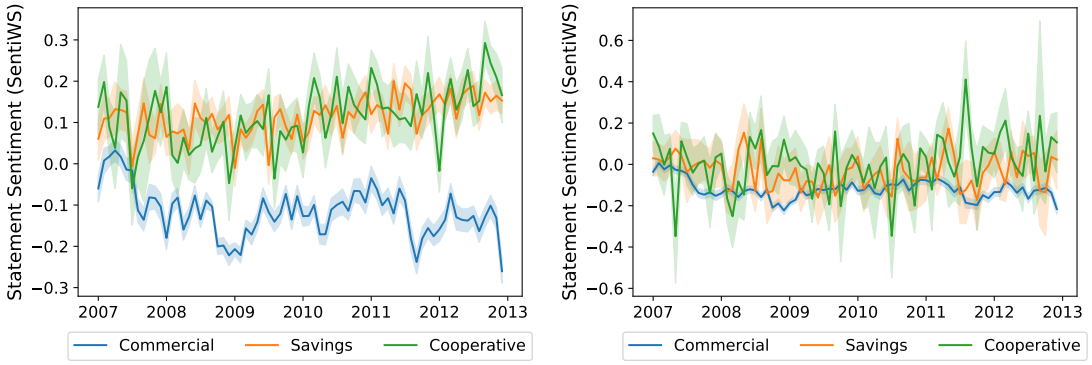
Figure 3.4: Monthly sentiment in regional and national newspapers



(a) Article Sentiment (SentiWS) (b) Statement Sentiment (SentiWS)

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Figure B.2 displays average sentiment calculated for articles and statements, respectively. Shaded areas indicate 95 %-significance intervals. Sentiment scores are calculated using the *SentiWS* dictionary in Remus et al., 2010.

Figure 3.5: Monthly sentiment by bank type in regional and national newspapers



(a) Regional outlets (b) National outlets

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Figure B.3 displays average *SentiWS*-sentiment scores for bank statements by bank type. Commercial banks include the three large banks. Shaded arias indicate 95 %-significance intervals.

We denote the set $N = \{1, \ldots, n\}$ as a set of nodes representing banks that are mentioned in articles. An undirected link $g_{ij} = g_{ji}$ is formed for articles mentioning bank i and bank j such that $ij \in g$. Nodes are assigned the following attributes: bank types k, where $k \in \{$*commercial incl. large, savings and cooperative, Landesbanken and cooperative banks' "head institutions", other banks*$\}$[23], news source $r_i \in \{$*regional, national*$\}$, and a weight w_i for the number of statements on bank i over the considered period 2007-2012. Links receive the attributes news source $r_g \in \{$*regional, national*$\}$, and average normalized *SentiWS*-sentiment

[23]For an overview of German bank types' governance models see Arnold et al. (2016).

$s_g \in [-1; 1]$. A force-directed graph drawing algorithm is applied in Figure 3.6 for representing the bank network g. To elaborate the relationship between bank types, banks of the same bank type $k_i = k_j$ are graphically pulled together by setting a community-weight w_k for a link between the two banks g_{ij}^k to

$$w_k = \begin{cases} 10 & \forall\, ij \in \{k\} \\ 1 & \text{else.} \end{cases}$$

We measure banks' connectedness by the number of links for each bank, i.e. by nodes' degrees in the network g, where a node i's degree $d_i(g)$ is

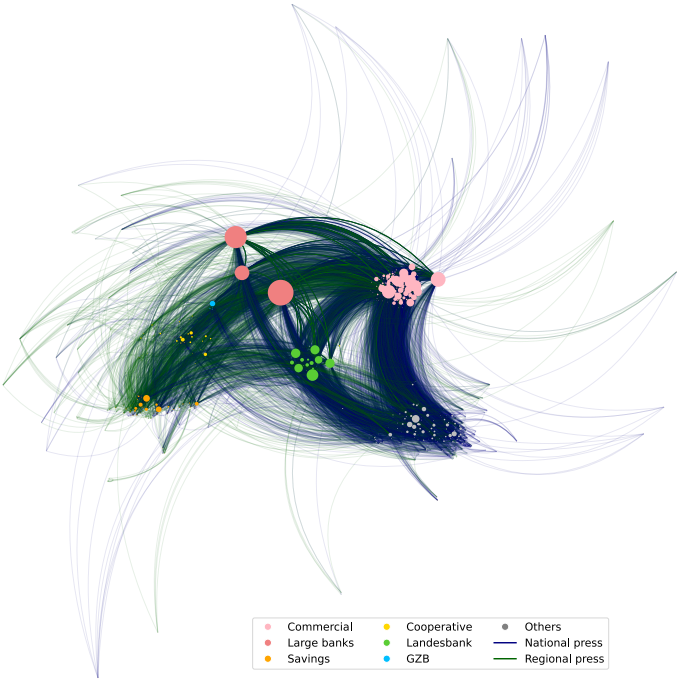
$$d_i(g) = \#\{j : g_{ij} = 1\} = \#N_i(g).$$

Figure 3.6 presents the bank network graph considering all news sources over the period 2007-2012. Banks with low degrees ($d_i < 5$) are not included as we are interested in relationships between banks and bank types in the first place. We distinguish between regional and national outlets by coloring the respective links on a range from green for a link only present in a regional outlet, to blue for observing a link in national newspapers only. Obviously, and as described above, a fraction of banks and links is innate to regional and national outlets, respectively.

The network graph not only shows which bank types are often mentioned in the same article, but also accentuates highly connected banks by letting the node size increase with degree. Apparently, at least two of the three large banks also have the highest degrees. The third large bank, however, is comparable in size to some commercial banks and Landesbanks, respectively. Interestingly, savings and cooperative banks are located close to each other, although they do not belong to the same bank type. They are also on the "green side" of the graph reflecting regional newspapers' distinct tendency to cover these bank types. Laterally reversed are "other banks" as well as commercial banks, though to a lesser extent. Newspapers devolve central positions to large banks, Landesbanken, and cooperative banks' head institutions. On average, a bank is linked to 34 other banks. The most connected banks, however, have been associated with up to 816 other banks during the considered time period. Moreover, "other" are predominantly linked to commercial and large banks, respectively, in national newspaper articles. On the other hand, regional newspapers mention cooperative and savings banks, respectively, predominantly jointly with large and commercial banks.

From Figure 3.6 some special features within regional and national bank coverage are already noticeable. Yet, each news type's contribution to informing the public becomes clearer in Figure 3.7, where we observe regional and national outlets separately. Therein, differences in the network structure between regional and national newspapers are captured given a subset

Figure 3.6: Bank network in regional and national newspapers



Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.
Note: Figure 3.6 shows the bank network extracted from banks covered in regional and national outlets. Node colors represent bank types Links' colors range from blue for articles in regional outlets only to red for articles in national newspapers only. Nodes with degree $d_i < 5$ are not displayed.

of nodes $S_{reg} \in N$ and $S_{nat} \in N$ in the network g. Let $g\,|_{S_{reg}}$ denote the network g restricted to the set of nodes covered in regional newspapers S_{reg}, such that

$$[g\,|_{S_{reg}}]_{ij} = \begin{cases} 1 & \text{if } i \in S_{reg},\ j \in S_{reg},\ g_{ij} = 1, \\ 0 & \text{else.} \end{cases}$$

Analogously, $g\,|_{S_{nat}}$ denotes the network g restricted to the set of nodes covered in national newspapers S_{nat}, so that

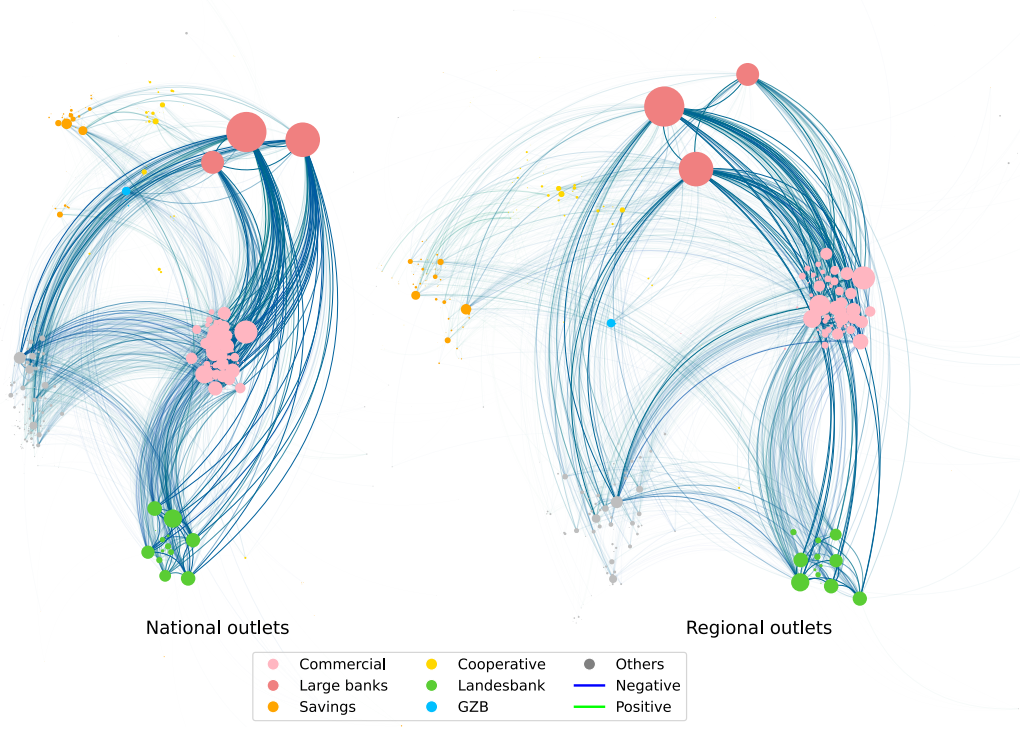
$$[g\,|_{S_{nat}}]_{ij} = \begin{cases} 1 & \text{if } i \in S_{nat},\ j \in S_{nat},\ g_{ij} = 1, \\ 0 & \text{else.} \end{cases}$$

The right-hand side in Figure 3.7 presents the network structure deduced from regional newspapers. Most striking is the largely missing link between Landesbanks and cooperative banks' central banks, and large banks. Instead, the path seems to be going through commercial banks. On the other hand, regional newspapers link savings and cooperative banks directly to their respective head institution.

National newspapers, in contrast, link these head institutions to all other bank types, including a direct link to large banks, however predominantly excluding a direct connection to

savings and cooperative banks, respectively (see left-hand side in Figure 3.7). Additionally, link color represents normalized average article sentiment scores $sg'_{ij} \in [-1;1]$. Overall, newspapers assess all banks rather negative than positive. Nonetheless, regional outlets seem to be more critical with respect to large and commercial banks compared to other bank types. Although we find negative connections there too.

Figure 3.7: Bank network through the lens of regional and national newspapers



Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Edges are colored ranging from blue (=negative) to green (=positive) according to the average normalized sentiment based on *SentiWS* $sg'_{ij} \in [-1;1]$. GZB denotes the cooperative banks' head institution (Genossenschaftliche Zentralbank).

The subset of nodes and links emerging from national newspapers in the left-hand side of Figure 3.7 reveals a strong –and negative– relationship between Landesbanks and large banks. "Other" banks predominantly have a negative sentiment, on average, if they are connected to large banks in contrast to commercial banks. On the whole, savings and cooperative banks seem to be evaluated less negative compared to other bank types across all news sources. This two bank types are also located close to each other regardless of the news source. Finally, degrees are distributed very similarly in national (left-hand side) and regional (right-hand side) newspapers, respectively. On average, banks are connected to 27 other banks in both national and local media's articles (see Figure B.4 in the Appendix).

3.5 Bias in Press Articles on Banks

Previous analyses point to differences between news media outlets, in particular those that engage largely in covering regional news compared to outlets with a national focus and distribution channel. Whether these findings, however, suggest biases among newspaper outlets is sill to be evaluated.

3.5.1 Graphical analysis

Bank type coverage

First, we compare bank groups' monthly relative coverage in regional and national outlets:

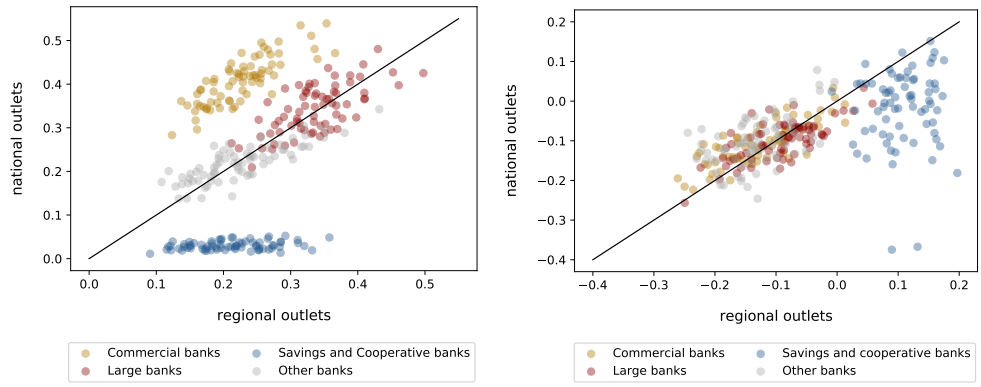
$$cov_{k,t}^{reg} = \frac{\#s_{k,t}^{reg}}{\#s_t^{reg}} \quad \text{and} \quad cov_{k,t}^{nat} = \frac{\#s_{k,t}^{nat}}{\#s_t^{nat}},$$

respectively, where $cov_{k,t}^{reg}$ denotes the number of statements ($\#s$) in regional newspapers on bank type k in month t as a ratio to the total number of statements in regional newspapers in month t ($\#s_t^{reg}$). Analogously, we calculate the monthly percentage of statements on each bank type in national newspapers $cov_{k,t}^{nat}$. In Figure 3.8a we compare the weights assigned to covering bank types in regional and national newspapers. The black line marks the 45-degree line. We find that savings and cooperative banks clearly receive more attention in regional outlets. On average, between 10 and 35 percent of all statements on individual banks in regional newspapers refer to savings and commercial banks, respectively. Commercial and other banks receive approximately the same amount of attention. Statements mentioning large banks, on the hand, account for 25 and up to 50 percent of regional statements. In contrast, national newspapers devote a larger part of their attention to commercial banks. Large and other banks' coverage, however, does not significantly differ between news outlets, on average.

Bank type sentiment

Even though news outlets do not pay the same amount of attention to all bank types, this does not imply that they also differ in banks' evaluation. We assess this aspect by comparing the average monthly sentiment towards bank types in regional newspapers $sent_{k,t}^{reg}$ with the average monthly statement-sentiment in national papers $sent_{k,t}^{reg}$. The black line in Figure 3.8b, again, indicates the 45-degree line. We find regional newspapers to show a positive bias towards savings and cooperative banks, with the monthly average statement-sentiment of these two bank types being significantly more positive than in national newspapers. Please note that sentiment averages have been calculated separately for each bank type and month.

Figure 3.8: Monthly coverage and sentiment in regional and national newspapers



(a) Coverage (b) Sentiment

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Figure 3.8a compares the monthly number of statements per bank type between relative to all bank statements in regional and national newspapers, respectively. Figure 3.8b displays the average monthly statement-sentiment score for German banks by national outlets against the average monthly sentiment score for German banks by regional newspapers. The black line indicates the 45-degree line. Sentiment scores are based on sentiment-bearing terms in *SentiWS* (Remus et al., 2010).

However, we use the same color for both bank types in Figure 3.8, because apparently newspapers view and evaluate them very similarly. While national newspapers' average sentiment ranges between 0.15 and -0.4, we find only one observation with a negative average sentiment among regional newspapers. In all other time periods, regional outlets rather use, on average, positive sentiment-bearing terms in connections with savings and cooperative banks, respectively. Commercial, large, and other banks' sentiment is, on average, not distinguishable between outlet types. However, at this point we consider all banks that have been mentioned throughout the period of observation, including banks that have been covered by regional or national newspapers only.

To shed more light on differences in sentiment, in Figure B.5 in the Appendix we focus on banks with at least twenty statements in both regional and national outlets. In particular, each subfigure displays the average statement-sentiment score for bank m by national outlets ($sent_m^{nat}$) against the average statement-sentiment score for bank m by regional newspapers ($sent_m^{reg}$). The 45-degree line visualizes unisonous evaluations ($sent_m^{nat} = sent_m^{reg}$). Over the considered period, 125 banks have been mentioned at least twenty times in both news sources. Almost half of these banks belong to the group of commercial banks (see B.5c), and 21 data points are available for commercial and cooperative banks, respectively.[24] The average statement sentiment for bank m is significantly more positive in regional than in national media B.5b. For the other bank types, however, the graphical evidence is much

[24]We do not distinguish between savings and cooperative banks here, because news outlets seem to be treating these two bank types quite equally.

less clear. Obviously, large banks' sentiment (red points in Figure B.5c) is right on the 45-degree line, indicating no ideological bias. On the other hand, observations for commercial and other banks, respectively, show a variation that does not point to unambiguous findings. We therefore proceed with formal tests for potential bias.

3.5.2 Regressions

The role of banks' location

A bank seeking to attract more customers may opt for newspaper advertising or engage in serving as information source to outlets. However, as pointed out in Mullainathan and Shleifer (2002), a bank will reveal only favorable information to promote a positive perception in the public. Which newspaper is of special interest to the bank will depend on banks' (potential) customers. In Germany, most firms as well as private households have a close relationship with their so called house bank with which they transact (Arnold et al., 2016). Usually, customers choose a nearby bank as their house bank. Hence, banks performing house banks' tasks are more likely to reach (potential) customers through a local newspaper. This can be either a regional or a national newspaper as long as the bank expects its potential customers to be reading this paper. On the other hand, the media themselves have an incentive to bias their stories to benefit advertisers (Baker, 1992; Ellman & Germano, 2009; Reuter & Zitzewitz, 2006). A regional newspaper is thereby more dependent on nearby banks compared to national outlets because of the expected stronger regional focus of regional newspapers' readers. Both arguments have a conspiring effect, that we call *customer proximity effect*. In a nutshell, we suspect regional outlets to benefit close banks stronger in comparison to national outlets, leading to our first hypothesis:

Hypothesis 1 (H1): *Regional outlets evaluate closer banks more positive than national newspapers.*

Methodologically we follow DellaVigna and Hermle (2017) and test H1 formally by estimating the following difference-in-difference model:

$$sent_{m,o} = \alpha + \beta^{CB} d_m^{CloseBank} + \beta^{RO} d_o^{RegOutlet} + \gamma^R d_m^{CloseBank} d_o^{RegOutlet} + \epsilon_{m,o}, \qquad (3.1)$$

with $sent_{m,o}$ denoting statement-sentiment on bank m in outlet o as the dependent variable. The average difference in evaluations of close banks is captured by the coefficient β^{CB}. The indicator variable CB takes the value 1 for a bank m being closely located to outlet o if its distance in kilometers is $km_{m,o} \leq 100$, and zero otherwise. We calculate $km_{m,o}$ as the air-line distance between the centers of the ZIP-code arias of bank m and outlet o, in

kilometers. The coefficient β^{RO} measures the average difference in bank sentiment in regional outlets RO compared to national newspapers. Potential bias arising from newspapers' and banks' mutual dependence on advertisement is captured by the γ^R coefficient. The standard errors are clustered at the bank level to allow for correlation of errors across multiple bank statements.

Panel A in Table 3.7 summarizes the estimation results. In the initial specification without control variables and sample restrictions (1) we find regional newspapers to assess banks more negative compared to national outlets, on average. The customer proximity effect in regional newspapers is positive and statistically significant, indicating that, on average, regional newspapers evaluate close banks more favorable that their counterpart. This finding remains after including time fixed effects (see column (2)). However, after additionally controlling for bank and outlet fixed effect, the differential effect of banks' proximity in regional newspapers becomes insignificant. Hence, we can reject our first hypothesis (H1).

For national outlets, a potential customer proximity effect would not be fully captured by the bank-newspaper distance. This is due to the fact that national newspapers' readers are not necessarily geographically close to the outlets. On the other hand, banks with either many branches or a business and governance model that is not geographically restricted, are more likely to reach their (potential) customers via national newspapers. This is why we expect the customer proximity effect to prevail in national outlets covering banks that have a high degree in the bank network. Hence, our second hypothesis is:

Hypothesis 2 (H2): *National outlets evaluate strongly connected banks more positive compared to regional newspapers.*

Hypothesis 2 translates into the following regression model:

$$sent_{m,o} = \alpha + \beta^{DB} d_m^{ConnectedBank} + \beta^{NO} d_o^{NatOutlet} + \gamma^N d_m^{ConnectedBank} d_o^{NatOutlet} + \epsilon_{m,o}, \quad (3.2)$$

where the dependent variable is again statement-sentiment on bank m in outlet o ($sent_{m,o}$). The average difference in sentiment for banks with a high degree $d_m^{ConnectedBank}$ is captured by the coefficient β^{DB}. We define that $d_m^{ConnectedBank} = 1$ if $log(d_m) > 5$, and zero otherwise. Analogously to Equation 3.1, the coefficient β^{NO} measures the average difference in bank sentiment in national newspapers as compared to regional outlets. The customer proximity effect is captured by the coefficient γ^N.

Estimation results for Equation 3.2 are displayed in Panel B of Table 3.7. The first three models yield a negative effect of a highly connected bank on its evaluation, on average. However, if the sample is restricted to banks that are covered in both regional and national outlets during the considered period (column (4)), the sign becomes positive. Across all specification, national outlets assess banks more negative, on average. The key finding here

Table 3.7: Customer proximity effect on bank sentiment $sent_{m,o}$: cross-sectional estimates

Specification	OLS regression			
Dependent variable	Sentiment score (SentiWS) for bank m in outlet o			
	(1)	(2)	(3)	(4)
Panel A: Regional Newspapers				
Indicator for close bank	0.0071	0.0068	-0.004	-0.0042
	[0.0078]	[0.0071]	[0.0109]	[0.0109]
Indicator for regional outlet	-0.0207**	-0.0169**	0.0413	0.0435*
	[0.0088]	[0.0076]	[0.0252]	[0.0262]
Indicator for close bank in regional outlet	0.1054***	0.1057***	0.0184	0.0186
	[0.0236]	[0.0228]	[0.0143]	[0.0144]
Constant	-0.1048***	-0.0277**	-0.0959***	-0.0947***
	[0.0084]	[0.0122]	[0.0205]	[0.0205]
R^2	0.01	0.01	0.04	0.04
Observations	479,260	479,260	479,260	468,509
Number of banks	1,449	1,449	1,449	677
Number of statements on close banks	80,826	80,826	80,826	71,938
Panel B: National Newspapers				
Indicator for highly connected bank	-0.1795***	-0.1767***	-0.0505***	0.1130***
	[0.0174]	[0.0174]	[0.0138]	[0.0148]
Indicator for national outlet	-0.0960***	-0.0995***	-0.0689**	-0.0710**
	[0.0121]	[0.0122]	[0.0275]	[0.0285]
Indicator for highly connected bank	0.1124***	0.1119***	0.0273**	0.0272**
in national outlet	[0.0153]	[0.0153]	[0.0113]	[0.0112]
Constant	0.0539***	0.1282***	-0.0035	-0.1636***
	[0.0117]	[0.0178]	[0.0325]	[0.0316]
R^2	0.01	0.02	0.04	0.04
Observations	479,260	479,260	479,260	468,509
Number of banks	1,449	1,449	1,449	677
Number of statements on highly connected banks	219,994	219,994	219,994	219,830
Control variables and sample restrictions				
Time fixed effects		X	X	X
Bank fixed effects			X	X
Outlet fixed effects			X	X
Exclude banks that are only covered in regional or national newspapers				X

Note: Sentiment scores are calculated using the *SentiWS*-dictionary from Remus et al. (2010) for statements in bank-related articles from *LexisNexis*, Handelsblatt, and Frankfurter Allgemeine Zeitung (FAZ). Asterisks indicate significance levels: * significant at 10%; ** significant at 5%; significant at 1%. Standard errors are clustered by bank.

is a positive and statistically significant customer proximity effect. National newspapers thus present highly connected banks on average more positive than regional outlets. We therefore cannot reject the second hypothesis (H2).

The role of bank type

That ideological biases can prevail in political news coverage has been discussed in the literature (Baron, 2006; Gentzkow & Shapiro, 2006). In their theoretical model, Mullainathan and Shleifer (2005) show that ideological bias stems from news outlets' desire to slant towards readers' opposing beliefs. Outlets thereby split the news market to match readers' beliefs. In relation to the German banking sector this potentially translates into a distinction between different kinds of prevailing bank governance models (Arnold et al., 2016), as the German banking sector comprises of three pillars. The first pillar is represented by private banks that are in private ownership. Among them are commercial banks, credit banks[25], large banks as well as regional banks. Especially in the case of large banks, private banks operate as stock-holding companies. Their primarily objective is the maximization of expected profits. In the following we will be referring to these banks as "private banks".

Savings and cooperative banks serve as the two other pillars to the German banking sector. Whereas savings banks operate under public law, cooperative banks are owned by their members. Both, savings and cooperative banks, are included in their respective financial network. For savings banks, Landesbanken act as their central banks and monitoring institutions. Similarly, two "head institution" ("Genossenschaftliche Zentralbank", GZB)[26] provide these functions for cooperative banks. Furthermore, savings and cooperative banks have in common their regional orientation. Since savings banks work under public low, they are obliged to promoting the economic welfare of the region they are located in. In contrast, cooperative banks' main objective is promoting their members' well-being. Based on the evidence in the graphical analysis (see Figure 3.8) and for the sake of convenience, in the following we subsume savings and cooperative banks, and call both "public banks".

Now, we presume that regional and national outlets attract different bank types to place advertisements or act as journalists' information source. Banks operating with a focus on regional businesses, like savings and cooperative banks, will reach their customers through regional newspapers, in the first place. These bank types will therefore have a higher incentive to increase their payoff by placing advertisement in a local newspaper. This could be even more the case considering regional newspapers' pronounced focus on covering local events. Again, as pointed out in Mullainathan and Shleifer (2002), serving as a source for bank information to a newspaper, public banks are also more likely to establish a relationship to a local outlet

[25] The terms commercial banks and credit banks are often used interchangeably.
[26] In 2016 the DZ Bank has merged with WGZ Bank.

where they will reveal only favorable information to promote a positive perception in the public and thus increase their payoff. Furthermore, national outlets' readers are more likely not to be located near the outlet. From a regionally operating bank's point of view, these outlets are therefore less suited for reaching their clients. In other words, public banks are (potential) customers to regional newspapers, and regional newspapers' readers are (potential) customers of public banks. This intuition leads to our third hypothesis:

Hypothesis 3 (H3): *Regional newspapers view savings and cooperative banks less critical compared to national outlets.*

We test Hypothesis 3 by estimating the following regression model:

$$sent_{m,o} = \alpha + \beta^{PU} d_m^{PublicBank} + \beta^{RO} d_o^{RegOutlet} + \gamma^{PU} d_m^{PublicBank} d_o^{RegOutlet} + \epsilon_{m,o}, \quad (3.3)$$

with statement-sentiment $sent_{m,o}$ remaining the dependent variable. The average difference in sentiment for public compared to private banks is captured by the coefficient β^{PU}. The coefficient β^{RO}, again, measures the differential effect of the statement being published in a regional outlet. The coefficient γ^{PU} indicates the presence of ideological bias.

Panel A in Table 3.8 presents the estimation results for Equation 3.3. Effects of the public bank indicator $d_m^{PublicBank}$ and regional regional outlets $d_o^{RegOutlet}$, respectively, are ambiguous. For the unconditional difference-in-difference model in Column (1) and after controlling for time fixed effect (Column (2)), we find a positive β^{PU} coefficient. According to that, public banks' sentiment in on average higher (or less negative) compared to private banks. However, with the inclusion of bank and outlet fixed effects in Column (3), the sign becomes negative. When banks that were covered exclusively in regional or national newspapers are excluded from the sample (Column (4)), the coefficient becomes statistically significant. Similar results, but with inverted signs, are found for the indicator of regional newspapers β^{RO}. In contrast, the key coefficient γ^{PU} remains positive and statistically significant in all specifications. This finding suggests that regional newspapers evaluate public banks more positive compared to national papers. Hence, we cannot reject Hypothesis 3.

In terms of national outlets, they might have an incentive to benefit private banks. On the one hand, private banks' activities do not aim at their geographical region. Even regional banks that used to be restricted to a certain aria, nowadays predominantly operate nationwide. From this it follows that private banks' customers cannot be found at specific regions but are more likely to be reached through nation-wide newspapers. Hence, national outlets are of more interest to private banks' advertising compared to regional papers. On the other hand, and maybe more importantly, news outlets that are ideologically biased will cater to readers beliefs (Baron, 2006; Mullainathan & Shleifer, 2005). Given that regional newspapers slant

towards savings and cooperative banks, national newspapers should be biased towards private banks. This way, outlets would be dividing the news market according to readers' opposite beliefs. From this we derive Hypothesis 4:

Hypothesis 4 (H4): *National newspapers evaluate commercial banks less negative compared to regional papers.*

To test Hypothesis 4 we run the following difference-in-difference regression:

$$sent_{m,o} = \alpha + \beta^{PR} d_m^{PrivateBank} + \beta^{RO} d_o^{NatOutlet} + \gamma^{PR} d_m^{PrivateBank} d_o^{NatOutlet} + \epsilon_{m,o}, \quad (3.4)$$

with statement-sentiment for bank m in outlet o still being the dependent variable. Now, the coefficient β^{PR} captures the difference in average sentiment of private banks compared to their counter part (savings and cooperative banks, and large banks).[27] The coefficient β^{RO} measures whether national outlets' bank assessment differs, on average, from regional newspapers. Finally, γ^{PR} captures slant towards commercial banks in national papers.

In Panel B of Table 3.8 the indicator for private banks' sentiment compared to their counter part switches signs after controlling for bank and outlet fixed effects. This corresponds to the indicator for public banks in Panel A. As already discussed in our previous descriptive analysis as well as in the estimation of Equation 3.2, bank sentiment is more negative in national newspapers, on average. This finding is statistically significant at the 1%-significance level and robust across all specifications. We also cannot reject Hypothesis 4 in face of a positive and statistically significant γ^{PR}-coefficient. National newspapers thus slant towards commercial banks with commercial banks' sentiment being, on average, more positive in national than in regional newspapers.

3.6 Summary and Conclusions

For this study nearly half a million statements on banks have been collected covering the period 2007-2012. To assess whether available bank coverage is sufficiently represented by "leading outlets" (Cook, 2005), we gather and analyze a wide range of regional and national daily newspapers. Therein contained statements refer to all bank types from almost all German regions.

This study contributes to the understanding of the media's role as a watchdog and the third pillar in banking supervision. In sum, we find all news sources to contribute to bank

[27] Large banks are not included in private banks because, similarly to savings and cooperative banks, newspapers seem to view large banks distinctive from commercial banks (see Figure 3.8a). A separate regression testing bias in national newspapers towards large banks is estimated as robustness check. When controlling for bank and outlet fixed effects, national outlets' sentiment towards large banks is found to more negative relative to regional newspapers, on average.

Table 3.8: The effect of bank i's bank type on outlet o's bank sentiment $s_{i,o}$: cross-sectional estimates

Specification Dependent variable	OLS regression Sentiment score (SentiWS) for bank m in outlet o			
	(1)	(2)	(3)	(4)
Panel A: Regional Newspapers				
Indicator for public bank	0.0873***	0.0847***	-0.0099	-0.1419***
	[0.0158]	[0.0155]	[0.0217]	[0.0085]
Indicator for regional outlet	-0.0161*	-0.0122	0.0424*	0.0445*
	[0.0086]	[0.0083]	[0.0246]	[0.0256]
Indicator for public bank in regional outlet	0.1351***	0.1355***	0.0607***	0.0607***
	[0.0187]	[0.0188]	[0.0189]	[0.0189]
Constant	-0.1031***	-0.0292**	-0.0960***	-0.0947***
	[0.0061]	[0.0121]	[0.0201]	[0.0200]
R^2	0.01	0.02	0.04	0.04
Observations	479,260	479,260	479,260	468,509
Number of banks	1,449	1,449	1,449	677
Number of statements with conflict of interest	34,405	34,405	34,405	25,415
Panel B: National Newspapers				
Indicator for private bank	-0.0984***	-0.1004***	0.0993***	0.0661***
	[0.0308]	[0.0297]	[0.0103]	[0.0042]
Indicator for national outlet	-0.0588**	-0.0605**	-0.0634**	-0.0655**
	[0.0257]	[0.0249]	[0.0295]	[0.0304]
Indicator for private bank in national outlet	0.0910***	0.0886***	0.0354***	0.0354***
	[0.0271]	[0.0260]	[0.0078]	[0.0078]
Constant	-0.0375	0.0403	-0.0438	-0.0404
	[0.0277]	[0.0301]	[0.0277]	[0.0287]
R^2	0.01	0.01	0.04	0.04
Observations	479,260	479,260	479,260	468,509
Number of banks	1,449	1,449	1,449	677
Number of statements with conflict of interest	159,179	159,179	159,179	158,063
Control variables and sample restrictions				
Time fixed effects		X	X	X
Bank fixed effects			X	X
Outlet fixed effects			X	X
Exclude banks that are only covered in regional or national newspapers				X

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.
Note: Private banks include commercial banks without large banks, and other private banks.

coverage. Moreover, regional and national newspapers not only address readers with different levels of literacy, they also focus on different bank types. Over the course of the financial crisis, newspapers have intensified bank-related coverage. Throughout the whole considered period, we were able to identify $1,546$ unique banks. It is, however, worth noting that 443 (385) of these banks were mentioned in regional (national) newspapers only.

The tone became increasingly more negative until the announcement of a state guarantee on deposits in October 2008. Overall, daily newspapers thus have followed their surveillance function. Nonetheless, we also identify biases in coverage and tone. In particular, national and regional newspapers divide the market for bank news between bank types. Whereas national outlets have a clear focus on commercial banks, savings and cooperative banks receive significantly more attention from regional newspapers. Additionally to bias through omission, we find newspapers slanting towards readers' beliefs. Regional newspapers' sentiment towards savings and cooperative banks is found to be significantly more positive (or less negative) compared to their national counterparts. The same finding holds true for national newspapers with respect to commercial banks. Moreover, the inclusion of different news types opens up a new way of looking at the bank network, because apparently national outlets link different bank types than regional newspapers. Leaving out either news source can hence alter the overall evaluation of the banking network. By including regional and national newspapers, a reader can get an unbiased perspective in the aggregate (Mullainathan & Shleifer, 2005). Thus, we can clearly reject the assumption that leading media suffice as a source of information contained in newspaper articles.

As Jansen et al. (2015) show, negative media reports can dampen trust in banks through subjective evaluations of the current and expected financial and economic situation (Knell & Stix, 2010). Related to this, research on the effects of media coverage of the real economy, notably recessions, suggests a forward-looking role of the media. We argue that the general public, at least partially, perceives bank risk and uncertainty from newspapers' coverage. Even if the media was not a strong causal factor in influencing personal risk perception, the media may affect general risk perception via increased coverage (af Wåhlberg & Sjöberg, 2000). Thus, a newspaper's negative evaluation of a bank is captured by the appearance of negatively toned terms, irrespective of appearing quantitative risk measures per se. From bank-related sentiment in newspaper articles we can therefore infer the general public's perception of banks. To what extent this is the case and bank risk perception influences behavior, is yet to be analyzed. We leave this for future research.

Chapter 4

The Informational Role of the Media in the Deposit Market

> "[. . .] [H]uman decisions affecting the future, whether personal or political or economic, cannot depend on strict mathematical expectation, since the basis for making such calculations does not exist; [..] it is our innate urge to activity which makes the wheels go round, our rational selves choosing between the alternatives as best we are able, calculating where we can, but often falling back for our motive on whim or sentiment or chance." (Keynes, 1936, p. 162 f.)

4.1 Introduction

This paper addresses depositor-imposed market discipline by explicitly modeling that banks disclose information somewhat delayed in time or incomplete (Quagliariello, 2020; Song & Wang, 2019) to the general public. In both cases, market participants have incentives to compensate for not readily available, fully disclosed, relevant information by drawing to secondary sources of information. The Basle Committee on Banking Supervision (1998) acknowledges that market participants then rely on the media to substitute for the informational gap.[1] To the best of our knowledge, this is the first investigation of the extent of bank risk information in daily newspapers and the impact of bank-related media sentiment on the behavior of depositors and banks.

Several considerations suggest a prominent role of daily newspapers in depositors' decision-making. News media are essential for spreading ideas and reducing the cost for market participants to get informed (Dyck et al., 2008; Shiller, 2016). To private depositors, media may arguably be the primary source of information. On the one hand, decision-makers use

[1] Other sources of information named by the Basle Committee on Banking Supervision (1998) are rating agencies and rumors. However, this paper aims to evaluate the media's role in market discipline.

easily accessible information more frequently, even if it were a less qualified source (O'Reilly, 1982). On the other hand, depositors lack the training to monitor banks' risk exposures based on their public disclosures (Basle Committee on Banking Supervision, 1998). Understanding the relationship between mass media and depositor behavior is vital, particularly throughout a financial crisis when information about bank safety truly matters. So far, little research exists on the impact of bank-related media sentiment on depositor behavior. Thus, this work analyzes the relationship between banks and the media and the media's role in enforcing depositor market discipline.

Because of divergent business and governance models across bank types, the German banking sector is particularly well suited for this purpose. First, recent studies for Germany on the level of trust in the media show that most of the general public trusts regional daily newspapers and public broadcasting. National-wide daily newspapers are in third place in terms of trust in the media (Jackob et al., 2019). Also, in times of crisis, when the COVID-19 pandemic led to high degrees of uncertainty in 2020, the media seems to have been able to provide guidance and information to the general public (Jakobs et al., 2021). In a cross-country comparison, Germany has a significantly higher proportion of the population that trusts "in most media most of the time" ($50\,\%$) compared to the U.S. ($34\,\%$), for instance, (Newman et al., 2018, p. 16). Assuming that private depositors have no access to (monthly) bank balance sheet data, their primary source of information regarding bank risks – especially in times of financial turmoil – is arguably newspapers' bank coverage. Hence it is likely that the type of coverage will influence depositors' perceptions and, in the end, their behavior. Thus, our main interest lies in the information on banks available to depositors in newspaper articles. Based on a survey for Germany, Arnold et al. (2014) show that households incorporate observed economic news when adjusting their savings portfolio. However, to the best of our knowledge, the role of the daily press in informing depositors has not been analyzed so far.

Second, the German banking industry rests upon three pillars that represent consisting of savings, cooperative, and private banks.[2] The corporate governance structure differs between these bank types. Firstly, most savings banks are publicly owned and are supposed to act in the interest of public welfare. Although revenues should cover costs, profit maximization is not their primary goal. Secondly, cooperative banks stand out because most of their customers also have to be members of the cooperative. As single investors, they have a share in the bank's profit. Savings and cooperative banks have in common that their business is regionally oriented. Both saving and cooperative banks receive deposits from and grant loans to mostly domestic customers. International capital market operations thus play only a minor role in their businesses. Thirdly, commercial banks, on the contrary, attract more than one-third of their deposits from abroad and focus on foreign borrowers. They are in private ownership,

[2]We use the terms private, commercial, and credit banks interchangeably.

aiming for profit maximization to increase shareholder value. All three bank types act as universal banks, offering a wide range of financial services (Gischer & Reichling, 2010), and attract almost equal shares of all private deposits in Germany.[3] For instance, in 2007, the total shares in private deposits comprised about one-third in commercial, $27\,\%$ in savings, and $22\,\%$ in cooperative banks, respectively. By 2012, commercial and cooperative banks each gained slightly in market shares to the detriment of savings and other banks (Deutsche Bundesbank, 2012).[4]

It is essential to consider that German savings and cooperative banks usually operate in regional markets (Arnold et al., 2016; Goedde-Menke et al., 2014). Therefore, our analysis must include regional and national newspapers. The structure of the German banking system requires the selection of relevant news sources from the point of view of depositors seeking to gain timely, relevant, and reliable information. Both savings and cooperative banks operate with a regional focus aiming to promote their region's welfare and depositors' welfare. The regional business focus makes regional newspapers seem more relevant as an information source to depositors.

In contrast, commercial banks' business activities extend to foreign business activities. National newspapers may thus better reach their customers. Arnold (2020) provides evidence for this kind of coverage bias in an analysis of German daily newspapers' articles on banks. The coverage bias translates into biased sentiment towards bank types. By including regional and national newspapers in our analysis, we ensure to capture as much bank-related information as possible.

According to Soo (2018), the theory of sentiment suggests that depending on the bank type, depositors may be subject to media sentiment to different degrees. For instance, we should observe a larger sentiment effect in markets with low-income depositors and greater speculation, respectively. For lack of depositor-level information and to get at least anecdotal evidence on whether we can observe differences between depositors across bank types on average, we conducted a survey. The Hamburg-BUS Survey was conducted at the University of Hamburg in 2014/15. A representative cross-section of the population in Hamburg's city (and the federal state) was interviewed via telephone on political and economic topics. Survey questions also included self-reported personality characteristics, socio-demographic background, and bank type of the bank account. Evidence from our survey suggests that savings banks have a higher ratio of low-income depositors compared to the other two bank types. On the other hand, among the three German bank groups, commercial banks suffered the most from

[3] In addition to the three bank types, specialized banks had a market share of about $17\,\%$ in 2010. We do not include specialized banks in our analyses as these are small in number, and their business model differs largely from universal banks (Kick & Jahn, 2014).

[4] Furthermore, all three bank types differ in their governance models and ownership structures. Brunner et al. (2004) provide a cross-country comparison of banking systems in Europe. Arnold et al. (2016) analyze depositor market discipline in light of Germany's different bank governance models.

the financial crisis (Gischer & Reichling, 2010). Based on these aspects, we expect to observe a larger sentiment effect for savings and commercial banks than for cooperative banks.

Having this in mind, we investigate whether bank fundamentals and depositor behavior are linked via newspaper articles. The following Section 4.2 provides an overview of related literature. After that, Section 4.3 describes the news and bank balance data. In Section 4.4.1, we investigate whether increased bank risks – as measured by balance sheet data – affect newspaper tone towards banks and bank types, respectively. The effect of sentiment on depositor behavior is analyzed in Section 4.4.2. Finally, Section 4.5 summarizes our results.

4.2 Related Literature

A large body of literature investigates whether depositors discipline banks for taking risks for which they have not been adequately compensated. Depositors are found to punish banks in the European Banking Industry (Distinguin et al., 2013; Sironi, 2003), Asian countries (Afzal et al., 2021; Hou et al., 2016), Mexico, Chile, and Argentina (Martínez & Schmukler, 1999), Russia (Karas et al., 2010; Pyle et al., 2012), and developing countries (Hadad et al., 2011; Hamada, 2011). Some work compares depositor behavior during normal times with periods of crisis (Cubillas et al., 2012; Lin et al., 2022; Martinez Pería & Schmukler, 2001).

Empirical approaches to test the existence and extent of market discipline vary, mainly depending on data availability. Some studies relate increased bank risk-taking to increased paid interest rates on deposits (Hannan & Hanweck, 1988). Other works investigate the effect of risk-taking on deposit growth rates (Hasan et al., 2013). Park (1995) estimates reduced-form equations to assess how bank risk-taking affects the equilibrium between deposits and interest rates. Building on Park's model, Arnold et al. (2016) introduce an additional measure by analyzing the effect of bank risk on the interaction of the ratio between time and sight deposits and the corresponding interest rate spread. They show that German private depositors punished banks for increased risk-taking behavior during the 2003 to 2012 period across different bank types and governance models.[5] Households' reactions to increased bank risks include reduced growth rates in deposits, shifting from long-term to short-term deposits, and demanding higher interest rates on their deposits.

The empirical investigations in the abovementioned studies primarily rely on bank-specific variables from financial reports, balance sheets, and ratings. Based on the financial information of a sample of banks from 20 emerging economies and 14 developed countries, Godspower-Akpomiemie and Ojah (2021) generate composite measures by extracting principal components of standard financial indicators. They find that their measures' association with market dis-

[5] Altunbas et al. (2011) analyze how banks' business models are related to bank risk during the financial crisis.

cipline differs between emerging economies and developed countries. Most authors thereby implicitly assume that banks provide timely and credible information that depositors incorporate (correctly) into their disciplinary behaviors. Others, like Pyle et al. (2012), explicitly mention the time lag until financial statements are available.

Several considerations suggest that additional information sources would allow for assessing depositor behaviors better. Balance sheet data published in annual reports are usually available with a substantial time lag (Rönnqvist & Sarlin, 2015). Monthly balance sheet data that banks report to supervisory institutions are not accessible to the public in general. Besides, bank balance sheets are "notoriously opaque" (Macey & O'Hara, 2003, p. 93), and (especially insured) depositors probably lack incentives and the training to interpret bank results correctly (Basle Committee on Banking Supervision, 1998). Depositors also seem not to access information provided by banks on their websites (Michal Munk & Blažeková, 2017; Munk et al., 2021). In the end, banks disclose information somewhat delayed in time or incomplete to the general public (Kozłowski, 2016; Munk et al., 2021; Quagliariello, 2020; Song & Wang, 2019). Hence, market participants must draw on secondary sources of information on banks and their risk-taking behavior to compensate for not readily available or not disclosed relevant information. The Basle Committee on Banking Supervision (1998) acknowledges that market participants then rely on news media, rating agencies, and rumors to substitute for the information gap.[6]

Based on survey data, a large body of literature studies the impact of investor sentiment on stock returns (Baker & Wurgler, 2006, 2007; Brown & Cliff, 2005; Lux, 2011). In this regard, the role of news media in influencing the assessment of economic fluctuations through narratives gains attention. Stories about businesses, people, and the (macro-) economy influence the perceptions and expectations of market participants (Shiller, 2017). In a growing body of literature, coverage and sentiment extracted from different kinds of text have been an increasingly popular source for forecasting stock markets (Antweiler & Frank, 2004; Carlini et al., 2020; Chan, 2003; Chen et al., 2014; Fang & Peress, 2009; Tetlock, 2007)[7], financial stability (Nyman et al., 2015, 2018), firm value (Dang et al., 2020), house prices (Soo, 2018), and public opinions (Blood & Phillips, 1995; O'Connor, 2010). In financial markets, "media reflects and shapes investors' and managers' expectations, which affect the supply and demand for securities as well as firms' financial policies." (Tetlock, 2015, p. 703). In their analysis of the causal effects of media on financial markets, Engelberg and Parsons (2011) find that local media coverage of financial events causes changes in investor behavior. Irresberger et al.

[6]Chen (2013) introduces a new measure to capture the extent of future orientation in languages in general. He finds that languages in which the present is grammatically linked to the future strengthen households' future-oriented behavior, thus reducing risk-taking behavior in the present. Applying this measure to banks, Osei-Tutu and Weill (2021) find increased bank risk-taking in countries with grammatically weaker associations between present and future.

[7]See Tetlock (2015) for an extensive literature review on media's role for information transmission in finance.

(2015) and Wisniewski and Lambe (2013) demonstrate the significant negative effect of crisis sentiment on banks' stock performance. Strong monitoring abilities of the media also improve the performance of government-owned banks (Ho et al., 2016). The media's causal impact is large. Nevertheless, even without a causal influence, media content can effectively represent readers' beliefs (Tetlock, 2015). In line with the role of "animal spirits" (Keynes, 1936) and the theory of "conviction narratives" (Tuckett & Nikolic, 2017), Nyman et al. (2018) show that sentiment extracted from financial texts has predictive power for consumer confidence and market volatility measures.

While the studies mentioned above rely on sentiment-bearing word lists to extract sentiment, a new growing strand of literature engages in text-based computational methods for measuring financial risk and distress. Rönnqvist and Sarlin (2015, 2017) apply a data-driven approach to detect and describe coinciding bank risks in news articles from Reuters. For this purpose, they connect news data to 243 distress events of 101 large European banks over the period 2007–2009. Their stress index detects important distress events at the individual bank and on an aggregate European level.[8] Moreover, Rönnqvist and Sarlin (2017) apply a deep learning approach that extracts excerpts from news on the respective event underlying the risk index. In a related work, Cerchiello et al. (2018) enrich the textual data with standard financial figures. They aim to improve the predictive performance of their financial risk indicator and the information content of news data compared to financial variables. Although numerical data contain more information for labeling distress events, bank distress prediction improves if financial variables are combined with textual data.

In a time-series analysis for the U.S., Wu et al. (2002) analyze the relationship between economic news coverage, the public's perception of the state of the economy, and the actual economic situation. Interestingly for our purposes, in particular during a (potential) economic downturn, people feel a greater need to consult the media about the state of the economy. Media coverage forecasts the public's perception of the current economic state, especially during economic downturns. Though in the long run, news media reflects the economic state rather than people's perceptions. This insight is in line with Nyman et al. (2018), whose results indicate that text-based measures are useful for short-term forecasting or 'now-casting', because they Granger cause survey-based consumer sentiment. In the same vein as in Baker et al. (2016), their sentiment measure predicts U.K.'s industrial production, unemployment, and the stock market. Based on text-based sentiment from local housing news media coverage for 34 U.S. cities, Soo (2018) provides further evidence for leading patterns of housing sentiment on housing price growth. Notably, from 2000 to 2014, media sentiment accounts for a substantially more significant part of house price increases than economic fundamentals.

[8]For literature on bank risk prediction using accounting data, please refer to Betz et al. (2014), Cole and Gunther (1998), and Milne (2014), for instance.

In contrast to Nyman et al. (2018), Soo's media sentiment measure lags the housing survey index, thus supporting theories that the media cater to readers' beliefs. Further analyses indicate that the media captures real-time sentiment from home buyers and reflects sentiment from all agents across the housing market.

Goidel et al. (2010) investigate the importance of different news sources for households' economic expectations in the U.S. They point out that citizens' understanding of changing economic conditions largely depends on the news sources they follow. Both regional newspapers and national television affect households' economic expectations significantly. However, current family finances and financial expectations are unrelated to national or regional newspaper coverage. They also identify no significant effects of the *New York Times* for households' economic expectations. This finding corresponds to households – at least in this sample – stating that national television is the essential news source, followed by local television and local newspapers. In this vein, based on a survey in Germany, Arnold et al. (2014) show that households incorporate observed economic news when adjusting their savings portfolio.

To private depositors, media may arguably become the primary source of information as "the news media are essential vehicles for the spread of ideas." (Shiller, 2016, p. 101) For instance, based on household surveys, Pyle et al. (2012) find that depositor behavior in Russia largely depends on access to free television channels. Besides, even sophisticated decision makers use easily accessible information more frequently, even if it is from a less qualified source (O'Reilly, 1982). Particularly throughout a financial crisis, i.e., when information about bank safety truly matters, understanding the relationship between media and depositor behavior is especially important. According to Artavanis et al. (2020) and Chen et al. (2020), depositors use two sources of information when deciding whether to withdraw their deposits. First, they incorporate signals about their bank's fundamental strength. Second, expectations of other depositors' behaviors enter into the decision-making. Still, little research has been done on the impact of bank-related media sentiment on depositor behavior.

Hasan et al. (2013) are the first to introduce negative press rumors in Reuters news service on commercial banks in transition countries as an additional source of information in their analysis of market discipline. They determine negative rumors by counting the yearly number of news items containing the terms "loss, capital injection, state aid, restructuring, or emergency" regarding the respective banks' parent company relative to all news items concerning the parent company. According to their results, depositors process information rationally, especially if rumors are correct ex post. The effect of rumors on depositor behavior is even stronger than bank fundamentals. Nopp and Hanbury (2015) investigate the opportunities of sentiment analysis in detecting risks in the banking system. By extracting sentiment scores from banks' CEO letters and outlook sections from annual reports, they can predict next year's average evolution of tier 1 capital. For the period 2007-2015, Chavaz and Slutzky (2019) track google

searches for U.K. bank names as a proxy for depositor risk perception. They find elevated google searches to correlate with increasingly negative sentiment in the media and reduced growth in current accounts. Banks respond to deteriorating bank perceptions by offering higher interest rates on deposits. The disciplining effect is stronger for uninsured deposits.

This paper adds to the literature on depositor market discipline by introducing information on banks in daily newspaper articles as a source of information for depositors. In contrast to previous studies that rely on few sources, often with a limited audience, in the English language, we use a variety of news outlets with a broad audience in the national language. By combining news data with monthly balance sheet data, we track the flow of information with contemporaneous idiosyncratic bank fundamentals. Thus, we compare newspaper evaluations with bank fundamentals and investigate how newspaper sentiment affects depositor behavior. Moreover, we address differences in media coverage and risk-taking behavior between bank types. In particular, we investigate empirically how sentiment toward specific bank types translates into changes in depositor behavior across different bank types from 2007–2012.

4.3 Data

Our analysis rests on two sources of information that cover the period 2007-2012 in Germany. On the one hand, bank balance sheet data and bank-specific interest rates provide bank and depositor behavior information, respectively. On the other hand, text analyses of daily newspaper articles allow assessing both bank-specific and banking sector sentiment by specifically extracting information on respective entities (Nyman et al., 2018).[9] We consider all bank types k representing the three pillars of the German banking sector: savings (sav), cooperative (coo), and commercial (com) banks, where $k \in \{sav, coo, com\}$.

Previous studies have shown that selecting a wide range of news sources is crucial to avoid biased results (Arnold, 2020; Kearney & Liu, 2014). Hence, our news data considers 52 regional and 5 national newspapers from the database *LexisNexis*. Additionally, we include two more national outlets (Handelsblatt and Frankfurter Allgemeine Zeitung), thus covering nearly all regions and with different audiences in Germany. We collect each article that contains the term (part) "bank" or "Sparkasse" (savings bank in German). After that, we identify individual banks within article texts (including headlines) by drawing on a list of all bank names (including different spellings and abbreviations) operating in Germany provided by the Deutsche Bundesbank. Additionally, we search for terms referring to each bank type specifically.

The sentiment analysis is conducted using a dictionary of sentiment-bearing words (*SentiWS*) from Remus et al. (2010). Even though deep learning algorithms are a linguistically more sophisticated method for extracting semantic meaning from text, they also need (often

[9] We use the terms tone and sentiment interchangeably.

manually) annotated corpora. Simple sentiment analysis based on sentiment-bearing word lists works quite well in reflecting human emotions as strong behavioral drivers (Rönnqvist & Sarlin, 2017), and therefore serves our purpose aptly. As an alternative, we also apply a dictionary (*BPW*) that has been adjusted to German financial texts from Bannier et al. (2019) that accounts for finance-specific terminology (Loughran & McDonald, 2011). However, we presume the latter dictionary to be less suited for our analyses based on three considerations: First, it does not contain polarity weights which allow a more nuanced and, therefore, potentially more robust sentiment measure compared to counting the number of sentiment-bearing terms. Second, newspaper articles' wording is less specialized than analyst reports. Third, the dictionary with ordinary words contains substantially more terms that can enter our sentiment measure. Based on these considerations, a broader dictionary seems more appropriate. Nevertheless, we also run all analyses using the dictionary from Bannier et al. (2019) and point out differences in Subsection 4.4.3.[10]

After identifying all sentiment-bearing words w^{sws} within a given article a, each sentiment-bearing word is assigned a polarity score $c^{sws} \in [-1, 1]$, indicating the degree of the word's tone. A negative (positive) score reflects a negative (positive) sentiment associated with the word. The sum of identified polarity weights for each article yields the sentiment. Several potential pieces of information from the media enter our further analyses: First, we capture information on individual banks i belonging to bank type k by using each article's sentiment score for bank i at publication date τ that lies within a month t ($BankS_{i,\tau}$). As articles may contain several banks and multiple articles may cover a bank within a month, there can be several bank articles in any month t. Since newspapers do not cover each bank monthly, we do not have news data on each bank every month. Second, for each bank type k, we differentiate between two measures for bank type sentiment: A monthly average sentiment score only based on the articles explicitly referring to the bank type k (e.g., savings banks) allows grasping news on bank types in general and thus accounting for information that potentially applies to all banks belonging to that bank type.

Additionally, we calculate the average sentiment score across all articles on individual banks i from bank type k ($BankS_{k,t}$). This captures the bank type-specific average sentiment in the news concerning any bank of bank type k. By doing so, we suppose that information regarding a given bank may propagate to other banks of the same bank type.

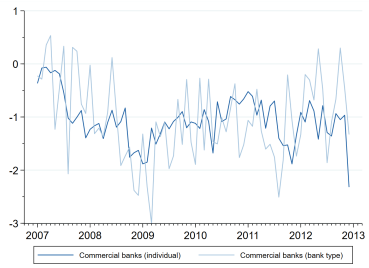
Figure 4.1 displays the monthly sentiment measures concerning bank groups. In Figure 4.1a, sentiment is aggregated across all information relevant to bank type k, thus including articles that refer to individual banks as well as to the bank type in general. Throughout the considered period, sentiment towards commercial banks is below savings and cooperative

[10] For extensive documentation and discussion of the text data collection, text mining procedures, and sentiment analysis, please see Arnold (2020).

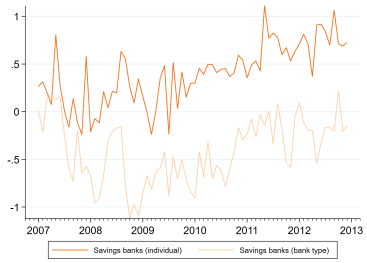
banks. In general, newspapers seem to be writing more favorably about cooperative than savings banks. While sentiment dropped substantially when the subprime crisis unfolded in August 2007 across all bank types, the tone towards savings and cooperative banks remained comparatively stable until the introduction of a government guarantee for private savings deposits in October 2008 (Deutsche Bundesbank, 2010). After that, newspapers evaluate savings and cooperative banks increasingly positively despite the European debt crisis. In contrast, sentiment regarding commercial banks followed a more prolonged downward trend until the beginning of 2009. It then recovers gradually, although we observe a sharp short-time drop at the outbreak of the Greek crisis in May 2010. On average, the intensifying sovereign debt crisis strains commercial banks in the second half of 2011. Media sentiment improved after announcing additional policy responses aimed at providing short-term liquidity and ensuring that credit lines would be maintained.[11]

Figure 4.1: Monthly average sentiment by bank type (2007-2012)

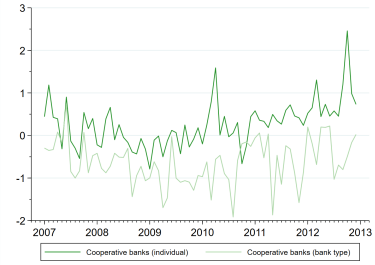
(a) Overall bank-related sentiment



(b) Commercial banks and bank type



(c) Savings banks and bank type



(d) Cooperative banks and bank type

Now, given our focus on a period of crises, we want to consider that depositors and banks may not only react to news about their bank but also about other banks or bank groups. Therefore, in Figures 4.1b-4.1d, we decompose newspaper sentiment into their average tone towards individual banks and bank types, respectively. As Figure 4.1b shows, newspaper evaluation of the bank type "commercial banks" is closely related to the average sentiment regarding individual commercial banks. In contrast, newspapers evaluate the group of "savings banks" and "cooperative banks", respectively, more negatively compared to newspapers'

[11] Please see Cour-Thimann and Winkler (2012) for an extensive discussion of the ECB's non-standard monetary policy measures.

average tone regarding individual banks of the same bank types (see Figure 4.1c and Figure 4.1d, respectively). Sentiment concerning individual banks positively relates to the respective bank-type sentiment within commercial and savings banks. Newspaper tone towards individual cooperative banks, on the contrary, is comparatively detached from their bank-type sentiment – especially after the government announced the safety of savings deposits.

Table 4.1: Correlation matrix for news sentiment across all outlets

	A	B	C	D	E	F	G	H
A. $BankS_i$	1							
B. $BankS$	0.14	1						
C. $BankS_{sav}$	0.05	0.36	1					
D. $TypeS_{sav}$	0.09	0.66	0.60	1				
E. $BankS_{coo}$	0.06	0.39	0.73	0.62	1			
F. $TypeS_{coo}$	0.06	0.43	0.22	0.57	0.34	1		
G. $BankS_{com}$	0.14	0.98	0.33	0.58	0.32	0.36	1	
H. $TypeS_{com}$	0.07	0.48	0.25	0.39	0.32	0.32	0.43	1

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung.
Note: This table shows the correlations between news variables. $BankS_i$ is the article sentiment regarding bank i in outlet o. $BankS$ is the monthly average across all bank-related articles and bank types. $BankS_k$ is the average across articles referring to individual banks belonging to bank type k. $TypeS_k$ represents monthly sentiment of articles mentioning bank type k explicitly. All sentiment measures are calculated based on the dictionary in Remus et al. (2010).

Although all sentiment measures correlate positively (see Table 4.1), newspapers distinguish their assessment of individual banks from the respective bank type. We find the strongest correlation between average bank sentiment ($BankS_{sav}$) and the corresponding bank type sentiment ($TypeS_{sav}$) for savings banks ($r = 0.6$). These two measures are related less strongly among cooperative and commercial banks. When we look at correlations between different bank types, we find that sentiment towards individual savings banks correlates positively with sentiment towards individual cooperative banks ($r = 0.73$). Average sentiment regarding individual commercial banks ($BankS_{com}$) is most strongly related to the *group* of savings banks ($TypeS_{sav}$, $r = 0.58$). In the following analyses, we need to consider that the overall average sentiment strongly correlates with article sentiment on individual commercial banks ($r = 0.98$). Apart from that, our sentiment variables are suitable for further econometric analyses in Section 4.4. Correlations based on the finance-related dictionary yield qualitatively the same result (see Table C.2 in the Appendix).

Using banks' unique identifiers, we merge all media-based sentiment measures with monthly balance sheet data and interest rate statistics that banks report within the scope of banking supervision to the Deutsche Bundesbank. The supervisory data set contains monthly panel data for 68 savings banks, 40 cooperative banks, and 21 commercial banks (including large banks) for 2007-2012. After matching news data to bank data, 17 commercial banks, 35 cooperative banks, and 62 savings banks remain in the data set. Of course, we do not have

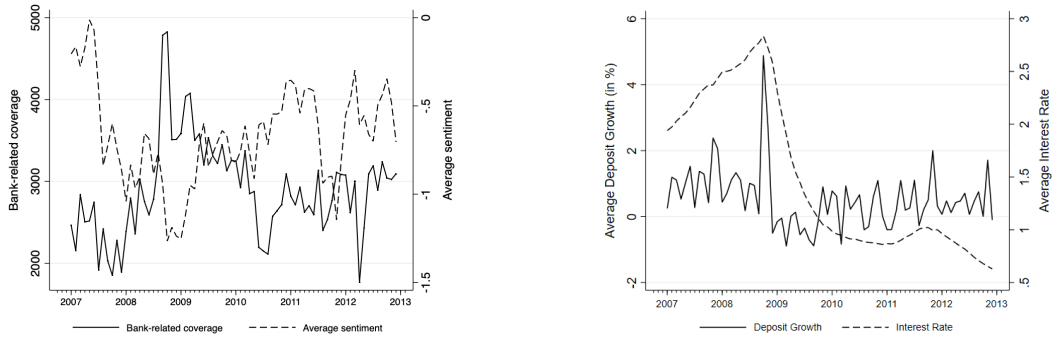
news observations for each bank and month. In order to exploit as much information in the news as possible, we follow Monteforte and Moretti (2013) and Cerchiello et al. (2018) by keeping the monthly observations constant for each bank-specific sentiment observed within the month t. Our final data set contains 111,869 bank news observations for 2007-2012, roughly $54\,\%$ of which are from regional newspapers. After merging the two data sets, most articles (92,777) concern private banks; 14,669 (4,423) articles refer to savings (cooperative) banks. The substantial differences in the number of observations available for each bank type, divergent governance models, and advertising and readership relationships indicate a separate analysis for each bank group.

We include r bank-specific monthly variables that represent banks' asset quality, capital adequacy, and risk-taking behavior ($RISK^r$): The difference between liquid liabilities (sight and time deposits) and liquid assets held by a bank, scaled by its total assets (LTG) is a measure for the liquidity transformation gap. $CREDIT$ represents the total credit volume relative to total assets and indicates to what extent banks engage in traditional lending activities. The ratio of tier 1 capital and risk-weighted assets ($Tier1$) reflects the degree of capitalization. With the natural logarithm of total assets ($SIZE$), we include a proxy for bank size. The bank-specific measures provide an insight into their role in newspaper sentiment towards banks in Section 4.4.1. Later on, we include these variables as controls in the analysis of disciplinary effects in Section 4.4.2, where we investigate the link between media sentiment and the growth rate in private households' deposits (ΔDEP) and corresponding (volume-weighted) interest rates (IR), respectively.

Additionally, we consider m important macroeconomic variables ($MACRO^m$): the monthly growth rate of the Harmonized Consumer Price Index in percent ($HICP_{gr}$), the monthly unemployment growth rate in percent (UR_{gr}), the real exchange rate (euro vs. EER-20) based on consumer price indices (base year 1999Q1) ($REALEX$), the yearly growth rate of GDP (GDP_{gr}), and the interest rate term structure approximated by the difference between the 10-year government bond yield and the 3-month Euribor rate ($IRSTRUC$).[12] Furthermore, we construct two dummy variables: $precrisis$ takes the value 1 for the months 2007/01–2007/07 to indicate the period prior to the financial crisis. Following the Bundesbank definition (Deutsche Bundesbank, 2011, p. 56), we mark the crisis's beginning with the financial market turmoil outbreak on August 9, 2007. The dummy variable PRM controls for the introduction of various rescue measures in October 2008 (Petrovic & Tutsch, 2009). Most importantly, despite (or in excess) of prevailing deposit insurance programs, the German government announces a guarantee on all deposits to the extent of Euro 100,000. Table C.1 in the Appendix gives an overview of all variable definitions.

[12] For an extensive discussion of bank-specific risk measures and their role for depository discipline across German bank types to the related study in Arnold et al. (2016).

Figure 4.2: Bank related coverage, interest rates, and deposits during the period 2007-2012



(a) Bank related coverage and sentiment (b) Interest rate and deposit growth

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations.

Figure 4.2 illustrates the monthly number of bank-related articles between 2007 and 2012 and the contained sentiment (see Figure 4.2a), and the average monthly deposit growth rate and interest rate (see Figure 4.2b). Both figures show the peak of the crisis in October 2008. Before the financial crisis outbreak, only around 4,000 articles per month covered banks. Following Lehman's collapse in September 2008, bank-related coverage reached its maximum, with almost 11,000 articles in October 2008. At the same time, we also observe the highest interest rates, on average (right y-scale in Figure 4.2b). Interest rates constantly increased until October 2008, when the ECB reduced the policy interest rate by 50 basis points (European Central Bank, 2010). On average, deposits grew by around $1\,\%$ during the first half of 2007 and started to decrease after the beginning of financial turmoil in August 2007 (left y-scale in Figure 4.2b). In October 2008, the German government announced a state guarantee on deposits for up to Euro 100,000 "to support confidence in the safety of deposits." (van Riet (ed.), 2010, p. 10) During that month, deposit growth increased to almost five percent, on average. However, apart from October 2010, deposits continued to decrease until the second half of 2009. Throughout the rest of the considered period, mean deposit growth remained slightly above zero.

4.4 Econometric Analysis

The concept of market discipline centers around banks' security holders disciplining banks that engage in excessive risk-taking behavior. In this respect, depositors play a prominent role as they hold a large proportion of bank liabilities. Following Flannery and Bliss (2019), in order for market discipline to be effective, two steps are necessary: First, market participants who fund the bank have to monitor its activities. Monitoring is efficient if depositors can collect

and assess banks' conditions correctly and timely. Second, disciplinary depositor behavior has to influence banks' risk-taking behavior. We conduct a step-wise strategy to approach our research questions in line with these considerations.

In the first step, we investigate to what extent bank-related sentiment in the media is linked to balance sheet-based risk indicators (Section 4.4.1). We then analyze the effect of media-based sentiment on households' deposit growth and corresponding interest rates, respectively, in Section 4.4.2. All specifications consider that the textual data contains months with either no or multiple observations for a specific bank. Hence, a time variable would not uniquely identify the observations, so the regression models cannot be expressed as an (accurate) panel model. However, we include multi-way fixed effects in the form of an interaction term between bank- and newspaper-specific fixed effects. By including multiple levels of fixed effects, we control for unobserved heterogeneity specific to each bank and newspaper outlet. We apply Correia's (2016) estimator that is optimized for large datasets with high-dimensional fixed effects.

For all following regression models, we adjust our media-based bank sentiment ($BankS_i$) to have a comparable measure across all articles, irrespective of their length: For each article, we divide the sentiment score of bank i at publication day τ that lies within a month t in outlet o by the number of words in the respective article and scale the resulting value into the range $[-1, 1]$. This procedure levels out differences in text lengths as articles in regional newspapers are usually shorter than in national outlets (Arnold, 2020). In all regression models, we use sentiment measures calculated based on the *SentiWS* dictionary from Remus et al. (2010). We expect this dictionary to be well-suited for non-financial texts like newspaper articles. On the other hand, bank (risk-taking) behavior and economic indicators are financial topics. Hence, a finance-specific dictionary might better capture the article tone (Loughran & McDonald, 2011). Therefore, we add to the literature on the appropriate selection of sentiment-bearing terms and run all regressions using a dictionary that has been adapted to German financial texts (*BPW*) from Bannier et al. (2019) as a robustness check. We present the results in Section 4.4.3.[13]

4.4.1 Bank Risks in the Media

This section aims to identify sentiment determinants in newspaper articles on banks. First, we test whether newspapers reflect banks' risk-taking behavior. Second, we compare sentiment towards risk-taking behavior depending on bank types.

[13] See Arnold (2020) for an extensive comparison and discussion of both dictionaries.

Does newspaper sentiment reflect bank risks?

One of the most fundamental journalistic objectives is to monitor companies, even though publishing unfavorable information can spawn negative consequences. Mandatory bank risk disclosures are one of the sources on which journalists can build their coverage. In so doing, they assess bank fundamentals and grasp qualitative information through manager tone, which at least partly explains quantitative measures of bank financial stability (Del Gaudio et al., 2020) and risk-taking (Mio et al., 2021). Moreover, to provide relevant – i.e., correct, timely, and detailed – information, journalists use their access to firm disclosures in personal communication with decision makers (Call et al., 2021). Risk-related information can thus originate both from public disclosures and direct communication, on the one hand. Overall, if the media communicates about increasing bank risks, this should be related to decreasing bank-specific sentiment.

Hypothesis 1 (H1): *Media sentiment decreases following increased bank risk.*

However, the media do not only cover banks but also stories about business, people, and maybe most often, the (macro-) economy. These narratives influence perceptions and expectations (Shiller, 2017). In particular, we include the inflation rate ($HICPgr$) as a vital economic indicator covered by the media, often citing analysts from banks. Moreover, inflation is highly related to interest rates. Other important topics covered by the media are unemployment and economic growth changes. The media will likely pick up stories indicating an increasing monthly unemployment rate in percent ($URgr$) and slowing economic growth ($GDPgr$), respectively (see also Fogarty, 2005). We also take the interest rate term structure ($IRSTRUC$) and the real exchange rate ($RealEx$) into account. We therefore expect to observe that sentiment improves with better economic conditions.

Hypothesis 2 (H2): *Media sentiment decreases following deteriorating economic conditions.*

We test H1 and H2 by estimating various versions of the following multi-way fixed effects model:

$$\begin{aligned} BankS_{i,o,\tau} = \alpha_{i,o} &+ \beta_1 CREDIT_{i,t-1} + \beta_2 LTG_{i,t-1} + \beta_3 Tier1_{i,t-1} + \beta_4 SIZE_{i,t} \\ &+ \beta_5 HICPgr_{t-1} + \beta_6 URgr_{t-1} + \beta_7 GDPgr_{t-1} + \beta_8 IRSTRUC_{t-1} + \beta_9 RealEx_{t-1} \\ &+ \gamma_1 precrisis_t + \gamma_2 PRM_t + \epsilon_{i,o,\tau}, \end{aligned} \tag{4.1}$$

where $\alpha_{i,o}$ represents fixed effects for bank i in outlet o. $BankS_{i,o,\tau}$ is standardized for each article by dividing the sentiment score of bank i at day τ that lies within a month t in outlet o

by the number of words in the respective article, and then normalized by scaling the sentiment values into the range $[-1, 1]$. The error terms $\epsilon_{i,o,\tau}$ is potentially heteroscedastic due to varying numbers of observations per bank and outlet. Thus, we use heteroscedasticity-robust standard errors in all regressions (White, 1980).

The null hypotheses corresponding to H1 is that bank risk r does not affect media sentiment ($\beta^r = 0$), with β^r denoting the estimated coefficient for the respective bank risk. Hypothesis 2 has to be rejected if we cannot reject the null of $\beta^m = 0$, where β^m is the coefficient for the macro-economic indicator m. In particular, the ratio of tier 1 capital to risk-weighted assets ($Tier1$) indicates banks' financial strength. Thus, we expect $BankS_i$ to decrease if $Tier1$ decreases ($\beta_3 > 0$), implying lower solvency and a higher need for liquidity (Acosta-Smith et al., 2019). The ratio of total loans to total assets ($CREDIT$) measures banks' involvement in traditional lending activities. Given the considered period of analysis, it is ambiguous how newspapers assessed $CREDIT$. An increase in the ratio of loans to assets indicates that a bank intensifies its traditional lending activities (Altunbas et al., 2011; Arnold et al., 2016). On the one hand, higher involvement in credit supply may be associated with low liquidity and a higher risk of default. A $\beta_1 < 0$ indicates that the media perceives increasing credit risks due to raised lending activities. On the other hand, lower loan-to-assets ratios can be evaluated as increased credit crunch risks resulting from the dry-up in the inter-bank markets (Iyer et al., 2014) or liquidity hoarding (Berrospide, 2021). If the latter considerations predominated, we would observe that $\beta_1 > 0$. An increase of LTG suggests a higher liquidity transformation gap, making a bank more vulnerable to deposit withdrawals and increasing the probability of bank failure. A negative perception of an increasing discrepancy between liquid liabilities and liquid assets corresponds to $\beta_2 < 0$. However, a positive relationship between LTG and media sentiment $\beta_2 > 0$ can also be plausible in several cases: First, a lower liquidity transformation gap also allows lower profits (Chen et al., 2020). Banks could reduce their liquidity transformation gap using additional liquidity provided by the ECB during the financial crisis. Insofar liquidity did not increase bank output, potentially withholding positive effects for the economy (Berger et al., 2022). Second, Berrospide (2021) shows that banks hoarded liquidity during the financial crisis as a precaution to expected losses. In this respect, the media could regard a reduction in liquidity transformation gaps as an indication of increased bank risk. Third, during the financial crisis (in light of mistrust in the inter-bank market), institutions with fewer customer deposits – thus having a lower liquidity transformation gap – were perceived more negatively (Altunbas et al., 2011).

Table 4.2 presents the results of several models that we derive from the following hypotheses: The publication of any given statistic – be it balance sheet data or macroeconomic indicators – refers to past periods. If media coverage incorporates this information, we should observe a time lag of at least one month. Hence, in all models, we investigate how the previous

month's bank risk indicators impact present-day's news sentiment. In Model 3, we account for economic conditions as additional explanatory variables for article sentiment. All models include the interaction between bank i and outlet o, capturing fixed effects of bank i covered in newspaper o.

Table 4.2: Effect of bank risk measures on bank sentiment

	Model 1		Model 2		Model 3	
$CREDIT_{t-1}$	0.070***	[0.014]	0.052***	[0.014]	-0.001	[0.014]
LTG_{t-1}	-0.102***	[0.016]	-0.022	[0.016]	0.049***	[0.017]
$Tier1_{t-1}$	0.122***	[0.016]	0.128***	[0.016]	0.076***	[0.020]
$SIZE_t$	-0.006***	[0.003]	0.003	[0.003]	-0.007**	[0.003]
$precrisis_t$			0.027***	[0.001]	0.024***	[0.001]
PRM_t			-0.013***	[0.002]	-0.012***	[0.002]
$HICPgr_{t-1}$					0.085	[0.062]
$URgr_{t-1}$					-0.024***	[0.007]
$GDPgr_{t-1}$					0.001***	[0.000]
$IRSTRUC_{t-1}$					0.002***	[0.000]
$RealEX_{t-1}$					0.000	[0.000]
Constant	0.211***	[0.017]	0.154***	[0.017]	0.207***	[0.019]
Observations	109,777		109,777		109,777	
adj. R^2	0.102		0.110		0.112	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations.
Note: All models include the interaction between bank i and outlet o capturing fixed effects of bank i being covered in newspaper o. Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

In Model 1, outlets' sentiment decreases with lower involvement in traditional lending activities ($CREDIT$). This finding is in line with concerns of a credit crunch during the financial crisis (Allen et al., 2014; European Central Bank, 2010). The negative association between a liquidity transformation gap (LTG) with sentiment in the media points to concerns about deposit withdrawals that would increase the probability of bank failure. The same notion holds for the tier 1 ratio, with less capitalized banks receiving a deteriorating tone in the media. Finally, the newspaper tone is more negative towards larger banks. In Model 2, we add dummy variables for the pre-crisis ($precrisis$) period and the introduction of policy rescue measures (PRM). As expected, in comparison to the average sentiment of the considered period, newspaper sentiment was, on average, higher prior to August 2008 and lower in October 2008. While the coefficient for $CREDIT$ and $Tier1$ retain their signs and significance, LTG becomes insignificant. So the dummy variables seem to capture the potential risk of deposit withdrawals. After including macroeconomic variables in Model 3, the impact of the liquidity transformation gap on newspaper tone even becomes positive at the $1\,\%$ significance level.

Newspapers thus respond negatively to a lower liquidity transformation gap during the previous month. This result suggests that newspapers reflect fears that banks will refrain from lending available liquidity to other financial institutions due to mistrust between market participants, a precautionary action against expected future losses, liquidity hoarding, and massive asset write-downs, respectively (European Central Bank, 2010; van Riet (ed.), 2010). Regardless of the estimation specification, media sentiment positively correlates with bank capitalization ($Tier1$), such that sentiment decreases when tier 1 ratios decline.

As expected, we observe that sentiment improves when the economy grows ($\beta_7 > 0$), and unemployment decreases ($\beta_6 < 0$), respectively. Surprisingly at first glance, and in contrast to Fogarty (2005), the inflation rate does not affect media sentiment. However, in a situation with central banks' policy interest rate reaching the zero lower bound and inflation (expectations) remaining low, effective real rates could not be further decreased. The risk of deflation in European countries during the period also led to concerns over an increase in the real value of debt (Blanchard, 2014). With household debt accounting for more than $90\,\%$ of gross disposable income in Germany and rising in many European countries (OECD, 2013), inflation could thus have been perceived, on average, neutrally by the press during that time. Overall, we find bank risk and macroeconomic indicators to correlate meaningfully with media sentiment.

Does media evaluation of bank risk differ in bank types?

Our descriptive analysis shows that media sentiment differs between bank types (see Figure 4.1a), with sentiment concerning commercial banks being more pessimistic than towards savings and cooperative banks. In this subsection, we analyze if these differences are related to divergent assessments of bank risk-taking behavior.

Of the three German bank groups, commercial banks suffered most from the financial crisis (Gischer & Reichling, 2010). However, besides one private bank, four Landesbanken[14] had to be rescued by the federal government (Dam & Koetter, 2012). Since most Landesbanken do not offer deposit accounts to private customers and also differ in their business model from savings banks, we exclude Landesbanken from our analyses. Differences in business models and risk exposures between bank types suggest that the media also differentiates in their sentiment towards bank groups. These consideration lead to the following hypothesis:

Hypothesis 3 (H3): *Newspapers evaluate bank risk indicators in savings banks differently than in commercial and cooperative banks.*

[14] Landesbanken combine central bank functions for savings banks with commercial bank activities. They are also the main lenders to the states in which they are located.

The media's evaluation of bank risks differs for cooperative and commercial banks from savings banks (H3), if we can reject that:

$$H_0 : \beta_3^r = 0 \quad \text{and} \quad H_0 : \beta_5^r = 0, \text{respectively,}$$

where β^r denotes the coefficient for bank risk indicator r in the following model:

$$\begin{aligned} BankS_{i,o,\tau} = \alpha_{i,o} &+ \sum_r \beta_1^r RISK_{i,t-1}^r + \beta_2 SIZE_{i,t} + COO \left[\sum_r \beta_3^r RISK_{i,t-1}^r + \beta_4 SIZE_{i,t} \right] \\ &+ COM \left[\sum_r \beta_5^r RISK_{i,t-1}^r + \beta_6 SIZE_{i,t} \right] + \sum_m \beta_7^m MACRO_{t-1}^m \\ &+ \gamma_1 precrisis_t + \gamma_2 PRM_t + \epsilon_{i,o,\tau}, \end{aligned} \tag{4.2}$$

where $BankS_{i,o,\tau}$ is the standardized and normalized sentiment score of bank i at day τ that lies within month t in outlet o. Analogously to the previous analyses, the vector $RISK$ captures banks' risk-taking behavior of month $t-1$. $SIZE$ controls for bank size, measured by the natural logarithm of total assets. The vector $MACRO$ contains the macroeconomic variables. The interaction between each risk measure r and the dummy variable COO (COM) captures differences in the effects of bank risks on media sentiment between savings and cooperative (commercial) banks. Savings banks thus serve as the reference category. The indicator variable $precrisis$ equals one for the period prior to August 2007 and is zero otherwise. The dummy variable PRM equals one for October 2008, capturing the introduction of policy rescue measures. $\epsilon_{i,o,\tau}$ is the heteroscedastic error term.

Table 4.3 provides the estimates for Equation 4.2. The media sentiment toward savings banks declines when they provide more loans. The negative relationship between $CREDIT$ and sentiment implies that increased involvement in traditional lending is associated with higher credit risks. The liquidity transformation gap has a statistically significant positive effect on media sentiment for savings banks in Model 2 and Model 3. Hence, newspapers assess savings banks with a lower difference between liquid liabilities and liquid assets to total assets more negatively. This finding corresponds to discussions about revenue-effectiveness than bank risks (Brunner et al., 2004). In all specifications, media sentiment deteriorates for less capitalized savings banks. These findings support previous evidence for a better performance of banks with more deposits and a higher tier 1 ratio during the financial crisis (Beltratti & Stulz, 2012). Finally, the media views larger banks more critically. However, bank size is only statistically significant for savings banks as long as we do not control for the pre-crisis period, the announcement of a state guarantee for deposits, and the current economic state.

A positive response of media sentiment to increasing tier 1 capital ratios is also present for commercial and cooperative banks, as the coefficient for the interaction term $Tier1 * COM$

and $Tier1 * COO$, respectively, is statistically not significantly different from zero. However, the media's reaction to the ratio of granted loans in total assets ($CREDIT$) is significantly stronger concerning commercial and cooperative banks than for savings banks at the $1\,\%$ level in Model 3. The difference to savings banks might capture discussions about credit crunch risk. There is also a statistically significant negative difference in the average effect of the liquidity transformation gap (LTG) on media sentiment for cooperative and commercial banks. The media view increases in the liquidity transformation gap as more negative for cooperative and commercial banks, respectively than concerning savings banks. However, both coefficients become insignificant when we include the vector $MACRO_{t-1}$.

Table 4.3: Differences in the effect of bank risk on media sentiment depending on bank type

	Model 1		Model 2		Model 3	
$CREDIT_{t-1}$	-0.138***	[0.042]	-0.097**	[0.042]	-0.138***	[0.043]
LTG_{t-1}	0.031	[0.036]	0.154***	[0.036]	0.190***	[0.036]
$Tier1_{t-1}$	0.158***	[0.047]	0.153***	[0.047]	0.142***	[0.049]
$SIZE_t$	-0.072***	[0.025]	-0.021	[0.025]	-0.002	[0.025]
$CREDIT_{t-1} * COO$	0.197***	[0.057]	0.147**	[0.057]	0.163***	[0.057]
$LTG_{t-1} * COO$	-0.118**	[0.048]	-0.185***	[0.048]	-0.204***	[0.048]
$Tier1_{t-1} * COO$	-0.001	[0.122]	0.060	[0.122]	0.071	[0.122]
$SIZE_t * COO$	0.114***	[0.029]	0.086***	[0.029]	0.056*	[0.029]
$CREDIT_{t-1} * COM$	0.249***	[0.045]	0.177***	[0.045]	0.153***	[0.046]
$LTG_{t-1} * COM$	-0.205***	[0.042]	-0.261***	[0.042]	-0.201***	[0.043]
$Tier1_{t-1} * COM$	-0.042	[0.051]	-0.042	[0.051]	-0.077	[0.051]
$SIZE_t * COM$	0.070***	[0.025]	0.026	[0.026]	-0.005	[0.026]
$HICPgr_{t-1}$					0.087	[0.062]
$URgr_{t-1}$					-0.023***	[0.007]
$GDPgr_{t-1}$					0.001***	[0.000]
$IRSTRUC_{t-1}$					0.002***	[0.000]
$RealEx_{t-1}$					0.000*	[0.000]
$precrisis_t$			0.028***	[0.001]	0.024***	[0.001]
MSG_t			-0.013***	[0.002]	-0.012***	[0.002]
Constant	0.217***	[0.019]	0.153***	[0.019]	0.199***	[0.021]
Observations	109,777		109,777		109,777	
adj. R^2	0.102		0.110		0.112	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations.
Note: All models include the interaction between bank i and outlet o capturing fixed effects of bank i being covered in newspaper o. Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

In a nutshell, our results indicate that bank-specific media sentiment is related to banks' risk-taking behavior. Decreasing capitalization ($Tier1$) consistently reduces media sentiment

across all bank types. We can also see clear indications that media sentiment differs significantly between bank types. The tone is pessimistic towards savings banks with smaller chances for higher profitability (LTG) and increased exposure to credit risk ($CREDIT$). However, sentiment is, on average more positive for cooperative and commercial banks that increase their lending activities than for savings banks. More significant liquidity transformation gaps receive significantly more pessimistic sentiment in cooperative and commercial banks than in savings banks. Concerning indicators of the economic state, we find that increasing unemployment, decreasing economic growth, a decreasing term structure of interest rates, and a depreciation of the real exchange rate statistically significantly reduce media sentiment.

4.4.2 The Media's Role in the Deposit Market

Building on key findings from the literature on media in corporate finance (Tetlock, 2015), we presume that media coverage correlates with depositor sentiment and is an informative measure of bank condition. In this regard, Nyman et al. (2018) find stronger Granger causality from news and broker reports to consumer sentiment than the other way around. Chavaz and Slutzky (2019) also provide evidence in support of depositors rather incorporating information from the media than in the opposite direction. Similarly, we use negative bank-related news in the media as a proxy for negative information about bank fundamentals that affect depositors. However, there is likely a link in the opposite direction so that the media may also reflect current or past depositor behavior (Tetlock, 2007). This section investigates how news sentiment affects the growth of deposits and corresponding interest rates. Our balance sheet and interest rate data allow the distinction between sight and time deposits. This information provides an opportunity to test depositor discipline in more detail.

Our empirical analysis of market discipline builds on a model for the deposit market first introduced in Park (1995). Following previous studies, we estimate two reduced form equations (Arnold et al., 2016; Martinez Pería & Schmukler, 2001; Park, 1995) that we extend to include media sentiment as an information source for bank risk. Depositor (bank) behavior is characterized by a positively (negatively) sloped supply (demand) curve for deposits.

The estimation strategy relies on rules of thumb for interpreting equilibrium values of the growth rate of deposits and interest rate, respectively. When the supply curve shifts to the right, this leads to a new equilibrium with higher deposit growth and lower deposit rates. On the contrary, lower deposit growth rates coupled with higher interest rates result from a leftward supply curve shift. The combination of increased deposit growth and higher interest rates follows from a rightward shift of the demand curve. In contrast, a leftward demand curve shift implies lower interest rates combined with lower deposit growth rates.

Concerning private depositors, the media can help attract customers by promoting opti-

mism on the one hand. In that case, positive bank-related coverage would lead to increased deposit growth rates without or despite increasing interest rates. On the other hand, by informing depositors of increased risk-taking behaviors, the media enables depositors to discipline banks. Increasingly pessimistic bank sentiment would result in reduced deposit growth with or without higher deposit rates. Thus, the media affects deposit supply and demand by reflecting and determining depositors' and managers' expectations. The previous section confirms that our media sentiment measure reflects bank risks and the current macroeconomic situation. In line with Park (1995), we may conclude that depositors exert disciplinary behavior if, as a reaction to deteriorating media sentiment, the growth rate of deposits declines while interest rates are either not affected or increase. The other side of the coin suggests that lower sentiment leads banks to increase their interest rates without increasing deposits' growth. Banks cannot attract as many deposits as they would prefer in these cases, which we interpret as a sign of market discipline. All other combinations in response to media sentiment indicate changes in the demand or supply curve that meet the preferences of both depositors and banks.

Sight deposits, time deposits, and the media

Our data set provides a unique opportunity to study the effects of media sentiment on sight and time deposits and the respective interest rates. However, decreasing growth rates of sight or time deposits may reflect a change in a bank's composition of different liabilities, which is not necessarily evidence for market discipline.[15] Therefore, we also look at the effect of negative sentiment on the equilibrium growth rate across all deposits and the corresponding value-weighted average interest rate. For depositors to discipline banks effectively, we would observe the following:

Hypothesis 4 (H4): *Deteriorating media sentiment leads to reduced deposit growth rates.*

Hypothesis 5 (H5): *Deposits rates increase following falling media sentiment.*

Depositors use two sources of information when deciding whether to withdraw their deposits. First, they incorporate signals about their bank's fundamental strength. Additionally, they consider expectations about the behavior of other depositors (Artavanis et al., 2020; Chen et al., 2020). When depositors cannot observe actions from others directly, expectations regarding the behavior of others are of particular importance (Kiss et al., 2022). Hence, the reduced-form regression model incorporates these considerations by including bank-related information extracted from newspaper articles.

[15] A higher interest rate spread between sight and time deposits or a lower time-to-sight deposit ratio following negative information on banks would point to indirect market discipline (Arnold et al., 2016; Flannery & Bliss, 2019).

In particular, we consider individual news about bank i in outlet o to capture signals about that bank's fundamental health. We take all days during the previous month *t-1* into account with observations for bank i ($BankS_{i,o,\tau-1}$). Here and below, the subscript τ*-1* is a shortcut symbol for all days during the previous month. To measure available signals regarding other banks and bank groups, we include the previous month's overall media sentiment $BankS_{t-1}$ (average bank- as well as bank type-related sentiment over all banks and bank types) in our regression model. Thus, $BankS_{t-1}$ is a proxy for the systemic risk in the banking sector that could enhance panics in times of a banking crisis (Goldstein, 2013) and $BankS_{i,o,\tau-1}$ is a proxy for idiosyncratic risk. Similar to Chen et al. (2020), we expect depositors to respond more strongly to negative sentiment regarding the banking sector than to idiosyncratic shocks to bank i. However, it is essential to note that $BankS$ is dominated by sentiment regarding commercial banks, as the media covers private banks far more often than the other two bank types. Furthermore, we include the ratio of loans to total assets ($CREDIT$), the liquidity transformation gap (LTG), and the ratio of tier 1 capital to risk-weighted total assets ($Tier1$) to account for bank fundamentals that are known to have strong predictive power for bank distress (Cerchiello et al., 2018).

Our estimation strategy follows Monteforte and Moretti (2013), who find models with daily instead of monthly variables to reduce forecasting errors. Therefore, we specify our regression model to exploit our data's high-frequency structure fully. In particular, similar to Cerchiello et al. (2018), we match our media sentiment for bank i at publication day τ that lies within a month t in outlet o to monthly indicators by keeping the latter constant for each time τ during the month t. We estimate multi-way fixed effects models to test whether the media entails depositors to discipline banks. This specification allows for possible fixed effects between news outlets and individual banks. Depositors, too, may have preferences for specific newspapers as their information source. Not to mention the relationship between depositors and their main bank.[16]

Hence, our regression model is based on two reduced-form equations: Equation 4.1a represents the impact of bank-related media sentiment on the equilibrium value of households' deposit growth. Equation 4.1b estimates how media sentiment affects the equilibrium interest rate. Following Soo (2018), we expect sentiment to lead actions across all agents in the market for deposits. This approach also corresponds to models of limited investor attention that lead to slightly delayed responses of market prices to linguistic information contained in the media (Tetlock, 2015).

We estimate multi-way fixed effects models for each type of liability (ΔDEP, where $DEP \in$ {sight deposits, time deposits, total deposits}) to test Hypothesis 4. The second reduced-form

[16] For a discussion of differences in relationships between customers and banks in Germany, please see Arnold et al. (2016).

equation for the corresponding deposit rate ($IR \in$ {sight deposit rate, time deposit rate, the volume-weighted average interest rate between sight and time deposits}) tests Hypothesis 5:

$$\Delta DEP_{i,t} = \alpha_{i,o} + \beta_1 BankS_{i,o,\tau-1} + \beta_2 BankS_{t-1} + \sum_r \beta_3^r RISK_{i,t-2}^r + \beta_4 SIZE_{i,t-1} + \sum_m \beta_5^m MACRO_t^m + \beta_6 precrisis_{t-1} + \beta_7 PRM_{t-1} + \epsilon_{i,o,\tau} \quad (4.1a)$$

$$IR_{i,t} = a_{i,o} + b_1 BankS_{i,o,\tau-1} + b_2 BankS_{t-1} + \sum_r b_3^r RISK_{i,t-2}^r + b_4 SIZE_{i,t-1} + \sum_m b_5^m MACRO_t^m + b_6 precrisis_{t-1} + b_7 PRM_{t-1} + \omega_{i,o,\tau} \quad (4.1b)$$

where β_1 (b_1) captures the estimated average effect of bank i's sentiment in outlet o at day τ-*1* that lies within month *t-1* on the bank-specific growth rate of household deposits ΔDEP (the corresponding interest rate IR) in month t. Therefore, β_1 and b_1, respectively, measure the response of ΔDEP and IR to article sentiment concerning bank i during month *t-1*. We test the null hypothesis that $\beta_1 = 0$ and $b_1 = 0$, respectively. Depositors reducing their supply with deposits as a reaction to negative information on their bank corresponds to $\beta_1 > 0$. If a bank increases deposit rates following deteriorating sentiment on its bank in the media, we would observe $b_1 < 0$. Including $BankS_{t-1}$ into the regression model allows us to capture the reactions of the equilibrium deposit growth rate and interest rate, respectively, to sentiment regarding the banking sector. A declining media tone towards banks, in general, has disciplinary effects if can reject the null of $\beta_2 = 0$ and $b_2 = 0$, and find that $\beta_2 > 0$ and $b_2 < 0$, respectively.

Moreover, we include balance sheet bank risk measures $RISK_{i,t-2}^r$ as control variables for quantitative information on bank risk-taking and capitalization not contained in the media. Further control variables are the natural logarithm of total assets as a proxy for bank size during the month of the respective media sentiment $SIZE_{t-1}$, and macroeconomic indicators $MACRO_t^m$. Note that the inclusion of $IRTERM$ approximates the interest rate term structure and accounts for the inter-bank market's impact on deposit rates. Additionally, we include the dummy variables $precrisis$ and PRM. $\epsilon_{i,o,\tau}$ and $\omega_{i,o,\tau}$, respectively, are the heteroscedastic error terms.

Panel A (B) in Table 4.4 presents the impact of media sentiment on sight (time) deposits. In Panel C, we aggregate all bank-specific household deposits and calculate a volume-weighted average interest rate on time deposits and sight deposits. We find that deteriorating bank-related individual sentiment $BankS_{i,o,\tau-1}$ leads to increased growth rates of sight deposits. The negative coefficient for the corresponding interest rate becomes insignificant in the models containing macroeconomic and bank risk controls (Model 2 and Model 3). A decline in overall bank-related sentiment ($BankS$) leads to higher interest on sight deposits. When we

Table 4.4: Impact of media sentiment on deposit growth and corresponding interest rate

	Model 1		Model 2		Model 3	
	ΔDEP	IR	ΔDEP	IR	ΔDEP	IR
Panel A: Sight deposits						
$BankS_{i,o,\tau-1}$	-0.857***	-0.070***	-0.306*	-0.014	-0.447**	-0.004
	[0.181]	[0.018]	[0.179]	[0.010]	[0.177]	[0.009]
$BankS_{t-1}$			-0.239***	-0.076***	0.093*	-0.047***
			[0.062]	[0.003]	[0.048]	[0.004]
adj. R^2	0.013	0.493	0.040	0.846	0.082	0.866
Observations	109,696	109,696	109,696	109,696	108,147	108,147
Panel B: Time deposits						
$BankS_{i,o,\tau-1}$	2.338***	-0.308***	1.067***	-0.021	1.323***	-0.021
	[0.301]	[0.036]	[0.283]	[0.015]	[0.278]	[0.014]
$BankS_{t-1}$			-0.359***	-0.075***	0.481***	-0.043***
			[0.123]	[0.006]	[0.116]	[0.005]
adj. R^2	0.043	0.286	0.161	0.869	0.205	0.883
Observations	109,696	109,696	109,696	109,696	108,147	108,147
Panel C: All deposits						
$BankS_{i,o,\tau-1}$	0.259**	-0.255***	-0.044	-0.037***	-0.059	-0.040***
	[0.124]	[0.032]	[0.120]	[0.013]	[0.119]	[0.012]
$BankS_{t-1}$			0.063	-0.084***	0.093*	-0.047***
			[0.048]	[0.005]	[0.048]	[0.004]
adj. R^2	0.022	0.258	0.093	0.865	0.121	0.900
Observations	109,696	109,696	109,696	109,696	108,147	108,147
$precrisis_{t-1}$	x	x	x	x	x	x
PRM_{t-1}	x	x	x	x	x	x
$MACRO_t$			x	x	x	x
$RISK_{t-2}$					x	x

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. $BankS_i$ is the articles sentiment regarding bank i in outlet o. $BankS$ is the monthly average across all bank-related articles and bank types. The constant is not reported.

control for bank fundamentals, the negative coefficient from Model 2 turns positive, indicating that sight deposit growth slows down following increasingly negative media sentiment. This combination points to disciplining depositor behavior following decreasing media sentiment resulting in an equilibrium with higher interest on sight deposits and lower sight deposit growth. We find a clear market discipline signal for time deposits (Panel B). Decreasing sentiment regarding individual banks ($BankS_{i,o,\tau-1}$) leads to lower time deposit growth rates. However, the corresponding interest rate only increases following a more pessimistic tone towards banks in general. When we include bank fundamentals, the coefficient for the time deposit growth rate turns positive at the $1\,\%$ level. Finally, considering all deposits and the volume-weighted interest rate in Panel C, a decreasing bank-specific sentiment in the media leads to higher equilibrium interest on deposits. In contrast, the deposit growth rate is not affected. Deposit rates also increase following a decline in overall bank-related sentiment. In Model 3, lower $BankS$ correlates positively with deposit growth at the $10\,\%$ level.

Overall, depositors discipline banks as a reaction to falling sentiment towards banks. After controlling for the current macroeconomic state and quantitative measures for bank risk-taking behavior and financial strength, our results indicate that media sentiment contributes to market discipline. The significant effect of media sentiment shows that the media contains new information. Following decreasing bank-specific sentiment ($BankS_{i,o,\tau}$), depositors seem to shift from time to sight deposits, which is a more subtle form of market discipline (Arnold et al., 2016). The growth rate of total household deposits is not statistically significantly affected, but banks increase their volume-weighted interest rate. A reduction in general bank-related sentiment leads to clear disciplinary behavior resulting in lower deposit growth and higher deposit rates. The average media sentiment ($BankS_t$) has a stronger impact on the growth rate of time deposits than on sight deposits. In contrast, the responses of the respective interest rate do differ significantly.

Several factors give reasons for time deposits being subject to stronger disciplinary behavior than sight deposits. First, depositors can withdraw their sight deposits without notice and thus threaten a bank's financial stability in case of a bank run (Baron et al., 2021). Flannery and Bliss (2019) point out that the mere threat of such a severe effect might deter banks from taking excessive risks in the first place. In this case, we would not be able to observe disciplinary effects empirically. Second, we should consider that, theoretically, insured depositors have neither the incentives nor adequate knowledge to monitor banks and exert disciplinary behavior. However, critical knowledge gaps regarding existing deposit insurance schemes have been documented in many countries (see, for instance, Bowyer et al., 1986; Inakura & Shimizutani, 2010; Şafakli & Güryay, 2007; Steiger et al., 2001). In Germany, before the financial crisis, depositors' knowledge about deposit insurance was also widely missing, although depositors held a substantial fraction of their financial assets as deposits. Since state guarantees had

to be implemented in October 2008 to calm depositors and prevent bank runs, depositors were not well informed of existing deposit insurance schemes (Goedde-Menke et al., 2014). Third, sight deposits primarily fulfill a transaction function and do not pay high-interest rates (Bikker & Gerritsen, 2018; Klein, 1971). Time deposits, in contrast, have fixed maturities so that depositors cannot withdraw their time deposits prematurely without paying the penalty (Chen et al., 2020). For their fixed commitment, banks need to reward depositors with higher interest rates (Bikker & Gerritsen, 2018). Hence, time deposit holders have stronger incentives to monitor and punish increasing risk-taking. However, since depositors cannot withdraw time deposits without notice, banks have time to increase deposit rates as risk increases and thus prevent disruptive disciplinary effects.

Considering these deliberations, it appears plausible that we observe more significant disciplinary effects on time deposits than on sight deposits. Note that if we use the finance-specific dictionary for our sentiment measure, the signs of market discipline become weaker (see Table C.15 in the Appendix). Since our previous analyses have shown that newspaper sentiment responds differently to bank risk indicators across bank types, we consider that news sentiment may also have a divergent impact on depositors and banks among the three bank types. Therefore, the upcoming section evaluates the media's role across bank groups to assess whether the media leads to depositors' disciplinary behavior concerning all bank groups.

Impact of media sentiment on different bank types

Following Soo (2018), the theory of sentiment suggests that depositors may be subject to media sentiment to different degrees depending on the bank type. For instance, we should observe a larger sentiment effect in markets with low-income depositors. These depositors tend to be less financially literate and have access to financial advice to a lesser degree (Lusardi & Mitchell, 2011). Our pre-study provides anecdotal evidence that customers of savings banks have, on average, lower income than customers of the other two bank types. Moreover, deposits account for a comparatively large share of total assets, especially among savings banks. Besides, the financial crisis spillover to several Landesbanken may have increased depositor sensitivity to negative sentiment concerning savings banks.

In contrast, financially literate depositors better understand the rationale of investment diversification and include stocks in their portfolios. Financially literate depositors attach greater importance to risk diversification due to speculation motives. The financial decisions of these agents thus depend, to a greater extent, on their expectations regarding other agents' behavior. These expectations, in turn, are derived from stories that may cause overconfidence followed by underconfidence (Akerlof & Shiller, 2009). Given commercial banks' orientation on international financial markets and customers and that the financial crisis most hit them (Gischer & Reichling, 2010), we expect media sentiment to have a significant effect on commercial

banks, too.

Cooperative banks stand out because they adopt a relational banking model with depositors that can identify bank risks appropriately (Kozłowski, 2016) and have suffered least from the financial crisis (Behr & Schmidt, 2015). In fact, Lamers (2015) identifies stronger market discipline in local markets that experienced bank failures in the U.S. He points out that depositors differentiated when failures occurred within their local market or outside, with the former having a stronger impact on market discipline. All things considered, we suppose that the role of media sentiment is stronger for savings and commercial banks than for cooperative banks.

It is important to remember that coverage of commercial banks dominates our measure for the overall bank-related sentiment ($BankS$). Focusing on the distinction between bank types in the media may provide deeper insights into the media's monitoring role. Therefore, in the following, we decompose the overall average sentiment into bank-type sentiment and investigate the impact of media sentiment on individual banks within each bank group. Moreover, bank group complementarities and similarities, respectively, may affect depositors additionally. As a result, depositors and banks, respectively, could respond not only to signals about their bank and bank group but also to information regarding other banks and bank types. Consequently, by looking closer into bank groups, we expect the relationship between bank types and media outlets to become more apparent.

Hypothesis 6 (H6): *Market discipline is more pronounced concerning savings and commercial banks than cooperative banks.*

Hypothesis 7 (H7): *Depositors and banks respond to sentiment concerning all bank types.*

For each bank type $k \in \{sav, coo, com\}$ and each type of liability ($\Delta DEP \in$ {sight deposits, time deposits, total deposits}) and the corresponding deposit rate ($IR \in$ {sight deposit rate, time deposit rate, volume-weighted average interest rate on sight and time deposits}), we estimate the following multi-way fixed effect model:

$$\begin{aligned}\Delta DEP_{i,t} = \alpha_{i,o} &+ \beta_1 BankS_{i,o,\tau-1} + \beta_2 BankS_{sav,t-1} + \beta_3 TypeS_{sav,t-1} \\ &+ \beta_4 BankS_{coo,t-1} + \beta_5 TypeS_{coo,t-1} \\ &+ \beta_6 BankS_{com,t-1} + \beta_7 TypeS_{com,t-1} \\ &+ \sum_r \beta_8^r RISK_{i,t-2}^r + \beta_9 SIZE_{i,t-1} \\ &+ \sum_m \beta_{10}^m MACRO_t^m + \beta_{11} precrisis_{t-1} + \beta_{12} PRM_{t-1} + \epsilon_{i,o,\tau} \end{aligned} \tag{4.2a}$$

$$
\begin{aligned}
IR_{i,t} = a_{i,o} &+ b_1 BankS_{i,o,\tau-1} + b_2 BankS_{sav,t-1} + b_3 TypeS_{sav,t-1} \\
&+ b_4 BankS_{coo,t-1} + b_5 TypeS_{coo,t-1} \\
&+ b_6 BankS_{com,t-1} + b_7 TypeS_{com,t-1} \\
&+ \sum_r b_8^r RISK_{i,t-2}^r + b_9 SIZE_{i,t-1} \\
&+ \sum_m b_{10}^m MACRO_t^m + b_{11} precrisis_{t-1} + b_{12} PRM_{t-1} + \omega_{i,o,\tau}
\end{aligned} \tag{4.2b}
$$

with $BankS_k$ denoting the average across articles referring to individual banks belonging to bank type k. $TypeS_k$ represents monthly sentiment of articles mentioning bank type k explicitly.

For more lucidity concerning the role of bank type-specific media sentiment on the equilibrium ΔDEP and IR in Tables 4.5-4.7, we compute point estimates and heteroscedasticity-robust standard errors for total bank type-specific sentiment measures ($SENT_k$) for each bank type k by adding the coefficient for $BankS_k$ to the coefficient for $TypeS_k$.[17] For instance, the total effect of sentiment regarding savings banks results from the sum of coefficients for $BankS_{sav}$ and $TypeS_{sav}$. By adding sentiment measures for individual banks and bank types, we assume they capture equally important information. For example, the impact of $BankS_{sav_t-1}$ and $TypeS_{sav,t-1}$ on time deposit rates of savings banks yields a total effect of $SENT_{sav,t-1} = -0.151 - 0.316 = -0.467$. The inclusion of sentiment measure for all bank types allows observing the responses of the equilibrium deposit growth rate and interest rate, respectively, to sentiment regarding each bank type of the banking sector.[18]

Table 4.5 shows the impact of individual and bank-type specific media sentiment on savings banks' equilibrium deposit growth and corresponding interest rate. When we control for the macro-economy and bank fundamentals in Model 3, the growth rate of deposits increases following negative sentiment concerning individual savings banks only at $10\,\%$ significance level (Panel C). Interest rates are not affected statistically significantly. Savings banks react to decreasing sentiment on their bank type with higher interest rates on sight and time deposits (Model 3 in Panel A and B, respectively). However, depositors discipline banks by providing more sight deposits while holding fewer time deposits.

Nevertheless, as a response to the negative sentiment on savings banks ($SENT_{sav}$), savings banks increase the overall growth of deposits by increasing interest rates (Panel C). Savings banks also increase the volume-weighted interest rate following decreasing sentiment towards cooperative banks, which attracts deposits to savings banks as well ($SENT_{coo}$). Obviously, the gain in total household deposits lies in an increase in savings banks' time deposit growth rates

[17] We use Newson's (2002) LINCOMEST module for STATA to generate linear combinations of estimators saved as estimation results.

[18] Estimation results containing separate sentiment measures are displayed in the Appendix.

Table 4.5: Impact of media sentiment on the growth of deposits and the corresponding interest rates of savings banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
Panel A: Sight deposits												
$BankS_{i,o,\tau-1}$	-0.334	[0.206]	0.058	[0.041]	-0.315*	[0.189]	0.018	[0.025]	-0.299	[0.187]	0.016	[0.023]
$SENT_{sav,t-1}$					-1.267***	[0.125]	-0.218***	[0.015]	-1.348***	[0.126]	-0.156***	[0.014]
$SENT_{coo,t-1}$					0.185*	[0.080]	-0.072***	[0.010]	0.251**	[0.081]	-0.042***	[0.009]
$SENT_{com,t-1}$					-0.242***	[0.060]	0.015	[0.009]	-0.193**	[0.061]	0.01	[0.008]
adj. R^2	0.115		0.667		0.251		0.884		0.264		0.894	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	
Panel B: Time deposits												
$BankS_{i,o,\tau-1}$	0.312	[0.538]	0.130*	[0.067]	0.106	[0.466]	0.063*	[0.036]	0.253	[0.464]	0.01	[0.033]
$SENT_{sav,t-1}$					1.577***	[0.267]	-0.611***	[0.024]	1.601***	[0.267]	-0.467***	[0.022]
$SENT_{coo,t-1}$					-2.319***	[0.206]	-0.098***	[0.015]	-2.109***	[0.209]	-0.011	[0.014]
$SENT_{com,t-1}$					1.944***	[0.154]	0.116***	[0.014]	2.017***	[0.151]	0.113***	[0.014]
adj. R^2	0.192		0.599		0.391		0.883		0.403		0.896	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	
Panel C: All deposits												
$BankS_{i,o,\tau-1}$	-0.332**	[0.155]	0.120**	[0.056]	-0.369**	[0.150]	0.062**	[0.026]	-0.270*	[0.144]	0.018	[0.024]
$SENT_{sav,t-1}$					-0.095	[0.092]	-0.420***	[0.016]	-0.376***	[0.089]	-0.291***	[0.015]
$SENT_{coo,t-1}$					-0.577***	[0.070]	-0.100***	[0.010]	-0.511***	[0.067]	-0.057***	[0.009]
$SENT_{com,t-1}$					0.569***	[0.050]	0.042***	[0.011]	0.669***	[0.050]	0.025**	[0.010]
adj. R^2	0.123		0.587		0.160		0.909		0.234		0.924	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	
$precrisis_{t-1}$	X		X		X		X		X		X	
PRM_{t-1}	X		X		X		X		X		X	
$Macro_t$					X		X		X		X	
$RISK_{t-2}$									X		X	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. The constant is not reported.

(Panel B). On the contrary, sight deposit growth slows down despite savings banks offering higher interest on sight deposits (Panel A).

We interpret the reaction of savings banks' sight deposit holders to negative information about cooperative banks as an indication of informational spill-overs. These could occur because depositors perceive savings and cooperative banks as similar bank types that differ from commercial banks. Firstly, neither savings nor cooperative banks compete directly against other banks within their bank type (Goedde-Menke et al., 2014). Secondly, both bank types focus on the welfare of their customers, members, and the regional economy. Thirdly, savings and cooperative banks belong to their respective financial association networks. These networks act as internal capital markets and clearing houses. If necessary, the financial networks support individual member banks by providing liquidity and protecting individual members from insolvency (Arnold et al., 2016).

In contrast, savings banks behave differently following deteriorating sentiment regarding commercial banks ($SENT_{com}$). The growth rate of sight deposit increases while time deposit growth and the corresponding interest rate decline. Thus, savings banks' demand curve for deposits shifts leftwards, leading to overall lower growth in deposits and interest rates.

The results for cooperative banks in Table 4.6 show no effect of bank-specific media sentiment on either the growth rate of deposits or the respective interest rates. Nevertheless, there is evidence for market discipline as a reaction to bank-type-related media sentiment. Cooperative banks' interest rates on sight deposit increase following deteriorating article tone referring to savings and cooperative banks, respectively. The growth rate of sight deposits remains unaffected (Panel A). Panel B shows that depositors of cooperative banks increase their supply with time deposits in response to decreasing sentiment of cooperative banks. However, a deteriorating sentiment concerning savings banks leads depositors of cooperative banks to reduce the growth rate in time deposits, although interest rates on time deposits increase. The same result remains for the growth rate of all deposits and the corresponding volume-weighted interest rate in Panel C. Lower sentiment concerning cooperative banks also leads to higher deposit rates. Although sight and time deposit rates, respectively, are positively correlated with sentiment for commercial banks ($SENT_{com}$), the effect becomes insignificant for the average interest rate (Panel C). Our results suggest that negative information on savings banks spills over to cooperative banks, emphasizing the similarity between the two bank types.

Interestingly, commercial banks are also subject to depositor discipline in response to decreasing sentiment for savings banks (Panel C in Table 4.5). Hence, in support of H7 and Morris and Shin (2002), we find that deteriorating bank type-specific sentiment can lead market participants to overreact to public information. In contrast to savings and cooperative banks, we find that bank-specific media sentiment impacts commercial banks. In particular, lower sentiment leads to a decreasing (increasing) growth rate of time (sight) deposits. Con-

Table 4.6: Impact of media sentiment on the growth of deposits and the corresponding interest rates of cooperative banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
Panel A: Sight deposits												
$BankS_{i,o,\tau-1}$	0.884	[0.729]	-0.061	[0.082]	0.891	[0.693]	-0.060	[0.052]	0.839	[0.709]	-0.013	[0.047]
$SENT_{sav,t-1}$					0.046	[0.418]	-0.165***	[0.035]	0.058	[0.413]	-0.140***	[0.029]
$SENT_{coo,t-1}$					0.636*	[0.307]	-0.078**	[0.025]	0.556	[0.306]	-0.087***	[0.021]
$SENT_{com,t-1}$					0.211	[0.240]	0.037	[0.019]	0.239	[0.242]	0.050**	[0.017]
adj. R^2	0.119		0.509		0.193		0.806		0.206		0.853	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	
Panel B: Time deposits												
$BankS_{i,o,\tau-1}$	0.178	[1.455]	-0.011	[0.143]	0.073	[1.368]	-0.001	[0.082]	-0.044	[1.365]	0.016	[0.079]
$SENT_{sav,t-1}$					2.546**	[0.936]	-0.322***	[0.059]	3.409***	[0.930]	-0.232***	[0.058]
$SENT_{coo,t-1}$					-3.975***	[0.587]	-0.034	[0.038]	-3.760***	[0.586]	-0.041	[0.035]
$SENT_{com,t-1}$					-0.116	[0.478]	0.123***	[0.032]	-0.061	[0.484]	0.150***	[0.030]
adj. R^2	0.146		0.544		0.269		0.837		0.299		0.859	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	
Panel C: All deposits												
$BankS_{i,o,\tau-1}$	-0.304	[0.517]	-0.087	[0.117]	-0.339	[0.507]	-0.082	[0.062]	-0.414	[0.523]	-0.001	[0.054]
$SENT_{sav,t-1}$					0.747*	[0.316]	-0.277***	[0.045]	0.947**	[0.317]	-0.216***	[0.038]
$SENT_{coo,t-1}$					-0.407	[0.218]	-0.068*	[0.029]	-0.309	[0.220]	-0.065**	[0.023]
$SENT_{com,t-1}$					0.391*	[0.193]	-0.003	[0.024]	0.348	[0.197]	0.000	[0.021]
adj. R^2	0.138		0.551		0.172		0.863		0.177		0.906	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	
$precrisis_{t-1}$	X		X		X		X		X		X	
PRM_{t-1}	X		X		X		X		X		X	
$Macro_t$					X		X		X		X	
$RISK_t - 2$									X		X	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. The constant is not reported.

Table 4.7: Impact of media sentiment on the growth of deposits and the corresponding interest rates of commercial banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
Panel A: Sight deposits												
$BankS_{i,o,\tau-1}$	-0.672***	[0.209]	0.093***	[0.017]	-0.442**	[0.206]	-0.012	[0.011]	-0.525***	[0.202]	0.000	[0.010]
$SENT_{sav,t-1}$					3.418***	[0.124]	-0.080***	[0.007]	2.618***	[0.121]	0.070***	[0.006]
$SENT_{coo,t-1}$					-4.175***	[0.083]	-0.139***	[0.004]	-4.023***	[0.086]	-0.088***	[0.004]
$SENT_{com,t-1}$					0.137	[0.074]	0.016***	[0.004]	-0.314***	[0.074]	0.017***	[0.004]
adj. R^2	0.035		0.646		0.063		0.851		0.113		0.873	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	
Panel B: Time deposits												
$BankS_{i,o,\tau-1}$	2.154***	[0.335]	0.097***	[0.030]	1.301***	[0.317]	-0.035**	[0.016]	1.516***	[0.308]	-0.023	[0.015]
$SENT_{sav,t-1}$					-2.410***	[0.219]	-0.317***	[0.010]	-1.222***	[0.210]	-0.212***	[0.010]
$SENT_{coo,t-1}$					-5.293***	[0.120]	-0.237***	[0.006]	-5.667***	[0.128]	-0.167***	[0.006]
$SENT_{com,t-1}$					1.898***	[0.145]	0.122***	[0.006]	2.293***	[0.136]	0.079***	[0.006]
adj. R^2	0.096		0.587		0.182		0.882		0.242		0.897	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	
Panel C: All deposits												
$BankS_{i,o,\tau-1}$	0.170	[0.139]	0.105***	[0.028]	-0.018	[0.135]	-0.049***	[0.014]	-0.028	[0.133]	-0.042***	[0.012]
$SENT_{sav,t-1}$					1.531***	[0.092]	-0.333***	[0.010]	1.668***	[0.091]	-0.169***	[0.009]
$SENT_{coo,t-1}$					-3.807***	[0.052]	-0.200***	[0.006]	-3.701***	[0.055]	-0.085***	[0.006]
$SENT_{com,t-1}$					0.809***	[0.051]	0.116***	[0.006]	0.666***	[0.052]	0.044***	[0.005]
adj. R^2	0.098		0.551		0.152		0.879		0.180		0.911	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	
$precrisis_{t-1}$	X		X		X		X		X		X	
PRM_{t-1}	X		X		X		X		X		X	
$Macro_t$					X		X		X		X	
$RISK_t - 2$									X		X	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. The constant is not reported.

sidering total deposits in Panel C, we find that negative sentiment increases the equilibrium interest rate but does not affect the growth rate of total deposits.

In line with Oliveira et al. (2015), who find evidence for depositors turning to systemically important banks which they perceive as "too-big-to-fail", deteriorating information on commercial banks ($SENT_{com}$) leads to higher sight deposit growth rates among commercial banks, despite lowered interest rates (Panel A). Contrary to our Hypothesis 6, the findings support previous evidence for market discipline across bank types in Germany in Arnold et al. (2016) that found depositors of savings and cooperative banks to exert stronger disciplinary behavior than commercial banks' depositors. Overall, our results provide clear evidence that "[...] linguistic media content captures otherwise hard-to-quantify aspects of firms' fundamentals." (Tetlock, 2015, p. 710)

Notably, after including macro-variables, R^2 becomes surprisingly high in all interest rate estimations across all bank and deposit types. We investigate this further by running OLS regressions for interest rates of all, sight, and time deposits, respectively, based on monthly balance sheet and interest rates statistics.[19] Table C.19 in the Appendix shows the Shorrocks-Shapley decomposition of R^2. In line with de Bondt et al. (2005), interest rates are closely related to the term structure of interest rates. Indeed, we find that the Shapley value for the term structure accounts for at least $43.3\,\%$ of R^2 (in the estimation for interest rates on time deposits offered by cooperative banks). The real exchange rate also contributes at least $20.4\,\%$ to R^2.

4.4.3 Robustness Checks

Do regional and national newspapers evaluate banks differently?

This subsection investigates whether regional newspapers assess banks differently than national outlets. Previous literature has so far built on information contained in "leading" newspapers (see, e.g. Baker et al., 2016), thus implicitly assuming that regional newspapers do not provide divergent information. Nevertheless, regional and national newspapers address different types of readership and diverge in their relationships with banks. Both aspects can lead to dissenting evaluations of bank activities between regionally and nationally oriented outlets (Arnold, 2020). Also, Dam and Koetter (2012) point out that local politicians' serving on supervisory boards of regionally operating banks influences bank bailout expectations and moral hazard. These considerations lead to the following hypothesis:

[19] The Stata module shapley2 computes additive decompositions of R^2 by regressors or groups of regressors. We rely on OLS estimations since we are only interested in the decomposition of R^2, and the Stata package shapley2 cannot handle indicator variables yet.

Hypothesis 8 (H8): *National newspapers differ in their assessment of bank risks and economic conditions from regional newspapers.*

We use our data set to shed light on potential differences between regional and national newspapers' evaluation of banks. Hence, we estimate various versions of the following model:

$$\begin{aligned} BankS_{i,o,\tau} = \alpha_{i,o} &+ \sum_r \beta_1^r RISK_{i,t-1}^r + \beta_2 SIZE_{i,t} + \sum_m \beta_3^m MACRO_{t-1}^m \\ &+ D^{nat} * \left[\sum_r \beta_4^r RISK_{i,t-1}^r + \beta_5 SIZE_{i,t} + \sum_m \beta_6^m MACRO_{t-1}^m \right] \\ &+ \gamma_1 precrisis_t + \gamma_2 PRM_t + \epsilon_{i,o,\tau}, \end{aligned} \tag{4.1}$$

where the indicator variable D^{nat} equals one for national newspapers and is zero for regional outlets. The null hypotheses that $\beta_4^r = 0$ for each risk measure r and $\beta_6^m = 0$ for the m macro-economic indicators test H8 formally.

In Table 4.8, we present the estimated differences in the effect of bank risk and macroeconomic indicators on media sentiment. We cannot reject the null hypothesis that $\beta_4^r = 0$ for any of the r risk variables. Therefore, we do not find evidence in support of H8. Regional and national newspapers' responses to bank risk measures are not different in national outlets compared to regional newspapers. The only striking difference is the statistically significantly higher coefficient for inflation in national newspapers (see the coefficient for $HICPgr * D^{nat}$). Thus, national newspapers seem to be capturing concerns regarding deflationary risks and hence react more negatively to declining inflation than regional newspapers.

Implications of dictionary choice for sentiment detection

When adapting the finance-adjusted dictionary for the calculation of sentiment measures, we still observe very similar results for the relationship between bank risk and macroeconomic indicators with media sentiment (see Table C.12 in the Appendix). Nevertheless, our findings change somewhat qualitatively. In particular, the inflation rate is positively related to media sentiment. The positive coefficient implies that the media clouds over decreasing inflation. The finance-adjusted dictionary likely captures concerns of deflation. Bank size, however, has no significant effect on media sentiment.

When news sources are decomposed into regional and national outlets (Table C.13 in the Appendix), inflation does not significantly affect the tone in regional outlets. We also find no significant difference in the reaction to inflation in national newspapers compared to regional outlets. Hence, our analysis of differences between regional and national outlets shows an apparent similarity in their sentiments towards bank risks using either dictionary. Analogously to our findings based on the common-terms dictionary in Subsection 4.4.1, we find differences

Table 4.8: Differences in the impact of bank risk taking on media sentiment in regional and national outlets

	Model 1		Model 2		Model 3	
$CREDIT_{t-1}$	0.062***	[0.020]	0.049**	[0.020]	0.003	[0.021]
LTG_{t-1}	-0.096***	[0.022]	-0.015	[0.022]	0.048**	[0.023]
$Tier1_{t-1}$	0.122***	[0.025]	0.120***	[0.025]	0.085***	[0.030]
$SIZE_t$	-0.008*	[0.005]	0.001	[0.005]	-0.008	[0.005]
$HICPgr_{t-1}$					-0.037	[0.090]
$URgr_{t-1}$					-0.032***	[0.009]
$GDPgr_{t-1}$					0.001***	[0.000]
$IRSTRUC_{t-1}$					0.002***	[0.000]
$RealEx_{t-1}$					0.000	[0.000]
$CREDIT_{t-1} * D^{nat}$	0.017	[0.028]	0.008	[0.028]	-0.005	[0.029]
$LTG_{t-1} * D^{nat}$	-0.017	[0.031]	-0.019	[0.031]	-0.001	[0.033]
$Tier1_{t-1} * D^{nat}$	0.000	[0.033]	0.015	[0.032]	-0.019	[0.040]
$SIZE_t * D^{nat}$	0.003	[0.006]	0.003	[0.006]	0.001	[0.006]
$HICPgr_{t-1} * D^{nat}$					0.271**	[0.122]
$URgr_{t-1} * D^{nat}$					0.017	[0.013]
$GDPgr_{t-1} * D^{nat}$					0.000	[0.000]
$IRSTRUC_{t-1} * D^{nat}$					0.001	[0.001]
$RealEx_{t-1} * D^{nat}$					0.000	[0.000]
$precrisis_t$			0.027***	[0.001]	0.024***	[0.001]
MSG_t			-0.014***	[0.002]	-0.012***	[0.002]
Constant	0.211***	[0.017]	0.154***	[0.017]	0.207***	[0.020]
Observations	109,777		109,777		109,777	
adj. R^2	0.102		0.110		0.112	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations.
Note: All models include the interaction between bank i and outlet o capturing fixed effects of bank i being covered in newspaper o. Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

in bank risk assessments between bank types using the finance-specific dictionary (Table C.14 in the Appendix). The sentiment measure based on the *BPW* dictionary yields very similar results. However, the relationship between bank capitalization and the finance-specific sentiment is only statistically significant at the $10\,\%$ level.

Moreover, the inflation rate's effect on media sentiment is indistinguishable in national from regional newspapers. Instead, economic growth, the term structure of interest rates, and the real exchange rate have statistically stronger impacts on national than regional outlets' sentiment. Notably, indicators for bank risks and the economic state account circa $10\,\%$ more for the variation in sentiment based on common tonality terms than the finance-adjusted dictionary. We may conclude that a list of standard tonality terms is more appropriate for capturing sentiment in daily newspaper articles.

The analysis of the media's role in the equilibrium growth rate of deposits and corresponding deposit rates points to disciplinary depositor behavior for all types of banks when we employ the finance-adjusted dictionary (see Tables C.16-C.18 in the Appendix), as well. However, both dictionaries appear to capture slightly different information, so some coefficients become (in)significant depending on the dictionary.

4.5 Summary and Conclusions

We find that media sentiment captures bank risk and the state of the economy in a meaningful way. In covering banks, regional and national outlets complement one another and do not provide divergent information on bank risks and the state of the economy. In particular, media sentiment towards bank fundamentals does not differ between regionally- and nationally-oriented outlets. However, we show that media sentiment differs significantly between bank types. Our results show that media sentiment regarding savings banks is associated with all considered balance sheet risk measures. The most robust finding among savings and commercial banks is that the media evaluates low-capitalized banks more negatively. Compared to savings banks, newspapers report more pessimistically about a decline in lending activities and liquidity transformation gap among cooperative and commercial banks.

We add to the literature by showing empirically that the media fulfills its role by distributing bank-related information and thus enabling market discipline. Our results suggest that media sentiment additionally captures otherwise hard-to-quantify aspects of bank fundamentals that influence bank and depositor behavior. Furthermore, combining bank-specific balance sheet data with bank-type-specific media sentiment provides a unique opportunity to study the impact of bank groups' complementarities and similarities on depositors. In line with Morris and Shin (2002), we find that deteriorating bank type-specific sentiment can lead market participants to overreact to public information. In particular, we observe that negative information

concerning savings banks leads to depositor discipline in cooperative and commercial banks. We find evidence for disciplinary actions in the supply with both time and sight deposits. Depositors exert more assertive disciplinary behavior for time deposits than for sight deposits. This difference in sensitivity to negative sentiment is not surprising, assuming that time deposit holders are more financially literate. Similar to Arnold et al. (2016), we find evidence for market discipline in all German bank types.

The results have implications for the media, depositors, banks, and supervising authorities. First, newspapers provide meaningful and relevant information and thus enable depositors to discipline banks effectively. However, quantitative risk measures and economic indicators only partially explain the variation in media sentiment. Media sentiment must therefore contain information beyond fundamentals that influence depositors and banks. Understanding the driving factors of media sentiment can provide valuable insights into depositor behavior, especially during a financial crisis. Second, accounting for media information on only one particular bank type would miss spill-over effects from other bank types that impact this bank type's banks and depositors. Third, contrary to survey data, information in the media provides a timely measure of bank-specific and bank-type-specific sentiment that can explain depositor behavior and serve as an early indicator of bank distress. However, the media do not cover each bank on a regular basis. Moreover, cooperative and savings banks receive much less attention than commercial banks despite the former accounting for nearly $50\,\%$ of all private deposits in 2012 (Deutsche Bundesbank, 2012).

Finally, comparing sentiment-bearing word lists yields nearly no qualitative differences in our analyses. However, using sentiment measures calculated with a finance-adjusted dictionary instead of the common German sentiment words list explains about $10\,\%$ less of the variation in the media's response to bank risk and economic indicators. If anything, using any of the two dictionaries captures slightly different information relevant to market participants.

Both dictionaries could, however, miss relevant emotions for decision-making. Based on the social-psychological theory of "conviction narratives" (Tuckett & Nikolic, 2017), a sentiment measure capturing excitement and anxiety may stronger affect "*action* in uncertain decision-making." (Nyman et al., 2018, p. 5). Future work could investigate the role of "conviction narratives" in depositor behavior. Another methodological extension is applying neural network (NN) language models to detect sentiment directed at specific entities. Recently, this class of models has become more and more popular due to its superior performance compared to bag-of-words approaches (Rönnqvist & Sarlin, 2017; Yadav & Bethard, 2019). However, NN semantic models require a substantial amount of (labeled) text that is often not readily available. We leave the adaptation of NN models for bank risk detection in German newspaper articles to future research.

Appendices

A Appendix to Chapter 2

Table A.1: Descriptive Statistics Split for Pre-Crisis, Crisis and Post-Crisis Periods

	Pre-Crisis (01/2003 - 07/2007)				Crisis (08/2007 - 11/2009)				Post-Crisis (12/2009 - 12/2012)			
	N	Mean	STD	Median	N	Mean	STD	Median	N	Mean	STD	Median
Bank-specific Variables												
All Banks												
$DEPOSITS$	7,146	2.47	5.05	1.12	3,612	3.40	6.87	1.47	4,695	3.97	9.03	1.60
$\Delta Deposits$	7,005	0.01	0.04	0.00	3,612	0.01	0.04	0.01	4,692	0.00	0.04	0.00
IR	7,146	1.65	0.53	1.59	3,612	2.17	0.83	2.26	4,695	0.91	0.39	0.84
IR_TD	7,146	3.02	0.57	3.03	3,612	3.63	0.71	3.81	4,695	2.20	0.60	2.16
IR_SD	7,146	1.03	0.53	0.96	3,612	1.34	0.76	1.27	4,695	0.55	0.31	0.52
$IRSPREAD$	7,146	1.99	0.65	1.97	3,612	2.29	0.68	2.31	4,695	1.65	0.59	1.64
TD	7,146	0.64	0.99	0.32	3,612	1.16	2.42	0.51	4,695	0.77	2.13	0.30
SD	7,146	1.84	4.37	0.74	3,612	2.24	4.71	0.93	4,695	3.20	7.21	1.23
TD/SD	7,146	0.55	0.50	0.40	3,612	0.69	0.55	0.56	4,695	0.34	0.39	0.23
TA	7,146	21.75	84.64	4.62	3,612	25.26	98.84	5.14	4,695	31.27	153.47	5.37
LTG	7,146	0.22	0.10	0.21	3,612	0.28	0.11	0.28	4,623	0.28	0.11	0.28
LR	7,146	0.02	0.01	0.02	3,612	0.02	0.01	0.02	4,695	0.02	0.01	0.02
$CREDIT$	7,146	0.56	0.17	0.59	3,612	0.52	0.17	0.55	4,563	0.53	0.17	0.57
$Tier1 - Ratio$	7,132	0.08	0.02	0.08	3,539	0.09	0.03	0.09	4,597	0.11	0.03	0.10
Savings Banks												
$DEPOSITS$	3,813	1.48	1.05	1.14	1,904	1.95	1.54	1.46	2,516	2.16	1.82	1.61
$\Delta Deposits$	3,741	0.00	0.03	0.00	1,904	0.01	0.02	0.01	2,516	0.00	0.01	0.00
IR	3,813	1.55	0.41	1.53	1,904	2.02	0.71	2.19	2,516	0.82	0.26	0.80
IR_TD	3,813	3.05	0.46	3.09	1,904	3.57	0.69	3.77	2,516	2.15	0.53	2.16
IR_SD	3,813	0.89	0.39	0.92	1,904	1.18	0.58	1.18	2,516	0.49	0.21	0.50
$IRSPREAD$	3,813	2.16	0.53	2.09	1,904	2.39	0.57	2.40	2,516	1.66	0.55	1.68
TD	3,813	0.44	0.34	0.34	1,904	0.63	0.51	0.53	2,516	0.37	0.28	0.31
SD	3,813	1.05	0.83	0.79	1,904	1.32	1.23	0.95	2,516	1.79	1.71	1.22
TD/SD	3,813	0.49	0.35	0.38	1,904	0.61	0.44	0.51	2,516	0.28	0.23	0.22
TA	3,813	6.59	5.15	5.19	1,904	7.27	5.86	5.66	2,516	7.45	6.09	5.68
LTG	3,813	0.20	0.05	0.20	1,904	0.26	0.07	0.26	2,516	0.27	0.07	0.26
LR	3,813	0.02	0.01	0.02	1,904	0.02	0.01	0.02	2,516	0.02	0.01	0.02
$CREDIT$	3,813	0.58	0.12	0.60	1,904	0.56	0.12	0.57	2,516	0.57	0.13	0.58
$Tier1 - Ratio$	3,807	0.08	0.02	0.08	1,904	0.10	0.02	0.09	2,516	0.11	0.03	0.11
Cooperative Banks												
$DEPOSITS$	2,139	1.10	1.13	0.73	1,092	1.46	1.33	1.08	1,401	1.75	1.50	1.24
$\Delta Deposits$	2,099	0.01	0.05	0.00	1,092	0.01	0.04	0.01	1,401	0.01	0.03	0.00
IR	2,139	1.75	0.52	1.64	1,092	2.22	0.79	2.27	1,401	0.91	0.29	0.87
IR_TD	2,139	3.05	0.56	3.00	1,092	3.66	0.65	3.82	1,401	2.19	0.57	2.11
IR_SD	2,139	1.08	0.44	1.05	1,092	1.39	0.66	1.32	1,401	0.59	0.22	0.61
$IRSPREAD$	2,139	1.96	0.61	1.92	1,092	2.27	0.57	2.24	1,401	1.61	0.52	1.53
TD	2,139	0.38	0.51	0.23	1,092	0.47	0.48	0.34	1,401	0.30	0.28	0.19

Continue on the next page

Continued: **Descriptive Statistics Split for Pre-Crisis, Crisis and Post-Crisis Periods**

	N	Mean	STD	Median	N	Mean	STD	Median	N	Mean	STD	Median
SD	2,139	0.73	0.78	0.43	1,092	0.98	1.06	0.60	1,401	1.46	1.41	0.83
TD/SD	2,139	0.72	0.71	0.47	1,092	0.76	0.63	0.61	1,401	0.37	0.43	0.21
TA	2,139	3.80	4.57	2.70	1,092	4.66	6.00	3.51	1,401	5.13	6.17	3.74
LTG	2,139	0.27	0.08	0.26	1,092	0.33	0.08	0.32	1,354	0.34	0.10	0.34
LR	2,139	0.02	0.01	0.02	1,092	0.02	0.01	0.02	1,401	0.02	0.01	0.02
$CREDIT$	2,139	0.57	0.14	0.58	1,092	0.52	0.15	0.51	1,333	0.53	0.14	0.54
$Tier1-Ratio$	2,139	0.08	0.02	0.08	1,092	0.09	0.02	0.09	1,398	0.10	0.02	0.10
Commercial Banks												
$DEPOSITS$	1,194	8.07	10.45	3.50	616	11.30	13.83	5.32	778	13.83	19.00	4.42
$\Delta Deposits$	1,165	0.01	0.06	0.00	616	0.01	0.06	0.00	775	0.01	0.08	0.00
IR	1,194	1.81	0.75	1.76	616	2.57	1.07	2.71	778	1.17	0.68	1.11
IR_TD	1,194	2.87	0.83	2.73	616	3.75	0.84	4.01	778	2.35	0.82	2.28
IR_SD	1,194	1.37	0.83	1.24	616	1.75	1.16	1.58	778	0.69	0.57	0.46
$IRSPREAD$	1,194	1.50	0.81	1.41	616	2.01	1.03	2.13	778	1.66	-0.78	1.61
TD	1,194	1.74	1.87	0.84	616	3.97	4.85	1.56	778	2.94	4.62	0.90
SD	1,194	6.33	9.32	2.76	616	7.33	9.59	3.98	778	10.89	15.17	3.83
TD/SD	1,194	0.46	0.33	0.36	616	0.82	0.66	0.63	778	0.50	0.62	0.32
TA	1,194	102.29	187.02	21.05	616	117.40	216.63	23.85	778	155.37	351.59	32.37
LTG	1,194	0.21	0.18	0.15	616	0.27	0.22	0.19	753	0.24	0.19	0.21
LR	1,194	0.02	0.01	0.01	616	0.02	0.01	0.01	778	0.02	0.02	0.01
$CREDIT$	1,194	0.49	0.29	0.43	616	0.42	0.28	0.31	714	0.41	0.26	0.34
$Tier1-Ratio$	1,186	0.09	0.04	0.08	543	0.10	0.04	0.09	683	0.12	0.05	0.12
Macroeconomic Variables												
$HICP_{gr}$	7,007	0.16	0.37	0.19	3,612	0.09	0.39	0.09	4,694	0.19	0.42	0.09
UR_{gr}	7,007	-0.36	3.52	-0.98	3,612	-0.46	3.61	-1.18	4,694	-0.26	4.11	-1.16
$RealEx$	7,146	103.85	2.32	104.31	3,612	108.58	2.16	108.70	4,695	99.58	3.69	99.79
GDP_{gr}	7,146	2.48	1.72	1.76	3,612	-0.12	4.01	0.79	4,695	3.58	1.67	3.50
$TERMSTRUC$	7,146	1.37	0.73	1.38	3,612	0.70	1.42	-0.25	4,695	1.61	0.67	1.40

Table A.2: Regression results: commercial banks

Dependent Variable	(1) $\Delta Deposits$		(2) IR		(3) TD/SD		(4) $IRSPREAD$	
				Pre-Crisis Period				
LTG_{t-1}	-0.0608	[0.0464]	1.6282	[0.9972]	0.4136	[0.9272]	-2.0855***	[0.5208]
LR_{t-1}	-0.1597	[0.1192]	0.2443	[5.0806]	-1.4345	[6.3721]	**-15.2898*** **	[2.8086]
$CREDIT_{t-1}$	0.0103	[0.0299]	-0.9491**	[0.4376]	-1.1557**	[0.5800]	-3.4453***	[0.3647]
$Tier1-Ratio_{t-1}$	-0.1285	[0.1480]	-0.3112	[1.5237]	1.0852	[2.2864]	**-4.3272*** **	[1.4209]
				Crisis Period				
LTG_{t-1}	**-0.0986*** **	[0.0339]	1.5760	[0.9677]	1.1066	[0.8904]	-2.6642***	[0.7125]
LR_{t-1}	-0.2845	[0.1867]	**-13.0765*** **	[5.3140]	1.0251	[2.2003]	**-20.4782*** **	[4.1397]
$CREDIT_{t-1}$	0.0129	[0.0406]	-1.3527***	[0.3743]	-1.2323***	[0.4996]	-2.8996***	[0.5640]
$Tier1-Ratio_{t-1}$	-0.1280*	[0.0771]	2.4871	[2.4298]	0.9185	[2.0134]	-7.2033	[5.2724]
$LTG_{t-1}*MS$	**-0.0848** **	[0.0403]	**2.2737** **	[1.1011]	1.6399	[1.2088]	-1.9507**	[0.9999]
$LR_{t-1}*MS$	-0.6403**	[0.3270]	-4.7602	[4.1546]	-6.5331*	[3.4845]	-11.7263**	[5.1462]
$CREDIT_{t-1}*MS$	0.0471	[0.0454]	-0.6429	[0.5829]	-1.0200*	[0.6146]	-2.5383***	[0.7470]
$Tier1-Ratio_{t-1}*MS$	-0.0553	[0.0851]	**-2.8666***	[1.6546]	-0.6246	[1.8820]	-1.2028	[2.4243]
				Post-Crisis Period				
LTG_{t-1}	-0.0542	[0.0333]	1.1284	[1.0647]	0.2353	[1.2810]	1.1574	[0.8427]
LR_{t-1}	0.1228	[0.1756]	-2.2350	[2.6078]	-2.5667	[2.7431]	-2.6218	[3.6168]
$CREDIT_{t-1}$	-0.0213	[0.0348]	-0.2908	[0.9552]	-0.6324	[0.8862]	-4.7489***	[0.8088]
$Tier1-Ratio_{t-1}$	-0.1986**	[0.0825]	-0.9028	[1.8599]	2.4167	[2.8321]	**-6.4116** **	[2.9045]
$SIZE$	0.0143	[0.0237]	-0.0072	[0.1991]	-0.2349	[0.1768]	-0.7424***	[0.2397]
$HICP_{gr}$	-0.0399	[0.4071]	-1.5388**	[0.7012]	0.5521	[0.6726]	0.8870	[1.4475]
UR_{gr}	-0.0051	[0.0289]	0.1911	[0.1296]	0.2047	[0.0946]	0.0327	[0.2440]
$RealEx$	0.0007	[0.0010]	0.0248***	[0.0053]	0.0132**	[0.0055]	0.0163**	[0.0074]
GDP_{gr}	-0.0010	[0.0011]	0.0215**	[0.0098]	-0.0042	[0.0077]	-0.0044	[0.0104]
$TERMSTRUC_{t-1}$	-0.0034	[0.0021]	-0.3354***	[0.0401]	-0.1120***	[0.0273]	-0.0421	[0.0507]
$Crisis$	-0.0214	[0.0247]	0.4391	[0.3851]	0.3418	[0.3869]	0.2663	[0.3485]
$Post-Crisis$	0.0157	[0.0211]	-0.5519	[0.4204]	-0.1030	[0.3218]	0.4076	[0.6132]
$Constant$	-0.0874	[0.1360]	-0.1910	[0.9347]	0.3679	[0.8419]	4.9335***	[0.9269]
R-squared	0.0206		0.7320		0.3381		0.4439	
Groups	29		29		29		29	
Observations	2,343		2,343		2,343		2,343	

Source: Deutsche Bundesbank, own calculations. Robust standard errors in brackets.
Statistical significance is indicated by asterisks: * ($p < 0.10$), ** ($p < 0.05$), *** ($p < 0.01$)

Table A.3: Regression results: cooperative banks

Dependent Variable	(1) $\Delta Deposits$		(2) IR		(3) TD/SD		(4) $IRSPREAD$	
				Pre-Crisis Period				
LTG_{t-1}	**-0.0586*** **	[0.0213]	**2.1432*** **	[0.6190]	1.3023***	[0.4984]	-2.0221**	[0.8924]
LR_{t-1}	-0.3459***	[0.1298]	2.9917	[2.2612]	-0.9335	[1.5951]	1.6056	[3.7254]
$CREDIT_{t-1}$	0.0077	[0.0190]	-1.4403***	[0.4796]	**-1.3086** **	[0.6762]	0.1920	[0.7465]
$Tier1-Ratio_{t-1}$	0.0729	[0.0874]	**-7.3719*** **	[2.2211]	-5.9625**	[2.4396]	-5.3913*	[2.9382]
				Crisis Period				
LTG_{t-1}	**-0.0580*** **	[0.0215]	**3.2660*** **	[0.5951]	1.3759***	[0.5344]	-0.9902	[1.3338]
LR_{t-1}	-0.2173	[0.1601]	**-11.2134*** **	[3.5828]	1.4418	[2.2681]	4.0422	[5.3190]
$CREDIT_{t-1}$	0.0092	[0.0210]	-1.0023*	[0.5425]	-0.6855	[0.5337]	0.9132	[1.1417]
$Tier1-Ratio_{t-1}$	**0.1849** **	[0.0870]	**-4.0835** *	[2.1462]	-1.0860	[1.5990]	-0.7849	[3.6492]
$LTG_{t-1}*MS$	**-0.0719*** **	[0.0247]	**3.4808*** **	[0.4917]	1.8194***	[0.4154]	-0.0451	[0.9310]
$LR_{t-1}*MS$	0.3549*	[0.1896]	5.8976***	[1.9797]	**5.7341** **	[2.5230]	5.5870	[4.3282]
$CREDIT_{t-1}*MS$	0.0072	[0.0205]	-1.0101**	[0.4782]	-0.4875	[0.4907]	0.3621	[0.8821]
$Tier1-Ratio_{t-1}*MS$	-0.0660	[0.0850]	**-2.8456** *	[1.5560]	-0.4035	[1.5167]	-2.4476	[2.7482]
				Post-Crisis Period				
LTG_{t-1}	**-0.0714*** **	[0.0171]	**2.2421*** **	[0.3729]	1.4326***	[0.3505]	-1.1527	[0.7503]
LR_{t-1}	0.0771	[0.0746]	10.8096***	[2.0502]	**9.5113*** **	[1.8432]	5.9351	[4.2953]
$CREDIT_{t-1}$	-0.0118	[0.0197]	-0.6861	[0.4726]	0.1301	[0.4836]	0.2112	[0.9273]
$Tier1-Ratio_{t-1}$	-0.0030	[0.0500]	**-4.0595*** **	[0.9336]	-2.1399**	[1.0036]	-3.1021	[2.3650]
$SIZE$	0.0070	[0.0060]	-0.3851***	[0.1465]	-0.0462	[0.1750]	-0.2271	[0.2450]
$HICP_{gr}$	-0.4368	[0.3215]	-1.0749***	[0.3724]	-0.1027	[0.5820]	1.2685*	[0.6636]
UR_{gr}	-0.0469**	[0.0220]	0.2015***	[0.0634]	0.1679**	[0.0688]	0.1515	[0.0980]
$RealEx$	-0.0001	[0.0002]	0.0160***	[0.0021]	-0.0036	[0.0023]	0.0014	[0.0040]
GDP_{gr}	-0.0004	[0.0003]	0.0047	[0.0028]	-0.0100***	[0.0027]	-0.0283***	[0.0050]
$TERMSTRUC_{t-1}$	-0.0038***	[0.0011]	-0.2598***	[0.0142]	-0.0323***	[0.0112]	-0.0265	[0.0272]
$Crisis$	-0.0138	[0.0116]	-0.3125	[0.4278]	-0.8082**	[0.3265]	-0.8443	[0.5528]
$Post-crisis$	0.0129	[0.0149]	-1.5476***	[0.4408]	-1.7395***	[0.5400]	-0.6631	[0.5795]
$Constant$	0.0333	[0.0267]	1.6039***	[0.4891]	2.1033***	[0.7705]	3.0162***	[0.8292]
R-squared	0.0202		0.8220		0.5331		0.3473	
Groups	41		41		41		41	
Observations	4,522		4,522		4,522		4,522	

Source: Deutsche Bundesbank, own calculations. Robust standard errors in brackets.
Statistical significance is indicated by asterisks: * ($p < 0.10$), ** ($p < 0.05$), *** ($p < 0.01$)

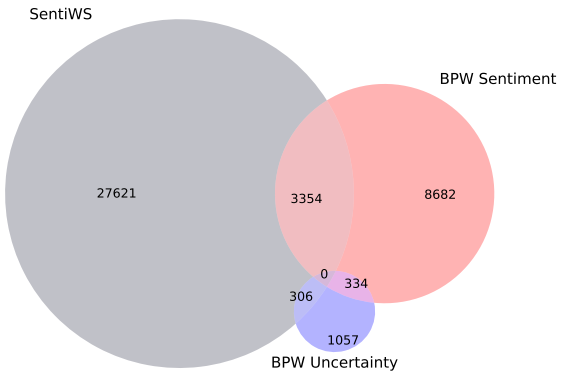
Table A.4: Regression results: savings banks

Dependent Variable	(1) $\Delta Deposits$		(2) IR		(3) TD/SD		(4) $IRSPREAD$	
Pre-Crisis Period								
LTG_{t-1}	**-0.0434*** **	[0.0155]	**3.7246*** **	[0.6155]	1.7108**	[0.7365]	-1.7295**	[0.8512]
LR_{t-1}	-0.1552**	[0.0656]	1.1683	[1.8600]	0.6418	[1.3987]	-2.0576	[2.3915]
$CREDIT_{t-1}$	0.0053	[0.0136]	-0.0201	[0.4282]	-0.1332	[0.4462]	-0.1383	[0.5692]
$Tier1-Ratio_{t-1}$	-0.0728	[0.0617]	**-7.3821*** **	[1.7255]	-2.9919*	[1.6339]	-5.6105***	[2.0696]
Crisis Period								
LTG_{t-1}	-0.0496	[0.0149]	**4.7687*** **	[0.4966]	2.4908***	[0.6015]	-1.6813	[1.1035]
LR_{t-1}	-0.1590	[0.1120]	**-6.8126***	[3.9203]	2.2339	[1.8038]	3.0613	[6.3200]
$CREDIT_{t-1}$	0.0134	[0.0159]	**0.7266***	[0.4151]	0.2928	[0.4643]	**1.3923****	[0.6685]
$Tier1-Ratio_{t-1}$	0.0300	[0.0814]	**-3.4749****	[1.5762]	0.5575	[1.4739]	1.9913	[2.5398]
$LTG_{t-1}*MS$	**-0.0699*** **	[0.0159]	**3.5694*** **	[0.4886]	2.1928***	[0.5542]	0.2898	[0.8124]
$LR_{t-1}*MS$	-0.1334	[0.1496]	-0.3429	[2.2046]	-0.3102	[1.1467]	**-6.5341***	[3.3986]
$CREDIT_{t-1}*MS$	0.0087	[0.0160]	-0.3904	[0.3995]	-0.0921	[0.4385]	0.3458	[0.6308]
$Tier1-Ratio_{t-1}*MS$	-0.0753	[0.0557]	**-5.7504*** **	[1.7048]	-1.1518	[1.5234]	-2.9575	[2.0459]
Post-Crisis Period								
LTG_{t-1}	**-0.0432*** **	[0.0096]	**1.8171*** **	[0.3886]	1.7422***	[0.4878]	-1.0509	[0.7130]
LR_{t-1}	-0.1512***	[0.0524]	7.7964***	[1.6264]	**2.9064***	[1.5317]	-1.2304	[2.8255]
$CREDIT_{t-1}$	0.0070	[0.0142]	-1.0031***	[0.3915]	-0.4369	[0.4324]	-0.0867	[0.6289]
$Tier1-Ratio_{t-1}$	-0.0417	[0.0319]	**-5.4881*** **	[1.1295]	-3.1664***	[0.9627]	-4.3869***	[1.5925]
$SIZE$	0.0058	[0.0062]	-0.1095	[0.1861]	-0.0689	[0.1695]	-0.1800	[0.2705]
$HICP_{gr}$	-0.7822***	[0.0905]	-1.2074***	[0.2705]	-0.8772***	[0.2312]	0.2808	[0.4136]
UR_{gr}	-0.0292***	[0.0112]	0.3413***	[0.0406]	0.1700***	[0.0385]	0.1817***	[0.0538]
$RealEx$	0.0000	[0.0001]	0.0136***	[0.0020]	-0.0011	[0.0015]	0.0034	[0.0026]
GDP_{gr}	0.0003	[0.0002]	0.0078***	[0.0026]	-0.0061***	[0.0019]	-0.0096**	[0.0046]
$TERMSTRUC_{t-1}$	-0.0040***	[0.0005]	-0.2334***	[0.0146]	-0.0402***	[0.0085]	-0.0561**	[0.0238]
$Crisis$	0.0087	[0.0118]	0.1980	[0.2268]	-0.3264	[0.2142]	-0.6421	[0.4095]
$Post-crisis$	0.0006	[0.0075]	0.1214	[0.2589]	-0.0669	[0.1983]	-0.5000	[0.3664]
$Constant$	0.0131	[0.0232]	0.4539	[0.5884]	0.7498	[0.5213]	3.1141***	[0.6457]
R-squared	0.0473		0.8269		0.4567		0.4170	
Groups	72		72		72		72	
Observations	8,155		8,155		8,155		8,155	

Source: Deutsche Bundesbank, own calculations. Robust standard errors in brackets.
Statistical significance is indicated by asterisks: * ($p < 0.10$), ** ($p < 0.05$), *** ($p < 0.01$)

B Appendix to Chapter 3

Figure B.1: Dictionaries for sentiment and uncertainty detection



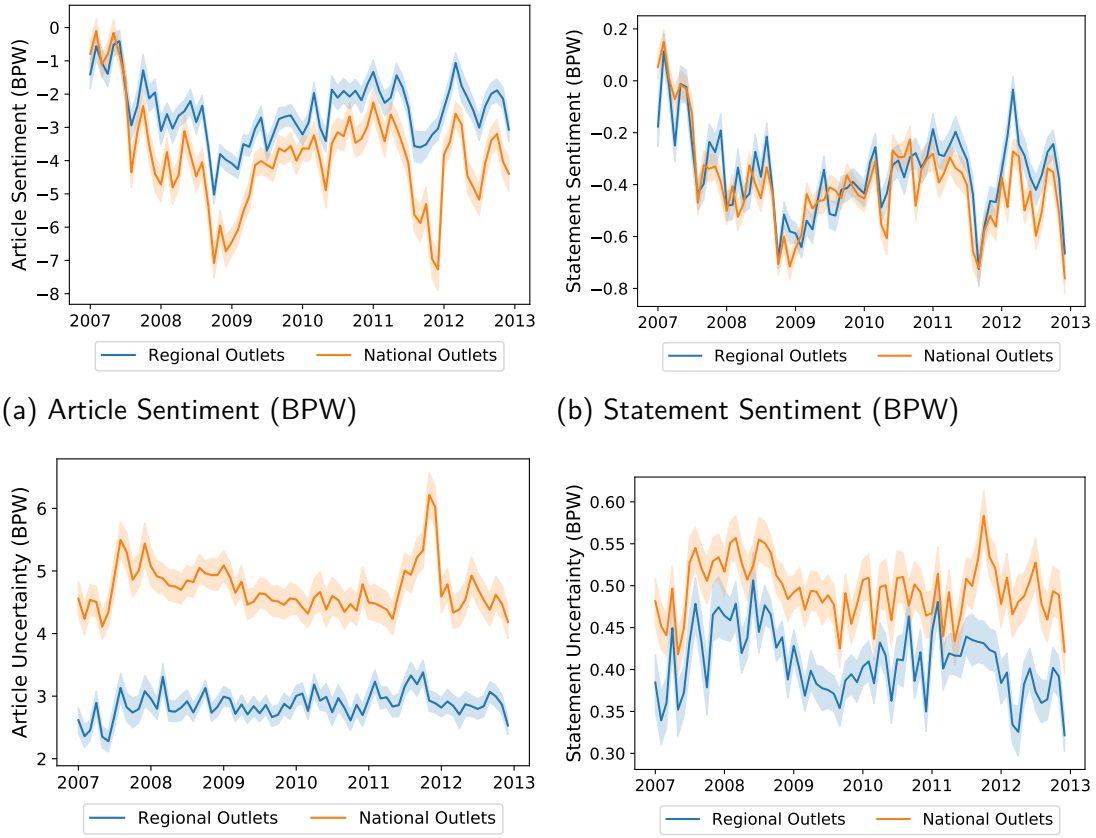
Source: Sentiment-bearing words with weights (*SentiWS*) are from Remus et al. (2010). *BPW* sentiment- and *BPW* uncertainty-terms for finance-related texts are from Bannier et al. (2019). Own presentation.

Table B.1: Pearson's correlations for sentiment and uncertainty measures

	Article Sentiment		Statement Sentiment		Uncertainty	
	(SentiWS)	(BPW)	(SentiWS)	(BPW)	(Article)	(Statement)
Article Sentiment (SentiWS)	1.00	0.74	0.41	0.31	-0.39	-0.11
Article Sentiment (BPW)	0.74	1.00	0.30	0.44	-0.36	-0.09
Statement Sentiment (SentiWS)	0.41	0.30	1.00	0.53	-0.09	-0.13
Statement Sentiment (BPW)	0.31	0.44	0.53	1.00	-0.06	-0.09
Article Uncertainty	-0.39	-0.36	-0.09	-0.06	1.00	0.32
Statement Uncertainty	-0.11	-0.09	-0.13	-0.09	0.32	1.00

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung (FAZ), own calculations.

Figure B.2: Monthly sentiment and uncertainty, respectively, in regional and national newspapers



(a) Article Sentiment (BPW)

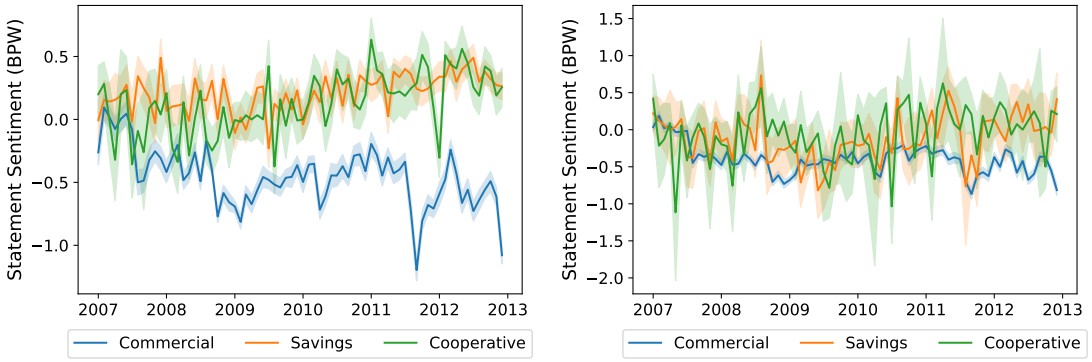
(b) Statement Sentiment (BPW)

(c) Article Uncertainty (BPW)

(d) Statement Uncertainty (BPW)

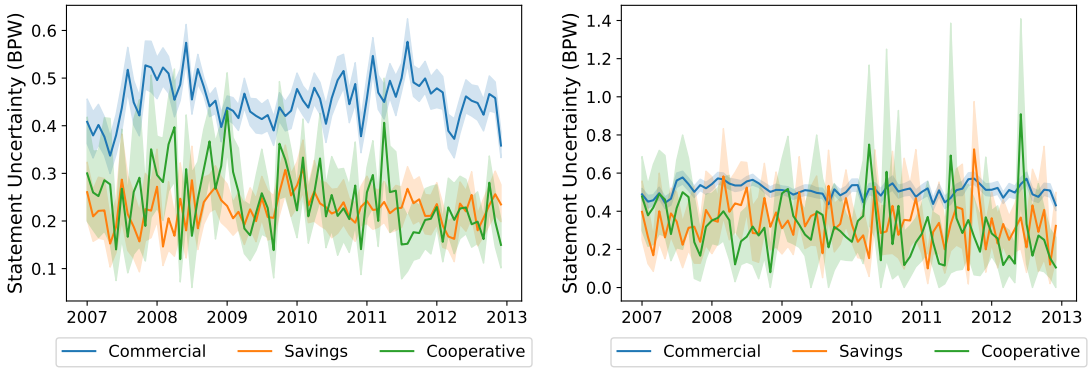
Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Figure B.2 displays average sentiment and uncertainty scores calculated for articles and statements, respectively. Shaded arias indicate 95 %-significance intervals. Sentiment and uncertainty scores are calculated using the *BPW*-dictionary in Bannier et al. (2019).

Figure B.3: Monthly sentiment and uncertainty, respectively, by bank type in regional and national newspapers



(a) Regional outlets

(b) National outlets

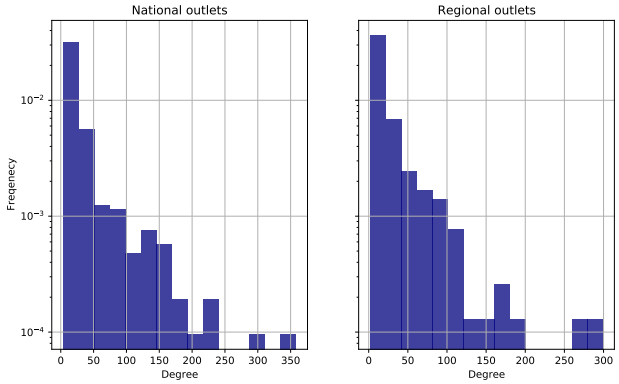


(c) Regional outlets

(d) National outlets

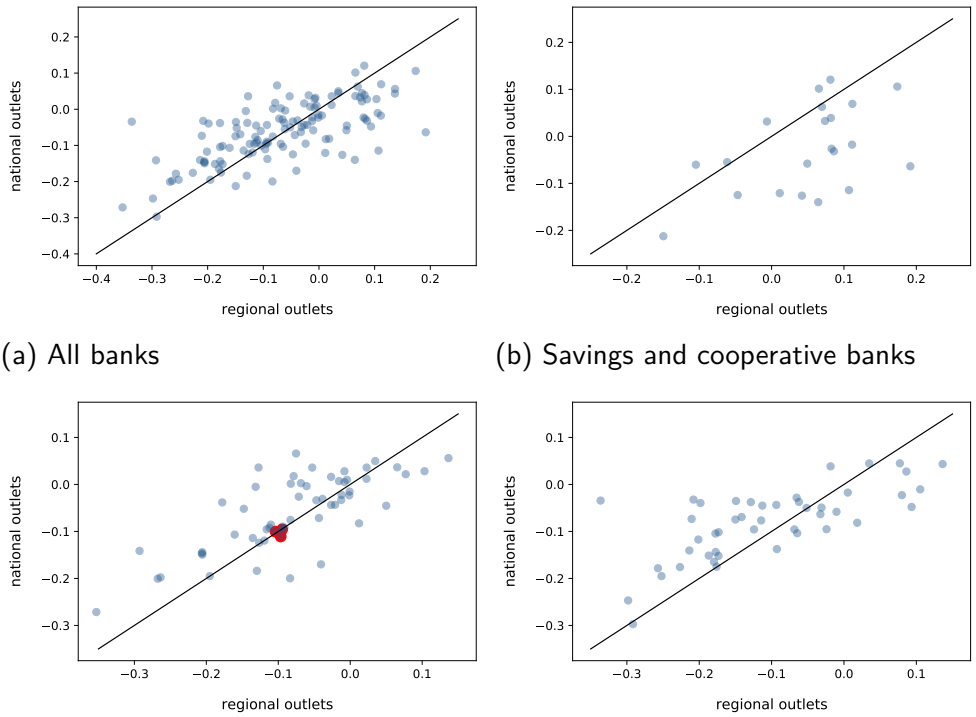
Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Figure B.3 displays average sentiment and uncertainty scores for bank statements by bank type. Commercial banks include the three large banks. Shaded arias indicate 95 %-significance intervals. Sentiment and uncertainty measures are calculated using the *BPW*-dictionary in Bannier et al. (2019).

Figure B.4: Degree distribution



Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Frequency is displayed on a log-scale.

Figure B.5: Individual bank sentiment in regional and national newspapers



(a) All banks

(b) Savings and cooperative banks

(c) Commercial banks

(d) Other banks

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung. Own calculations.
Note: Figure B.5 displays the average statement sentiment score for bank m by national outlets against the average sentiment score for bank m by regional newspapers. Only banks with at least twenty statements in regional and national outlets, respectively, included. The black line indicates the 45-Degree line. Figure B.5a shows all 125 banks that meet the criteria. Evidence for 21 savings and cooperative banks, respectively, is presented in Figure B.5b. Red dots in Figure B.5c indicate large banks among the 58 commercial banks. Figure B.5d presents 46 banks belonging to other bank types.

C Appendix to Chapter 4

Table C.1: Variable definitions

Variable	Definition
Bank-specific monthly balance sheet data	
$CREDIT_{i,t}$	Total loans to total assets
$LTG_{i,t}$	Difference between liquid liabilities (sight and time deposits) and liquid assets (banks'cash holdings + deposits held with the central bank + bills + treasury bills) scaled by total assets
$Tier1_{i,t}$	Ratio of bank's tier 1 capital to risk-weighted total assets
$SIZE$	Natural logarithm of total assets
$\Delta DEP_{i,t}$	Growth rate of households' deposits, differentiated between sight deposits, time deposits, and all deposits
$IR_{i,t}$	Interest rate, in percent. Differentiated between interest rate on sight deposits, time deposits, and an interest rate calculated as an volume-weighted average between sight and time deposits
Monthly macroeconomic variables	
$HICPgr_t$	Monthly growth rate of the Harmonized Consumer Price Index in percent
$URgr_t$	Monthly unemployment rate in percent
$RealEx_t$	Real exchange rate (euro vs. EER-20) based on consumer price indices (base year 1999Q1)
$GDPgr_t$	Yearly growth rate of GDP
$IRTERM_t$	Interest rate term structure approximated by the difference between the 10-year government bond yield and the 3-month Euribor rate
Sentiment measures	
$BankS_{i,o,\tau}$	Article sentiment regarding bank i in outlet o at publication day τ that lies within month t
$BankS_t$	Monthly average sentiment across all bank-related articles and bank types
$BankS_{sav,t}$	Monthly average sentiment across all articles mentioning a savings bank
$BankS_{coo,t}$	Monthly average sentiment across all articles mentioning a cooperaitve bank
$BankS_{com,t}$	Monthly average sentiment across all articles mentioning a commercial bank
$TypeS_{sav,t}$	Monthly average sentiment across all articles mentioning the group of savings banks
$TypeS_{coo,t}$	Monthly average sentiment across all articles mentioning the group of cooperative banks
$TypeS_{com,t}$	Monthly average sentiment across all articles mentioning the group of commercial banks

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank.

Table C.2: Correlation matrix for finance-adjusted news sentiment across all outlets

	A	B	C	D	E	F	G	H
A. $BankS_i$	1							
B. $BankS$	0.18	1						
C. $BankS_{sav}$	0.05	0.42	1					
D. $TypeS_{sav}$	0.11	0.68	0.65	1				
E. $BankS_{coo}$	0.04	0.40	0.59	0.58	1			
F. $TypeS_{coo}$	0.10	0.53	0.32	0.61	0.44	1		
G. $BankS_{com}$	0.17	0.98	0.34	0.56	0.31	0.45	1	
H. $TypeS_{com}$	0.10	0.59	0.38	0.56	0.30	0.43	0.51	1

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung.
Note: This table shows the correlations between news variables. $BankS_i$ is the articles sentiment regarding bank i in outlet o. $BankS$ is the monthly average across all bank-related articles and bank types. $BankS_k$ is the average across articles referring to individual banks belonging to bank type k. $TypeS_k$ represents monthly sentiment of articles mentioning bank type k explicitly. All sentiment measures are calculated based on the dictionary in Bannier et al. (2019).

Table C.3: Impact of media sentiment on the growth of all deposits and the corresponding volume-weighted interest rate of savings banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	0.312	[0.538]	0.130*	[0.067]	0.106	[0.466]	0.063*	[0.036]	0.253	[0.464]	0.01	[0.033]
$BankS_{sav,t-1}$	4.659***	[0.327]	-0.225***	[0.038]	-0.433	[0.282]	-0.272***	[0.022]	-0.164	[0.286]	-0.151***	[0.021]
$TypeS_{sav,t-1}$	3.878***	[0.207]	-0.099***	[0.026]	2.011***	[0.207]	-0.339***	[0.015]	1.764***	[0.204]	-0.316***	[0.015]
$BankS_{coo,t-1}$	-4.411***	[0.213]	-0.980***	[0.026]	-1.383***	[0.191]	-0.188***	[0.014]	-1.278***	[0.191]	-0.100***	[0.013]
$TypeS_{coo,t-1}$	0.185*	[0.099]	0.125***	[0.010]	-0.936***	[0.094]	0.091***	[0.007]	-0.831***	[0.094]	0.089***	[0.006]
$BankS_{com,t-1}$	-0.539***	[0.144]	-0.776***	[0.017]	1.655***	[0.152]	0.154***	[0.014]	1.676***	[0.152]	0.145***	[0.013]
$TypeS_{com,t-1}$	1.185***	[0.065]	0.059***	[0.008]	0.289***	[0.060]	-0.037***	[0.005]	0.342***	[0.061]	-0.032***	[0.004]
$precrisis_{t-1}$	3.303***	[0.254]	1.647***	[0.027]	-1.209***	[0.247]	0.341***	[0.017]	-2.150***	[0.257]	0.218***	[0.018]
MSG_{t-1}	3.258***	[0.240]	0.585***	[0.027]	1.614***	[0.267]	0.321***	[0.027]	1.336***	[0.276]	0.326***	[0.025]
Constant	0.34	[0.295]	2.072***	[0.038]	-4.550***	[1.423]	-3.936***	[0.106]	0.651	[4.470]	2.738***	[0.347]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.192		0.599		0.391		0.883		0.403		0.896	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.4: Impact of media sentiment on the growth of sight deposits and the corresponding interest rate of savings banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	-0.334	[0.206]	0.058	[0.041]	-0.315*	[0.189]	0.018	[0.025]	-0.299	[0.187]	0.016	[0.023]
$BankS_{sav,t-1}$	-1.473***	[0.129]	0.099***	[0.022]	-0.536***	[0.125]	-0.064***	[0.014]	-0.550***	[0.126]	0.007	[0.013]
$TypeS_{sav,t-1}$	-0.946***	[0.085]	-0.006	[0.015]	-0.731***	[0.081]	-0.154***	[0.009]	-0.798***	[0.080]	-0.163***	[0.009]
$BankS_{coo,t-1}$	0.801***	[0.069]	-0.609***	[0.016]	-0.042	[0.071]	-0.125***	[0.009]	0.002	[0.073]	-0.102***	[0.009]
$TypeS_{coo,t-1}$	-0.089**	[0.041]	0.103***	[0.006]	0.227***	[0.035]	0.053***	[0.004]	0.249***	[0.035]	0.060***	[0.004]
$BankS_{com,t-1}$	-0.417***	[0.059]	-0.494***	[0.010]	-0.338***	[0.064]	0.030***	[0.009]	-0.288***	[0.065]	0.016*	[0.008]
$TypeS_{com,t-1}$	-0.165***	[0.031]	0.052***	[0.005]	0.096***	[0.028]	-0.015***	[0.003]	0.095***	[0.028]	-0.006**	[0.003]
$precrisis_{t-1}$	0.613***	[0.110]	1.139***	[0.017]	1.375***	[0.113]	0.359***	[0.014]	0.820***	[0.126]	0.350***	[0.014]
MSG_{t-1}	1.190***	[0.119]	0.269***	[0.025]	0.712***	[0.121]	0.110***	[0.025]	0.670***	[0.120]	0.087***	[0.024]
Constant	0.142	[0.116]	0.482***	[0.022]	6.962***	[0.516]	-2.797***	[0.072]	23.441***	[1.844]	-3.734***	[0.232]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.115		0.667		0.251		0.884		0.264		0.894	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.5: Impact of media sentiment on the growth of time deposits and the corresponding interest rate of savings banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	0.312	[0.538]	0.130*	[0.067]	0.106	[0.466]	0.063*	[0.036]	0.253	[0.464]	0.01	[0.033]
$BankS_{sav,t-1}$	4.659***	[0.327]	-0.225***	[0.038]	-0.433	[0.282]	-0.272***	[0.022]	-0.164	[0.286]	-0.151***	[0.021]
$TypeS_{sav,t-1}$	3.878***	[0.207]	-0.099***	[0.026]	2.011***	[0.207]	-0.339***	[0.015]	1.764***	[0.204]	-0.316***	[0.015]
$BankS_{coo,t-1}$	-4.411***	[0.213]	-0.980***	[0.026]	-1.383***	[0.191]	-0.188***	[0.014]	-1.278***	[0.191]	-0.100***	[0.013]
$TypeS_{coo,t-1}$	0.185*	[0.099]	0.125***	[0.010]	-0.936***	[0.094]	0.091***	[0.007]	-0.831***	[0.094]	0.089***	[0.006]
$BankS_{com,t-1}$	-0.539***	[0.144]	-0.776***	[0.017]	1.655***	[0.152]	0.154***	[0.014]	1.676***	[0.152]	0.145***	[0.013]
$TypeS_{com,t-1}$	1.185***	[0.065]	0.059***	[0.008]	0.289***	[0.060]	-0.037***	[0.005]	0.342***	[0.061]	-0.032***	[0.004]
$precrisis_{t-1}$	3.303***	[0.254]	1.647***	[0.027]	-1.209***	[0.247]	0.341***	[0.017]	-2.150***	[0.257]	0.218***	[0.018]
MSG_{t-1}	3.258***	[0.240]	0.585***	[0.027]	1.614***	[0.267]	0.321***	[0.027]	1.336***	[0.276]	0.326***	[0.025]
Constant	0.34	[0.295]	2.072***	[0.038]	-4.550***	[1.423]	-3.936***	[0.106]	0.651	[4.470]	2.738***	[0.347]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.192		0.599		0.391		0.883		0.403		0.896	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.6: Impact of media sentiment on the growth of all deposits and the corresponding volume-weighted interest rate of cooperative banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	-0.304	[0.517]	-0.087	[0.117]	-0.339	[0.507]	-0.082	[0.062]	-0.414	[0.523]	-0.001	[0.054]
$BankS_{sav,t-1}$	2.858***	[0.290]	0.032	[0.066]	1.246***	[0.310]	-0.084**	[0.041]	1.535***	[0.328]	-0.035	[0.035]
$TypeS_{sav,t-1}$	-0.193	[0.197]	-0.022	[0.043]	-0.498**	[0.216]	-0.194***	[0.024]	-0.589***	[0.218]	-0.181***	[0.021]
$BankS_{coo,t-1}$	-1.011***	[0.177]	-0.998***	[0.044]	-0.315	[0.205]	-0.152***	[0.027]	-0.26	[0.205]	-0.132***	[0.022]
$TypeS_{coo,t-1}$	0.044	[0.082]	0.162***	[0.017]	-0.092	[0.093]	0.084***	[0.011]	-0.049	[0.098]	0.067***	[0.010]
$BankS_{com,t-1}$	-0.991***	[0.139]	-0.752***	[0.028]	-0.007	[0.187]	0.045*	[0.024]	-0.009	[0.188]	0.040**	[0.020]
$TypeS_{com,t-1}$	0.459***	[0.058]	0.076***	[0.013]	0.398***	[0.058]	-0.048***	[0.008]	0.358***	[0.061]	-0.040***	[0.006]
$precrisis_{t-1}$	1.401***	[0.218]	1.274***	[0.046]	0.257	[0.236]	0.284***	[0.032]	-0.031	[0.270]	0.312***	[0.026]
MSG_{t-1}	3.153***	[0.236]	0.412***	[0.037]	1.936***	[0.294]	0.331***	[0.033]	1.807***	[0.295]	0.392***	[0.026]
Constant	-1.148***	[0.277]	0.952***	[0.067]	3.794**	[1.550]	-4.618***	[0.197]	7.894**	[3.071]	-2.635***	[0.298]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.138		0.551		0.172		0.863		0.177		0.906	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.7: Impact of media sentiment on the growth of sight deposits and the corresponding interest rate of cooperative banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	0.884	[0.729]	-0.061	[0.082]	0.891	[0.693]	-0.060	[0.052]	0.839	[0.709]	-0.013	[0.047]
$BankS_{sav,t-1}$	0.720*	[0.397]	0.165***	[0.048]	2.003***	[0.422]	-0.057*	[0.033]	2.149***	[0.432]	-0.051*	[0.029]
$TypeS_{sav,t-1}$	-2.089***	[0.261]	0.016	[0.030]	-1.957***	[0.265]	-0.108***	[0.020]	-2.090***	[0.264]	-0.089***	[0.018]
$BankS_{coo,t-1}$	1.442***	[0.247]	-0.734***	[0.033]	0.273	[0.291]	-0.116***	[0.024]	0.181	[0.291]	-0.110***	[0.020]
$TypeS_{coo,t-1}$	-0.169	[0.119]	0.124***	[0.012]	0.363***	[0.120]	0.038***	[0.009]	0.375***	[0.121]	0.023***	[0.008]
$BankS_{com,t-1}$	-0.528***	[0.176]	-0.424***	[0.019]	-0.094	[0.223]	0.062***	[0.018]	-0.079	[0.225]	0.066***	[0.016]
$TypeS_{com,t-1}$	-0.076	[0.081]	0.078***	[0.009]	0.305***	[0.081]	-0.025***	[0.006]	0.317***	[0.084]	-0.015***	[0.006]
$precrisis_{t-1}$	1.324***	[0.287]	0.887***	[0.035]	1.797***	[0.297]	0.213***	[0.029]	2.009***	[0.331]	0.246***	[0.024]
MSG_{t-1}	2.028***	[0.302]	0.194***	[0.031]	1.306***	[0.356]	0.143***	[0.031]	1.362***	[0.350]	0.202***	[0.026]
Constant	-2.096***	[0.386]	0.722***	[0.047]	4.281**	[2.122]	-2.886***	[0.158]	2.174	[3.517]	-1.598***	[0.253]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.119		0.509		0.193		0.806		0.206		0.853	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.8: Impact of media sentiment on the growth of time deposits and the corresponding interest rate of cooperative banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	0.178	[1.455]	-0.011	[0.143]	0.073	[1.368]	-0.001	[0.082]	-0.044	[1.365]	0.016	[0.079]
$BankS_{sav,t-1}$	8.259***	[0.810]	-0.183**	[0.079]	0.485	[0.886]	-0.106*	[0.055]	0.843	[0.903]	-0.085	[0.054]
$TypeS_{sav,t-1}$	4.073***	[0.567]	-0.032	[0.053]	2.060***	[0.570]	-0.216***	[0.032]	2.566***	[0.572]	-0.147***	[0.031]
$BankS_{coo,t-1}$	-7.737***	[0.542]	-1.019***	[0.051]	-3.793***	[0.584]	-0.119***	[0.036]	-3.493***	[0.581]	-0.103***	[0.033]
$TypeS_{coo,t-1}$	1.296***	[0.243]	0.128***	[0.022]	-0.182	[0.244]	0.085***	[0.015]	-0.267	[0.249]	0.062***	[0.015]
$BankS_{com,t-1}$	-3.734***	[0.361]	-0.773***	[0.036]	-0.131	[0.464]	0.176***	[0.032]	0.082	[0.461]	0.199***	[0.029]
$TypeS_{com,t-1}$	0.978***	[0.164]	0.067***	[0.016]	0.015	[0.155]	-0.053***	[0.010]	-0.143	[0.157]	-0.048***	[0.009]
$precrisis_{t-1}$	3.482***	[0.603]	1.305***	[0.057]	-1.513**	[0.660]	0.202***	[0.041]	-2.996***	[0.779]	0.108***	[0.041]
MSG_{t-1}	5.925***	[0.703]	0.522***	[0.051]	2.245***	[0.787]	0.449***	[0.049]	2.125***	[0.747]	0.533***	[0.043]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
Constant	-2.307***	[0.725]	2.331***	[0.081]	14.598***	[3.967]	-4.371***	[0.255]	37.018***	[7.837]	-0.572	[0.408]
adj. R^2	0.146		0.544		0.269		0.837		0.299		0.859	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.9: Impact of media sentiment on the growth of all deposits and the corresponding volume-weighted interest rate of commercial banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	0.170	[0.139]	0.105***	[0.028]	-0.018	[0.135]	-0.049***	[0.014]	-0.028	[0.133]	-0.042***	[0.012]
$BankS_{sav,t-1}$	3.689***	[0.077]	0.217***	[0.016]	1.495***	[0.086]	-0.010	[0.009]	1.363***	[0.087]	0.030***	[0.008]
$TypeS_{sav,t-1}$	1.021***	[0.050]	-0.060***	[0.011]	0.036	[0.050]	-0.323***	[0.006]	0.306***	[0.050]	-0.199***	[0.005]
$BankS_{coo,t-1}$	-3.257***	[0.044]	-1.436***	[0.010]	-2.981***	[0.052]	-0.290***	[0.005]	-2.807***	[0.055]	-0.137***	[0.006]
$TypeS_{coo,t-1}$	-0.660***	[0.024]	0.202***	[0.005]	-0.826***	[0.026]	0.090***	[0.003]	-0.893***	[0.026]	0.052***	[0.003]
$BankS_{com,t-1}$	-0.661***	[0.039]	-0.728***	[0.007]	0.481***	[0.052]	0.143***	[0.006]	0.348***	[0.053]	0.058***	[0.005]
$TypeS_{com,t-1}$	0.520***	[0.015]	0.096***	[0.003]	0.328***	[0.015]	-0.027***	[0.002]	0.318***	[0.015]	-0.015***	[0.002]
$precrisis_{t-1}$	0.903***	[0.049]	1.393***	[0.012]	0.022	[0.058]	0.310***	[0.007]	-0.349***	[0.057]	0.261***	[0.006]
MSG_{t-1}	-3.076***	[0.119]	0.256***	[0.009]	-4.828***	[0.125]	0.224***	[0.007]	-4.741***	[0.117]	0.300***	[0.005]
Constant	0.152**	[0.077]	0.959***	[0.016]	16.700***	[0.340]	-5.781***	[0.041]	60.947***	[1.155]	-0.598***	[0.126]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.098		0.551		0.152		0.879		0.18		0.911	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.10: Impact of media sentiment on the growth of sight deposits and the corresponding interest rates of commercial banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	-0.672***	[0.209]	0.093***	[0.017]	-0.442**	[0.206]	-0.012	[0.011]	-0.525***	[0.202]	0.000	[0.010]
$BankS_{sav,t-1}$	1.950***	[0.114]	0.423***	[0.009]	3.368***	[0.115]	0.031***	[0.006]	2.316***	[0.113]	0.144***	[0.006]
$TypeS_{sav,t-1}$	0.375***	[0.069]	0.064***	[0.007]	0.05	[0.074]	-0.112***	[0.004]	0.302***	[0.072]	-0.074***	[0.004]
$BankS_{coo,t-1}$	-2.068***	[0.066]	-0.800***	[0.006]	-3.596***	[0.077]	-0.175***	[0.004]	-3.355***	[0.080]	-0.114***	[0.004]
$TypeS_{coo,t-1}$	-0.874***	[0.035]	0.144***	[0.003]	-0.580***	[0.038]	0.036***	[0.002]	-0.668***	[0.037]	0.025***	[0.002]
$BankS_{com,t-1}$	-0.650***	[0.066]	-0.469***	[0.004]	0.041	[0.079]	0.020***	[0.004]	-0.247***	[0.079]	0.002	[0.004]
$TypeS_{com,t-1}$	-0.119***	[0.026]	0.087***	[0.002]	0.096***	[0.026]	-0.004***	[0.001]	-0.067***	[0.025]	0.015***	[0.001]
$precrisis_{t-1}$	1.194***	[0.077]	0.851***	[0.007]	1.755***	[0.079]	0.222***	[0.005]	1.716***	[0.078]	0.225***	[0.005]
MSG_{t-1}	-1.836***	[0.152]	0.212***	[0.008]	-2.300***	[0.164]	0.119***	[0.008]	-2.032***	[0.150]	0.151***	[0.008]
Constant	0.250**	[0.118]	0.342***	[0.009]	14.550***	[0.554]	-2.033***	[0.030]	57.245***	[1.595]	-5.897***	[0.114]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.035		0.646		0.063		0.851		0.113		0.873	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.11: Impact of media sentiment on the growth of time deposits and the corresponding interest rates of commercial banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
$BankS_{i,o,\tau-1}$	2.154***	[0.335]	0.097***	[0.030]	1.301***	[0.317]	-0.035**	[0.016]	1.516***	[0.308]	-0.023	[0.015]
$BankS_{sav,t-1}$	6.276***	[0.178]	-0.161***	[0.017]	-0.674***	[0.208]	-0.039***	[0.010]	0.612***	[0.206]	-0.003	[0.010]
$TypeS_{sav,t-1}$	0.002	[0.119]	-0.094***	[0.012]	-1.736***	[0.113]	-0.278***	[0.006]	-1.833***	[0.110]	-0.209***	[0.006]
$BankS_{coo,t-1}$	-7.136***	[0.097]	-1.495***	[0.011]	-4.019***	[0.124]	-0.308***	[0.006]	-4.343***	[0.131]	-0.210***	[0.006]
$TypeS_{coo,t-1}$	-0.247***	[0.055]	0.135***	[0.005]	-1.274***	[0.059]	0.071***	[0.003]	-1.325***	[0.056]	0.043***	[0.003]
$BankS_{com,t-1}$	0.120	[0.101]	-0.650***	[0.008]	1.622***	[0.143]	0.103***	[0.006]	1.793***	[0.134]	0.049***	[0.006]
$TypeS_{com,t-1}$	1.194***	[0.036]	0.122***	[0.003]	0.275***	[0.040]	0.019***	[0.002]	0.500***	[0.039]	0.030***	[0.002]
$precrisis_{t-1}$	2.405***	[0.113]	1.379***	[0.013]	-0.548***	[0.142]	0.377***	[0.007]	-1.026***	[0.141]	0.386***	[0.007]
MSG_{t-1}	-8.372***	[0.162]	0.153***	[0.008]	-10.921***	[0.179]	0.306***	[0.006]	-11.204***	[0.183]	0.362***	[0.006]
Constant	-0.404**	[0.179]	2.607***	[0.018]	11.322***	[0.839]	-6.849***	[0.043]	117.073***	[2.967]	-2.416***	[0.141]
$MACRO_t$					X		X		X		X	
$SIZE_{t-1}$									X		X	
$RISK_{t-2}$									X		X	
adj. R^2	0.096		0.587		0.182		0.882		0.242		0.897	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Remus et al. (2010). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.12: Effect of bank risk measures on finance-adjusted bank sentiment

	Model 1		Model 2		Model 3	
$CREDIT_{t-1}$	0.139***	[0.021]	0.108***	[0.021]	0.014	[0.022]
LTG_{t-1}	-0.130***	[0.024]	0.013	[0.024]	0.128***	[0.025]
$Tier1_{t-1}$	0.099***	[0.025]	0.095***	[0.025]	0.070**	[0.031]
$SIZE_t$	0.000	[0.005]	0.016***	[0.005]	-0.004	[0.005]
$precrisis_t$			0.046***	[0.001]	0.038***	[0.001]
PRM_t			-0.036***	[0.002]	-0.032***	[0.003]
$HICPgr_{t-1}$					0.262***	[0.096]
$URgr_{t-1}$					-0.025**	[0.010]
$GDPgr_{t-1}$					0.002***	[0.000]
$IRSTRUC_{t-1}$					0.004***	[0.000]
$RealEx_{t-1}$					0.001***	[0.000]
Constant	0.022	[0.026]	-0.073***	[0.026]	-0.023	[0.030]
Observations	109,777		109,777		109,777	
adj. R^2	0.088		0.099		0.103	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: All models include the interaction between bank i and outlet o capturing fixed effects of bank i being covered in newspaper o. Heteroscedasticity robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels. *: $p < 0.10$, **: $p < 0.05$, ***: $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Bannier et al. (2019). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.13: Differences in the impact of bank risk taking on finance-adjusted media sentiment in regional and national outlets

	Model 1		Model 2		Model 3	
$CREDIT_{t-1}$	0.133***	[0.030]	0.110***	[0.029]	0.042	[0.031]
LTG_{t-1}	-0.133***	[0.032]	0.011	[0.032]	0.102***	[0.034]
$Tier1_{t-1}$	0.085**	[0.037]	0.063*	[0.037]	0.081*	[0.046]
$SIZE_t$	0.004	[0.007]	0.020***	[0.007]	0.005	[0.007]
$HICPgr_{t-1}$					0.178	[0.137]
$URgr_{t-1}$					-0.030**	[0.014]
$GDPgr_{t-1}$					0.002***	[0.000]
$IRSTRUC_{t-1}$					0.002***	[0.001]
$RealEx_{t-1}$					0.001***	[0.000]
$CREDIT_{t-1} * D^{nat}$	0.015	[0.042]	0.000	[0.042]	-0.059	[0.043]
$LTG_{t-1} * D^{nat}$	0.011	[0.047]	0.007	[0.047]	0.063	[0.049]
$Tier1_{t-1} * D^{nat}$	0.036	[0.050]	0.067	[0.050]	-0.034	[0.061]
$SIZE_t * D^{nat}$	-0.007	[0.009]	-0.007	[0.009]	-0.018*	[0.009]
$HICPgr_{t-1} * D^{nat}$					0.194	[0.188]
$URgr_{t-1} * D^{nat}$					0.012	[0.019]
$GDPgr_{t-1} * D^{nat}$					0.001***	[0.000]
$IRSTRUC_{t-1} * D^{nat}$					0.003***	[0.001]
$RealEx_{t-1} * D^{nat}$					0.000***	[0.000]
$precrisis_t$			0.046***	[0.001]	0.038***	[0.002]
MSG_t			-0.036***	[0.002]	-0.032***	[0.003]
Constant	0.020	[0.026]	-0.075***	[0.026]	-0.022	[0.030]
Observations	109,777		109,777		109,777	
adj. R^2	0.088		0.099		0.103	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations.
Note: All models include the interaction between bank i and outlet o capturing fixed effects of bank i being covered in newspaper o. Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Bannier et al. (2019). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.14: Differences in the effect of bank risk on finance-adjusted media sentiment depending on bank type

	Model 1		Model 2		Model 3	
$CREDIT_{t-1}$	-0.168***	[0.062]	-0.102*	[0.062]	-0.157**	[0.063]
LTG_{t-1}	0.043	[0.054]	0.252***	[0.055]	0.319***	[0.055]
$Tier1_{t-1}$	0.097	[0.068]	0.079	[0.068]	0.117*	[0.071]
$SIZE_t$	-0.087**	[0.037]	0.000	[0.037]	0.040	[0.038]
$CREDIT_{t-1} * COO$	0.215***	[0.082]	0.136*	[0.082]	0.152*	[0.082]
$LTG_{t-1} * COO$	-0.251***	[0.072]	-0.367***	[0.072]	-0.396***	[0.072]
$Tier1_{t-1} * COO$	0.056	[0.178]	0.163	[0.179]	0.181	[0.179]
$SIZE_t * COO$	0.154***	[0.042]	0.103**	[0.042]	0.047	[0.043]
$CREDIT_{t-1} * COM$	0.375***	[0.067]	0.256***	[0.067]	0.185***	[0.067]
$LTG_{t-1} * COM$	-0.219***	[0.064]	-0.305***	[0.064]	-0.215***	[0.065]
$Tier1_{t-1} * COM$	0.022	[0.074]	0.016	[0.074]	-0.058	[0.074]
$SIZE_t * COM$	0.093**	[0.037]	0.019	[0.038]	-0.045	[0.038]
$HICPgr_{t-1}$					0.265***	[0.096]
$URgr_{t-1}$					-0.024**	[0.010]
$GDPgr_{t-1}$					0.003***	[0.000]
$IRSTRUC_{t-1}$					0.004***	[0.000]
$RealEx_{t-1}$					0.001***	[0.000]
precrisis			0.046***	[0.001]	0.039***	[0.002]
MSG			-0.036***	[0.002]	-0.032***	[0.003]
Constant	0.026	[0.028]	-0.081***	[0.028]	-0.031	[0.032]
Observations	109,777		109,777		109,777	
adj. R^2	0,089		0.100		0.103	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations.
Note: All models include the interaction between bank i and outlet o capturing fixed effects of bank i being covered in newspaper o. Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Bannier et al. (2019). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$.

Table C.15: Impact of media sentiment on deposit growth and corresponding interest rate

	Model 1		Model 2		Model 3	
	ΔDEP	IR	ΔDEP	IR	ΔDEP	IR
Panel A: Sight deposits						
$BankS_{i,o,\tau-1}$	-0.567***	0.011	-0.126	0.007	-0.297**	0.009
	[0.120]	[0.012]	[0.119]	[0.006]	[0.117]	[0.006]
$BankS_{t-1}$			-0.034**	-0.016***	-0.137***	-0.005***
			[0.016]	[0.001]	[0.016]	[0.001]
adj. R^2	0.013	0.493	0.040	0.846	0.081	0.866
Observations	109,696	109,696	109,696	109,696	108,147	108,147
Panel B: Time deposits						
$BankS_{i,o,\tau-1}$	1.945***	-0.077***	0.800***	0.026***	1.002***	0.021**
	[0.195]	[0.023]	[0.184]	[0.010]	[0.181]	[0.009]
$BankS_{t-1}$			-0.165***	-0.006***	0.013	-0.002
			[0.031]	[0.002]	[0.029]	[0.001]
adj. R^2	0.043	0.285	0.161	0.868	0.205	0.883
Observations	109,696	109,696	109,696	109,696	108,147	108,147
Panel C: All deposits						
$BankS_{i,o,\tau-1}$	0.229***	-0.053**	-0.009	0.013	-0.061	0.006
	[0.081]	[0.021]	[0.079]	[0.009]	[0.078]	[0.008]
$BankS_{t-1}$			0.006	-0.008***	0.008	-0.004***
			[0.012]	[0.001]	[0.012]	[0.001]
adj. R^2	0.022	0.257	0.093	0.864	0.121	0.900
Observations	109,696	109,696	109,696	109,696	108,147	108,147
$precrisis_{t-1}$	x	x	x	x	x	x
PRM_{t-1}	x	x	x	x	x	x
$Macro_t$			x	x	x	x
$RISK_{t-2}$					x	x

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Bannier et al. (2019). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. $BankS_i$ is the articles sentiment regarding bank i in outlet o. $BankS$ is the monthly average across all bank-related articles and bank types. The constant is not reported.

Table C.16: Impact of media sentiment on the growth of deposits and the corresponding interest rates of savings banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
Panel A: Sight deposits												
$SENT_{i,o,\tau-1}$	-0.124	[0.138]	0.055**	[0.026]	-0.158	[0.128]	0.021	[0.016]	-0.153	[0.127]	0.005	[0.015]
$SENT_{sav,t-1}$					-0.208***	[0.030]	-0.044***	[0.004]	-0.206***	[0.030]	-0.031***	[0.004]
$SENT_{coo,t-1}$					-0.069**	[0.023]	-0.025***	[0.003]	-0.048*	[0.024]	-0.021***	[0.003]
$SENT_{com,t-1}$					-0.057***	[0.014]	0.006**	[0.002]	-0.047**	[0.014]	0.008***	[0.002]
adj. R^2	0.139		0.669		0.251		0.879		0.263		0.893	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	
Panel B: Time deposits												
$SENT_{i,o,\tau-1}$	0.022	[0.366]	0.135***	[0.045]	-0.021	[0.324]	0.074***	[0.025]	0.006	[0.324]	0.032	[0.023]
$SENT_{sav,t-1}$					0.287***	[0.073]	-0.107***	[0.006]	0.303***	[0.073]	-0.077***	[0.006]
$SENT_{coo,t-1}$					-0.418***	[0.053]	-0.067***	[0.005]	-0.428***	[0.055]	-0.033***	[0.004]
$SENT_{com,t-1}$					0.271***	[0.037]	0.033***	[0.003]	0.314***	[0.036]	0.032***	[0.003]
adj. R^2	0.228		0.600		0.384		0.877		0.396		0.895	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	
Panel C: All deposits												
$SENT_{i,o,\tau-1}$	0.022	[0.366]	0.135***	[0.045]	-0.256**	[0.102]	0.065***	[0.018]	-0.168*	[0.097]	0.023	[0.016]
$SENT_{sav,t-1}$					0.072**	[0.022]	-0.078***	[0.004]	0.039	[0.021]	-0.054***	[0.004]
$SENT_{coo,t-1}$					-0.252***	[0.019]	-0.046***	[0.004]	-0.225***	[0.018]	-0.033***	[0.003]
$SENT_{com,t-1}$					0.100***	[0.012]	0.015***	[0.002]	0.115***	[0.012]	0.013***	[0.002]
adj. R^2	0.228		0.600		0.170		0.902		0.240		0.922	
Observations	14,235		14,235		14,235		14,235		14,235		14,235	
$precrisis_{t-1}$	X		X		X		X		X		X	
PRM_{t-1}	X		X		X		X		X		X	
$Macro_t$					X		X		X		X	
$RISK_{t-2}$									X		X	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Bannier et al. (2019). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. The constant is not reported.

Table C.17: Impact of media sentiment on the growth of deposits and the corresponding interest rates of cooperative banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
Panel A: Sight deposits												
$SENT_{i,o,\tau-1}$	0.121	[0.482]	-0.053	[0.056]	0.237	[0.469]	-0.037	[0.037]	0.131	[0.474]	0.015	[0.033]
$SENT_{sav,t-1}$					0.297**	[0.105]	-0.026**	[0.008]	0.317**	[0.105]	-0.024***	[0.007]
$SENT_{coo,t-1}$					0.180*	[0.084]	-0.032***	[0.007]	0.169*	[0.085]	-0.029***	[0.006]
$SENT_{com,t-1}$					-0.057	[0.056]	0.007	[0.005]	-0.077	[0.058]	0.009*	[0.004]
adj. R^2	0.135		0.525		0.189		0.803		0.202		0.851	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	
Panel B: Time deposits												
$SENT_{i,o,\tau-1}$	-0.037	[1.018]	-0.022	[0.098]	-0.394	[0.980]	0.046	[0.059]	-0.853	[0.978]	0.061	[0.057]
$SENT_{sav,t-1}$					0.703**	[0.217]	-0.021	[0.015]	0.951***	[0.217]	-0.010	[0.014]
$SENT_{coo,t-1}$					-0.445**	[0.145]	-0.033**	[0.011]	-0.337*	[0.149]	-0.017	[0.010]
$SENT_{com,t-1}$					-0.416***	[0.119]	0.021**	[0.008]	-0.413***	[0.122]	0.026***	[0.007]
adj. R^2	0.156		0.546		0.261		0.835		0.292		0.857	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	
Panel C: All deposits												
$SENT_{i,o,\tau-1}$	-0.461	[0.370]	-0.097	[0.079]	-0.508	[0.366]	-0.052	[0.045]	-0.646*	[0.374]	0.014	[0.038]
$SENT_{sav,t-1}$					0.436***	[0.082]	-0.036***	[0.011]	0.503***	[0.084]	-0.027**	[0.009]
$SENT_{coo,t-1}$					-0.030	[0.056]	-0.035***	[0.009]	0.005	[0.058]	-0.025***	[0.007]
$SENT_{com,t-1}$					-0.029	[0.046]	-0.003	[0.006]	-0.050	[0.048]	-0.004	[0.005]
adj. R^2	0.141		0.551		0.172		0.858		0.180		0.903	
Observations	4,229		4,229		4,229		4,229		4,090		4,090	
$precrisis_{t-1}$	X		X		X		X		X		X	
PRM_{t-1}	X		X		X		X		X		X	
$Macro_t$					X		X		X		X	
$RISK_{t-2}$									X		X	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Bannier et al. (2019). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. The constant is not reported.

Table C.18: Impact of media sentiment on the growth of deposits and the corresponding interest rates of commercial banks

	Model 1				Model 2				Model 3			
	ΔDEP		IR		ΔDEP		IR		ΔDEP		IR	
Panel A: Sight deposits												
$SENT_{i,o,\tau-1}$	-0.348**	[0.137]	0.078***	[0.011]	-0.189	[0.136]	0.004	[0.007]	-0.350***	[0.134]	0.007	[0.006]
$SENT_{sav,t-1}$					0.647***	[0.035]	-0.016***	[0.002]	0.528***	[0.035]	0.025***	[0.002]
$SENT_{coo,t-1}$					-1.057***	[0.025]	-0.028***	[0.001]	-0.935***	[0.025]	-0.014***	[0.001]
$SENT_{com,t-1}$					0.195***	[0.016]	0.002	[0.001]	0.064***	[0.016]	-0.000	[0.001]
adj. R^2	0.037		0.653		0.062		0.847		0.108		0.872	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	
Panel B: Time deposits												
$SENT_{i,o,\tau-1}$	1.410***	[0.213]	0.093***	[0.019]	0.807***	[0.203]	-0.005	[0.010]	1.047***	[0.198]	-0.003	[0.010]
$SENT_{sav,t-1}$					0.350***	[0.050]	-0.013***	[0.003]	0.580***	[0.050]	0.018***	[0.003]
$SENT_{coo,t-1}$					-1.182***	[0.038]	-0.133***	[0.002]	-1.377***	[0.041]	-0.113***	[0.002]
$SENT_{com,t-1}$					0.063*	[0.032]	0.035***	[0.001]	0.223***	[0.030]	0.023***	[0.001]
adj. R^2	0.106		0.598		0.186		0.882		0.249		0.898	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	
Panel C: All deposits												
$SENT_{i,o,\tau-1}$	0.110	[0.090]	0.103***	[0.018]	-0.009	[0.087]	-0.011	[0.010]	-0.050	[0.086]	-0.010	[0.008]
$SENT_{sav,t-1}$					0.482***	[0.022]	-0.033***	[0.003]	0.516***	[0.023]	0.009***	[0.002]
$SENT_{coo,t-1}$					-0.995***	[0.013]	-0.074***	[0.002]	-0.940***	[0.013]	-0.034***	[0.002]
$SENT_{com,t-1}$					0.214***	[0.013]	0.026***	[0.001]	0.184***	[0.012]	0.005***	[0.001]
adj. R^2	0.113		0.549		0.159		0.873		0.189		0.910	
Observations	91,232		91,232		91,232		91,232		89,822		89,822	
$precrisis_{t-1}$	X		X		X		X		X		X	
PRM_{t-1}	X		X		X		X		X		X	
$Macro_t$					X		X		X		X	
$RISK_{t-2}$									X		X	

Source: *LexisNexis*, Handelsblatt, Frankfurter Allgemeine Zeitung, Deutsche Bundesbank. Own calculations. *Note*: Heteroscedasticity-robust standard errors in brackets using the Huber/White/sandwich estimator (White, 1980). Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Bank sentiment is calculated for each article based on the dictionary in Bannier et al. (2019). The sentiment score is then divided by the number of words in the respective article, and scaled into the range $[-1, 1]$. The constant is not reported.

Table C.19: Shorrocks-Shapley decomposition of R^2 for OLS estimations for interest rates across bank types

Dependent Variable: Interest rate for	All Deposits			Sight Deposits			Time Deposits		
	Coeff.	s.e.	Shapley	Coeff.	s.e.	Shapley	Coeff.	s.e.	Shapley
				Commercial banks					
$IRSTRUC_{t-1}$	-0.564***	[0.018]	0.327	-0.497***	[0.019]	0.300	-0.507***	[0.021]	0.262
$GDPgr_{t-1}$	-0.013**	[0.007]	0.010	0.016***	[0.006]	0.012	-0.046***	[0.009]	0.024
$URgr_{t-1}$	0.771	[0.502]	0.001	0.633	[0.483]	0.001	0.467	[0.595]	0.001
$HICPgr_{t-1}$	-1.558	[4.808]	0.000	0.604	[4.757]	0.001	-3.153	[5.675]	0.000
$RealEx_{t-1}$	0.089***	[0.004]	0.175	0.071***	[0.004]	0.121	0.082***	[0.005]	0.171
$precrisis_t$									
and MSG_t	X		0.027	X		0.032	X		0.022
$RISK_{t-1}$	X		0.091	X		0.102	X		0.050
$SIZE_t$	X		0.021	X		0.023	X		0.010
R^2	0.652			0.592			0.541		
Observations	1,197			1,197			1,197		
				Cooperative banks					
$IRSTRUC_{t-1}$	-0.462***	[0.009]	0.381	-0.318***	[0.007]	0.353	-0.444***	[0.010]	0.303
$GDPgr_{t-1}$	-0.019***	[0.003]	0.017	0.010***	[0.002]	0.013	-0.038***	[0.004]	0.035
$URgr_{t-1}$	1.189***	[0.211]	0.001	0.679***	[0.167]	0.001	1.150***	[0.279]	0.001
$HICPgr_{t-1}$	-0.625	[2.210]	0.000	0.649	[1.760]	0.001	-1.683	[2.751]	0.000
$RealEx_{t-1}$	0.078***	[0.002]	0.244	0.055***	[0.001]	0.197	0.095***	[0.002]	0.301
$precrisis_t$									
and MSG_t	X		0.043	X		0.045	X		0.034
$RISK_{t-1}$	X		0.049	X		0.056	X		0.017
$SIZE_t$	X		0.003	X		0.007	X		0.007
R^2	0.739			0.672			0.698		
Observations	2,690			2,690			2,690		
				Savings banks					
$IRSTRUC_{t-1}$	-0.410***	[0.006]	0.369	-0.255***	[0.005]	0.294	-0.445***	[0.007]	0.318
$GDPgr_{t-1}$	-0.009***	[0.002]	0.014	0.005***	[0.001]	0.009	-0.025***	[0.003]	0.018
$URgr_{t-1}$	1.195***	[0.143]	0.002	0.720***	[0.117]	0.001	0.773***	[0.192]	0.001
$HICPgr_{t-1}$	-0.408	[1.465]	0.000	0.753	[1.198]	0.000	-3.316*	[1.908]	0.000
$RealEx_{t-1}$	0.079***	[0.001]	0.276	0.047***	[0.001]	0.188	0.080***	[0.002]	0.262
$precrisis_t$									
and MSG_t	X		0.043	X		0.043	X		0.035
$RISK_{t-1}$	X		0.055	X		0.100	X		0.070
$SIZE_t$	X		0.001	X		0.018	X		0.012
R^2	0.759			0.654			0.715		
Observations	4,894			4,894			4,894		

Source: Deutsche Bundesbank, own calculations. *Note*: The Shapley-columns show the Shorrocks-Shapley decomposition of R^2 for all macroeconomic variables separately and for the dummy variables precrisis and MSG and banks' balance sheet-based risk indicators, respectively. Interest rate for all deposits is calculated as an volume-weighted average deposit rate for sight and time deposits. Robust standard errors in brackets. Asterisks indicate significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Constant not reported.

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List of individual papers

Chapter 2 is based on Arnold et al. (2016) and was largely written while I was working at the chair of Ingrid Größl. The idea of this paper, the compilation of the literature survey and the interpretation of the findings resulted from a close collaboration with Ingrid Größl. While the choice of the econometric techniques and writing the STATA codes required for analyzing the data was my sole responsibility, Stephan Beitz provided excellent research assistance. Philipp Koziol has collected the various data sources necessary for conducting this paper's analysis and supported the revision of the earlier draft during the processes of publishing.

All aspects of Chapter 3 have been my sole responsibility.

Eugen Cleveland provided the bank-specific and macroeconomic data sources for the Analyses in Chapter 4. The idea of this paper, the choice of econometric techniques, the compilation of the literature survey, and the paper were my sole responsibilities.

Erklärung

Hiermit erkläre ich, Eva Asja Arnold, dass ich keine kommerzielle Promotionsberatung in Anspruch genommen habe. Die Arbeit wurde nicht schon einmal in einem früheren Promotionsverfahren angenommen oder als ungenügend beurteilt.

Ort/Datum

Unterschrift Doktorand/in

Eidesstattliche Versicherung

Ich, Eva Asja Arnold, versichere an Eides statt, dass ich die Dissertation mit dem Titel:

"Market Discipline and Media Influence in the German Banking Industry"

selbst und bei einer Zusammenarbeit mit anderen Wissenschaftlerinnen oder Wissenschaftlern gemäß den beigefügten Darlegungen nach § 6 Abs. 3 der Promotionsordnung der Fakultät für Wirtschafts- und Sozialwissenschaften vom 18. Januar 2017 verfasst habe. Andere als die angegebenen Hilfsmittel habe ich nicht benutzt.

Ort/Datum

Unterschrift Doktorand/in