Financial Constraints and Corporate Credit Ratings

Essays in Corporate Finance and Risk Management

Dissertation

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To my Partner and my Parents.

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Synopsis

The 2008 global financial crisis tremendously impacted the supply of external financing for non-financial firms. Banks' behaviour in lending became extremely risk-averse and even more upside-oriented investors like private equity firms reduced their investments. Consequently, external financing became a critical issue for the global economy and financial constraints regarding the degree of access to external financing dramatically increased during this period.

Simultaneously, rating agencies were strongly criticised for the role they played before and during this crisis and were accused of wrong assessments and inaccurate credit ratings. Based on this criticism, regulatory authorities started to introduce a closer supervision of rating agencies and implemented new regulatory requirements, which more precisely defined the use of credit ratings as investment criterion for institutional investors.

Due to these regulatory developments, the relationship between credit ratings and the supply of external financing became stronger. Therefore, credit ratings might help to better model the impact of financial constraints and to overcome some of the shortcomings related to traditional measures of financial constraints.

Since almost three decades, there has already been detailed research providing evidence on the effects of financial constraints on firms' financing and investment patterns. The 2008 global financial crisis was also the starting point for a broader range of research studies dealing with the relationship between credit ratings and firms' capital structure and financing decisions.

Following the publication of Fazzari et al.'s (1988) seminal paper, investigating the economic effects of financial constraints has been of growing importance in the Corporate Finance literature, where constrained firms are considered to rely more on internal finance than unconstrained firms. While cash flows might serve more as an immediate source of funding, cash holdings could be used to finance long-term and future investment projects. As Myers and Majluf (1984) show in the pecking order theory, funding requirements, which cannot or shall not be met by internal funds must

be financed by raising capital from external lenders or investors. Contrariwise, there could exist a trade-off between raising external funds and using cash reserves. This is referred to as the trade-off theory (Shyam-Sunder and Myers, 1999; Frank and Goyal, 2008). An alternative explanation for why firms might raise debt and simultaneously hold cash is suggested by the free cash flow theory (Jensen, 1986), which suggests that firms are investing in negative net present value projects. In a more recent study, Denis and Sibilkov (2010) provide evidence on the simultaneous relationship between firm value, liquid funds and investment behaviour with respect to the financial constraints status. This analysis also requires a reliable measure for the degree of access to capital markets in order to determine whether firms belong either to the constrained or the unconstrained group. Recent studies have mainly applied four different classification criteria, i.e., dividend pay-out behaviour, firm size, the existence of a credit rating and a firm's rating status (Almeida et al., 2004; Campello and Chen, 2010). All of these financial constraints measures may, however, have several shortcomings. There exist a large number of studies, which have challenged different measures of financial constraints and provide evidence that some of them could only be marginally appropriate in differentiating between both groups of firms, and others may be highly sample-specific, e.g.:

- Firms with high dividend pay-out ratios are supposed either to have sufficient internal resources due to retained earnings in the previous years or high free cash flows or to have low investment opportunities (Gilchrist and Himmelberg, 1995; Cleary, 2006). Therefore, they are widely independent from external funds and access to capital markets is less important for them. However, a firm's pay-out policy may also rely on the overall corporate policy and management decisions, which, for example, might seek to hold dividend pay-outs stable over several years in order not to give a negative signal to equity investors when they plan a seasoned equity offering in future years (Brav et al., 2005).

- Larger firms are considered less constrained (Gertler and Gilchrist, 1994; Whited, 2006) because they are better known and often listed on a stock exchange. Thus, they can mitigate problems, which may arise from information asymmetries. However, this may particularly hold only for the access to public capital markets. Additionally, due to the typically higher borrowing amount, larger firms may benefit from economies of scale in external financing costs (Altınkılıç and Hansen, 2000). However, access to

private capital markets, bank financing and non-bank financing might not necessarily be limited for smaller or privately-held firms due to supply of external financing through financial intermediaries such as banks and institutional investors based on detailed insights into firms (Vander Vennet, 2002). Also, they may require collateral or certain financial and legal covenants, which can strengthen their position in a default scenario (Boot, 2000). In addition, Carreira and Silva (2012) report a non-monotonic relationship between firm size and the financial constraints status.

- A credit rating provided by an external credit rating agency such as Standard & Poor's or Moody's is an objective assessment of a firm's creditworthiness in terms of risk of default and is often required to raise debt from banks or capital markets, thus easing the access to outside financing (Whited, 1992; Denis and Sibilkov, 2010). Also, there exist several regulatory frameworks (e.g., for pension funds and insurance companies) or investors' internal guidelines, which exclusively allow investors to allocate their investment capital to (highly-)rated firms (Boot et al., 2006). Additionally, credit ratings can reduce information asymmetries due to the close monitoring through external credit rating agencies and the publication of detailed firm-level information in their rating reports. Even though a credit rating is an assessment of a firm's creditworthiness, it has been empirically found that also equity investors are sensitive to credit ratings and credit rating changes because they are supposed to contain additional information, which can serve as a signal to outside investors (Norden and Weber, 2004). Many firms are, however, not publicly rated even though they may belong to the highest-ranked group with respect to creditworthiness. Therefore, financial intermediaries and investors may still allocate funds to these firms due to their internal credit risk assessment processes, which can also comply with regulatory requirements (Grunert et al., 2005).

- In addition, investment grade rated companies often have a significantly better access to external financing (Boot et al., 2006; Hann et al., 2013). The cost of external debt disproportionately increases with lower ratings due to the exponential increase of default rates across lower rating categories (Datta et al., 1999). With respect to the aforementioned regulatory requirements, there also often exists a minimum rating below which some investors are prohibited to invest. Moreover, this measure eases the classification of firms into more than two groups because it can be assumed that the degree of access to external financing is directly related to different rating levels.

However, the same criticism applies as for the rated/not rated financial constraints indicator with respect to non-rated high-creditworthy firms. In addition, a sample split based on this measure is only appropriate for firms, which have a public rating.

Nevertheless, several survey studies have found that CFOs of listed and privately-held companies consider credit ratings highly relevant when undertaking financing decisions, and this holds particularly for debt-based financing choices (Graham and Harvey, 2001; Brounen et al., 2006). There are an increasing number of empirical studies investigating the effects of credit ratings and credit rating changes on capital structure decisions (Kisgen, 2006; Agha, 2011). They find that credit ratings issued by external rating agencies are significant in explaining firms' financing decisions.

This strand of the literature has been extended by various aspects such as the relationship between capital structure decisions and credit ratings (Hovakimian et al., 2009; Baghai et al., 2014), the relationship between ratings and the probability of default (Hilscher and Wilson, 2013; Löffler, 2013), rating transitions (Du and Suo, 2005; Friedman et al., 2011), bank-internal credit rating systems (Carey and Hrycay, 2001; Krahnen and Weber, 2001), numerous methodological approaches (Han and Shin, 2001; Altman et al., 2010), and different sets of quantitative and qualitative drivers for corporate ratings.

There is, however, increasing evidence that bank-internal ratings or external credit risk assessments through financial service providers besides credit rating agencies may also be appropriate measures of financial constraints. In recent years, several studies have applied a credit rating index provided by Italian CeBi. Bottazzi et al. (2014) note that due to CeBi's strong institutional role in the Italian banking system, their index is acknowledged as an official credit rating in the Italian financial markets. They provide a comprehensive study on the effects of financial constraints on firm growth. Their findings suggest that firm size and age systematically differ between different groups of limited liability firms in the manufacturing industries in Italy with respect to their financial constraints status. They argue that, contrary to other financial constraints measures, credit ratings implicitly incorporate firms' credit risk assessment through financial intermediaries and outside investors, which ultimately decide on the allocation of funds to these firms. Moreover, the use of these credit rating indices avoids the disadvantages of applying external credit ratings conducted through credit rating agencies. In addition, Panetta et al. (2009) and Guiso et al. (2010) find

that there exists a significant relationship between the CeBi rating and the cost of debt financing and the supply of credit, respectively. Further studies provide similar evidence on the CeBi credit rating index, e.g., Sangalli (2013) and Secchi et al. (2014).

Czarnitzki (2006) estimates the impact of financial constraints on R&D investment of German firms. Contrary to similar studies, his dataset contains small and medium enterprises (SME). To test the direct effect of external financial constraints, Czarnitzki applies a firm-level credit score. This credit score is provided by German enquiry agency Creditreform and captures quantitative and qualitative information on firms' creditworthiness applying a highly standardised approach. Therefore, it is not equivalent to a credit rating provided by an external credit rating agency, which is based on an analyst-driven approach. While the results in similar studies only suggest a weak relationship between financial constraints and R&D investment in Germany, he finds a significant relationship for firms in West Germany. R&D investment of firms in East Germany is not dependent on external financial constraints. He argues that R&D subsidies play an important role in firms' R&D investment behaviour. It is noteworthy that his results on the significance of this financial constraints measure are consistent throughout a number of robustness tests. Similarly, Egeln et al. (1997), Müller and Zimmermann (2009) and Czarnitzki and Hottenrott (2011) provide further evidence on the significant relationship between credit risk assessments provided by Creditreform and financial constraints.

The findings in these studies suggest that credit scores or bank-internal ratings may be considered a reliable proxy for classifying firms according to their financial constraints status. However, there exist only a small number of further studies, which apply credit risk assessments as a proxy for firms' access to external financing; e.g., Garmaise (2008) and Rice and Strahan (2010) use credit scores from Dun and Bradstreet, and the sorting mechanism in Gatchev et al. (2010) is based on the Shumway (2001) risk of default estimation.

This dissertation shall shed some light on both, traditional measures of financial constraints as well as the validity and reliability of credit ratings and credit risk assessments for explaining firms' financing and investing patterns.

The effects of financial constraints on firms' financing behaviour and the application of credit risk assessments as a reliable measure of firms' capital structure decisions

can be empirically tested. There exist a large number of research frameworks for financial constraints. Most of them investigate whether there exist any differences in firms' financing and investment decisions based on subsamples. These subsamples can be chosen according to one of the financial constraints measures summarised in Chapter 1, i.e., a) univariate measures related to agency problems, risk of default and firms' internal cash generating ability, b) index-based measures, c) investment-sensitivity models and d) Euler equation models. However, there is increasing evidence that estimation results can significantly vary with respect to different classification procedures or may even be opposite.

A small number of studies apply bank-internal ratings or credit risk assessments of financial service providers, which are not regulatorily registered as external credit rating agencies. Their empirical findings suggest that these risk assessments may capture information, which is substantially related to the degree of access to outside financing. Additionally, there are some major advantages over external credit ratings in terms of the available number of observations, continuous updates and the relevance of these assessments for investors and financial intermediaries. It may therefore be necessary to go beyond traditional measures of financial constraints, which have not empirically been proven to sufficiently capture information on firms' access to external financing. Thus, measuring financial constraints may particularly be based on simultaneously measuring the firm-level supply and demand of external financing, which both may be captured through credit risk assessments.

In addition to firm-level measures, some studies apply their research frameworks to several countries with different levels of financial markets development and governance structures. The relationship between firm-level and country-level measures of financial constraints is investigated in Chapter 2. Specifically, the effect of corporate governance regimes and financial market development on the value of cash holdings and investments as well as on the relationship between investment activity and liquid funds is investigated in the context of financial constraints.

The results indicate that the market value of cash reserves and investments depend on financial constraints as well as on differences in corporate governance structures and the financial market development between countries. However, the relationship between the investment activity and holding cash might also be affected by a firm's growth opportunities. Specifically, the market value of cash is greater for constrained

firms in the U.S. and in strongly governed or highly developed countries. Constrained firms might benefit from holding cash because they can undertake investment projects, which would otherwise be bypassed. This relationship is supported for the U.S. and other strongly governed and highly developed countries but becomes non-significant or even negative for less developed/poorly governed countries. This can be interpreted in the context of the life cycle hypothesis because growth opportunities may affect the investment-cash sensitivity. However, a poor corporate governance infrastructure or a weak financial market development still have detrimental effects on this relationship, and this is more pronounced for constrained firms because they could be less monitored by banks and outside investors or could undertake riskier investment projects. This view is supported by the findings on the market value of investments, which is lower for constrained firms in weakly governed/less developed countries while it is greater for the U.S. and the remaining countries.

Based on a corporate credit rating model developed in Chapter 3 and following previous research frameworks, the relationship between firms' capital structure decisions and (estimated) credit ratings is examined in Chapter 4 for U.S. and German firms. The rating model empirically investigates the determinants of corporate credit ratings from two rating agencies in terms of financial and business risk factors. The findings could make a contribution to better understand the "black box" effect of what factors drive corporate ratings when there is no mathematical or statistical model available due to the analyst-driven approach, which most rating agencies apply.

The results indicate that corporate ratings are based on both, the financial risk and business risk profile of firms. Qualitative information is significant in explaining credit ratings, and the pure financial information is – at least to some extent – predominated by soft facts. Specifically, with respect to the financial risk profile, the findings suggest that the ability to meet financial obligations, the level of debt and access to external financing are the most important factors in deriving corporate ratings. Moreover, rating agencies seemingly take into account interdependencies between financial ratios. Profitability does not significantly affect the rating assessment. Financial liquidity and strategic objectives turn out to be the most significant business risk factors. The assessment of a firm's financial planning may capture some qualitative information and, therefore, weakens the impact of the market-related qualitative criteria. Additionally, there might exist some differences between investment grade ratings

and non-investment grade ratings, where financial ratios are seemingly more important for non-investment grade ratings.

Based on that, the relationship between capital structure choices and credit ratings is investigated. The findings for U.S. companies indicate that the effect of rating changes on capital structure decisions and individual financing choices is more pronounced for rating downgrades – particularly at non-investment grade levels – than for upgrades. This result suggests that there exists a minimum target rating and that financial distress concerns are only of secondary importance. However, taking into account additional estimations of the speed of capital structure adjustment, these results show that financing activities could also be directly affected by the access to external financing and the remaining debt capacity (as well as the related financial distress concerns). In sharp contrast, publicly listed firms in Germany are widely independent from changes in their creditworthiness due to extensive bank-internal monitoring in a bank-based financial regime and their access to public capital markets. Similarly, the capital structure choices of high creditworthiness privately-held firms in Germany are more or less independent from credit rating changes; nonetheless, investment grade rated firms are relatively more proactive following an upgrade, i.e., they tend to increase leverage. However, firms at non-investment grade rating levels implement financing activities, which strengthen their capital structure subsequent to a downgrade. Both findings are supported by the results for the speed of adjustment and they indicate that their close relationship to banks helps firms mitigating otherwise substantial effects of changes in their creditworthiness. The empirical evidence for upgrades to lower rating levels remains to some extent contradictory, although it may be explained on the basis of the different levels of target leverage deviation.

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Chapter 1

A Critical Review on Firm-specific Measures of Financial Constraints

Abstract

Financial constraints refer to the degree of access to external financing. There exist different econometric models and classification schemes, which are supposed to capture information on either the pure existence of financial constraints or the degree to which these constraints may hinder firms to access external financing. It is crucial to find precise and unbiased measures of financial constraints for estimating their effects on firms' investment and capital structure decisions. However, a large number of studies have challenged these measures due to severe shortcomings and provide empirical evidence on their criticism. Recent studies have investigated whether credit ratings issued by external rating agencies are a significant element in explaining firms' capital structure behaviour. As some of the measures of financial constraints are already based on credit ratings, it should be asked whether external credit ratings or any derivatives thereof could provide an appropriate and objective measure of financial constraints.

Keywords: financial constraints, measures, univariate, sensitivity, index-based, credit ratings

JEL classification codes: G24, G30, G32

I Introduction

Since the seminal work by Fazzari et al. (1988), there has been a growing literature providing evidence on the effects of financial constraints on firms' financing and investment patterns. Financial constraints refer to the degree of access to capital markets or, more generally, external financing. Most of the studies deal with their economic effects, while they apply econometric models and classification schemes, which are supposed to capture information on either the pure existence of financial constraints or the degree to which these constraints may hinder firms to access outside financing. To a great extent, their results depend on the validity of how companies are classified into mutually exclusive groups of financially constrained and unconstrained firms. In a number of studies, it has been shown that estimation results can vary with respect to different classification schemes or may even be opposite. It is therefore crucial to find precise and unbiased measures of financial constraints.

However, the research design of many studies relies on classification procedures, which have strongly been criticised or even questioned in the past. They primarily include discrete firm-level measures such as the dividend pay-out ratio, firm size in terms of total assets or revenues, liquidity, group membership or the presence of a credit rating. Additionally, some studies have more focused on institutional classification schemes such as the relationship to financial intermediaries or group-internal financial markets.[1]

In a second strand of the literature, the sample separation is index-based. These financial constraints indices can basically be split into those where the index parameters are derived from either a qualitative assessment of company reports or firm-specific characteristics and those, which are based on an Euler equation estimation approach.

Third, a number of studies have investigated whether sensitivity analyses may be appropriate to analyse the effects arising from financial constraints. They have mainly focused on the sensitivity of investment on internally generated funds.

[1] From a more macroeconomic perspective, there also exist a number of studies, which differentiate between countries with more or less developed financial markets and different legal or governance structures (e.g., Love, 2003; Beck et al., 2005). These characteristics then serve as indicators for financial constraints across all firms in the respective country. As the focus of this paper is to review firm-level measures of financial constraints, I do not give an overview on this strand of the literature (see Carreira and Silva (2010) for a survey).

All of these approaches may have several shortcomings. There exist a large number of studies, which have challenged different measures of financial constraints and provide evidence that some of them could only be marginally appropriate in differentiating between both groups of firms, and others may be highly sample-specific. Also, some of the concepts trigger econometric issues or require data, which are not necessarily available for all firms.

Recently, there have been an increasing number of studies investigating whether credit ratings issued by external rating agencies such as Standard & Poor's or Moody's are a useful element in explaining firms' capital structure behaviour. As some of the measures of financial constraints already include either the pure presence of a credit rating or characteristics, which are similarly investigated by rating agencies, it should be asked whether external credit ratings or any derivatives thereof may provide an appropriate and more objective measure of financial constraints.

This paper is organised as follows: Section II describes and critically reviews the commonly used measures of financial constraints. Section III focuses on credit ratings as a measure of financial constraints. Section IV concludes.

II Measures of financial constraints

There exist a number of measures, which are used to classify firms according to their financial constraints status. These measures can be grouped into several subcategories with respect to their classification mechanism (univariate measures based on a single separation variable) or their econometric approach (sensitivity measures, Euler equation, index-based measures). It is noteworthy that most of the latter financial constraints measures are based on a classification scheme derived from the first group. Therefore, any interpretation of the results from an econometric approach directly depends on the discriminatory power of the underlying classification mechanism. Thus, any test can be considered – at least to some extent – as a test of the classification scheme itself. This indicates that these tests may comprise a joint hypothesis issue because the estimation outcome is conditional on the discriminatory power of the sample separation (Bruinshoofd, 2003).

A. Univariate measures

Most studies classify firms into financially constrained and unconstrained according to univariate firm-level measures, which are supposed to be highly correlated with firms' financial constraints status. These indicators are typically derived from theoretical assumptions on the relationship between the constraints status and the corresponding factor. There is supporting evidence that these indicators may capture some information related to the effects of financial constraints. However, a substantial number of studies have challenged these measures.

Most of the factors are related to either the access to external financing due to agency problems (e.g., arising from information asymmetries between firms and investors), the risk of default or firms' internal and external financing behaviour with respect to their internal cash generating ability.

These indicators have the main advantage that they are widely available for most samples on which estimates are conducted, and that they can be easily implemented in most estimation frameworks where the sample is typically split between financially constrained and unconstrained firms or according to an incremental classification, e.g., "most constrained firms", "constrained firms", "less constrained firms" and "least constrained firms". However, for each of the aforementioned measures, there may exist a different reasoning why it is correlated to firms' financial constraints status.

A.1. Firm size: Basically, larger firms in terms of total assets or turnover are considered less constrained (Devreux and Schiantarelli, 1990; Gertler and Gilchrist, 1994; Becchetti and Trovato, 2002; Carpenter and Petersen, 2002; Oliveira and Fortunato, 2006; Whited, 2006). They are better known and often listed on a stock exchange. Thus, they can mitigate problems, which may arise from information asymmetries (Jaffee and Russell, 1976; Stiglitz and Weiss, 1981; Myers and Majluf, 1984; Petersen and Rajan, 1995). While this is an intuitive assumption, it may particularly hold for one aspect of outside financing, i.e., access to public capital markets. Additionally, due to the typically higher borrowing amount, larger firms may benefit from economies of scale in external financing costs, e.g., because transaction costs such as upfront fees for external legal consultation are – at least to a certain extent – fixed and independent from the nominal issuance amount (Barclay and Smith, 1996; Altınkılıç

and Hansen, 2000). However, access to private capital markets, bank financing and non-bank financing (such as short-term trade credit) might not necessarily be limited for smaller or privately-held firms taking into account that financial intermediaries such as banks and institutional investors can request detailed insights into companies' financial reporting as well as strategic and operational measures (Audretch and Elston, 2002; Vander Vennet, 2002). Also, they may require collateral or certain financial and legal covenants, which can strengthen their position in a default scenario (Rajan and Winton, 1995; Boot, 2000). Oliner and Rudebusch (1992) find no significant relationship between the investment-cash flow sensitivity and different size classes, while Carreira and Silva (2012) report a non-monotonic/U-shaped relationship between firm size and the financial constraints status.

A.2. Firm age: Similar to larger firms, more mature firms can be considered less constrained mainly because they are better known and exhibit a reliable track record in terms of strategic and operational performance over a longer period of time (Devreux and Schiantarelli, 1990; Chirinko and Schaller, 1995; Honjo and Harada, 2006; Rauh, 2006; Fee et al., 2009). However, there exist three main frameworks for measuring firm age, i.e., date of formation, date of incorporation (stock listing) and the period of occurrence in a specific database (e.g., Brown and Kapadia, 2007; Fink et al., 2010). Each of them is applied in some studies, which makes it difficult to directly compare their empirical findings. Also, the correlation between firm age and the financial constraints status may be U-shaped (Carreira and Silva, 2012). In addition, some firms change their product portfolio or even their entire business concept over time with varying financing requirements (Hoberg et al., 2014). It is then questionable whether firm age is a good proxy for firms' financial constraints status regardless of what a firm has actually done in the last years or decades.

A.3. Dividend pay-out ratio: Firms with high dividend pay-out ratios are supposed either to have sufficient internal resources built up through retentions in the previous years and/or high free cash flows or to have low investment opportunities (Fazzari et al, 1988; Bond and Meghir, 1994; Gilchrist and Himmelberg, 1995; Cleary, 2006; Whited, 2006). Thus, they are widely independent from external funds and access to capital markets is less important for them. However, firms' pay-out policy may also rely on the overall corporate policy and management decisions, which, for example, might seek to hold dividend pay-outs stable over several years in order

not to give a negative signal to equity investors when they plan a seasoned equity offering (SEO) in future years (Brav et al., 2005).

A.4. Liquidity: Similar to the dividend pay-out ratio, measures related to firms' liquidity such as operating or free cash flows and the amount of liquid funds can be considered to be correlated with the financial constraints status in that they provide a direct indicator for a firm's ability to finance its investment projects internally (Cleary et al., 2007). However, these measures can depend on the respective reporting standards (e.g., lines of credit are not required to be reported under IFRS) and firms may hold a large portion of cash for operational purposes instead of funding future growth opportunities (Lins et al., 2010). Therefore, liquidity-based indicators may yield inaccurate classification patterns particularly if they are used on a yearly basis. Also, Almeida et al. (2004) argue that financially constrained firms may hold higher levels of cash due to their restricted access to external financing. As an alternative, Sufi (2009) argues that the access to bank lines of credit is a powerful indicator for firms' financial constraints status.

A.5. R&D investment: Investment in R&D projects is considered more financially constrained than investment in property, plant and equipment for a number of reasons (Himmelberg and Petersen, 1994; Hall et al., 1999; Hall, 2002; Colombo and Grilli, 2007; Scellato, 2007; Savignac, 2009). First, the future outcome of R&D projects is uncertain. Outside investors cannot precisely estimate the risk associated with these projects and are less willing to provide external capital. Second, firms seek to withhold most information of R&D projects from third parties in order not to threaten their competitive advantage related to these projects. This intensifies the effect that outside investors do not provide external capital to firms. Third, R&D investment enters into the balance sheet as intangible assets, which are difficult to evaluate when used as collateral for debt-based external financing. However, the effects resulting from financial constraints for R&D investment may substantially depend on the industry (e.g., pharmaceuticals; Chiao, 2002). Therefore, any classification of the financial constraints status based on R&D investment requires detailed information at the R&D project level. Also, most firms with only low or no R&D expenditures will automatically be classified as unconstrained making it difficult to further separate these firms into subgroups.

A.6. Credit rating (rated/not rated): A credit rating through an external credit rating agency such as Standard & Poor's or Moody's is an objective assessment of a firm's creditworthiness in terms of risk of default and is often required to raise debt from banks or capital markets, thus easing the access to outside financing (Whited, 1992; Gilchrist and Himmelberg, 1995; Denis and Sibilkov, 2010). Also, there exist several regulatory frameworks (e.g., for pension funds and insurance companies) or investors' internal guidelines, which exclusively allow investors to allocate their investment capital to (highly-)rated firms (see Boot et al. (2006) and Kisgen and Strahan (2010) for an overview). Additionally, credit ratings can reduce information asymmetries due to the close monitoring through external credit rating agencies and the publication of detailed firm-level information in their rating reports. Even though a credit rating is an assessment of a firm's creditworthiness and its ability to meet its debt-servicing obligations in due time, it has been empirically found that also equity investors are sensitive to credit ratings and credit rating changes because they are supposed to contain information, which can serve as a signal to outside investors (Norden and Weber, 2004). A sub-category of credit ratings are commercial paper ratings (short-term ratings), which enable firms to raise short-term debt, typically with a fixed maturity between 30 and 270 days (Calomiris et al., 1995). This short-term debt is only provided to firms with a very high creditworthiness in order to ensure that they can repay it through internally generated cash flows based on a very stable operating and financial performance at any time. They may, hence, be the least constrained firms. However, many firms are not publicly rated even though they may belong to the highest-ranked group with respect to creditworthiness. Therefore, financial intermediaries and investors may still allocate funds to these firms due to their internal credit risk assessment processes, which can also comply with regulatory requirements (see Grunert et al. (2005) for an overview). Therefore, the sole existence or non-existence of a credit rating may not be sufficient for sample classification.

A.7. Credit rating (investment grade/speculative grade): Along with the rationale behind credit ratings, investment grade rated companies (BBB- and better) often have a significantly better access to external financing (Boot et al., 2006; Hann et al., 2013; similarly, Fee et al. (2009) apply a BBB+ threshold). In addition, the cost of external debt disproportionately increases with lower ratings due to the exponential increase of default rates across lower rating categories (Datta et al., 1999). With respect to the

aforementioned regulatory requirements, there also often exists a minimum rating (usually BBB-) below which some investors are prohibited to invest. Moreover, this measure eases the classification of firms into more than two groups because it can be assumed that the degree of access to external financing is directly related to different rating levels. However, the same criticism applies as for the rated/not rated financial constraints indicator with respect to non-rated high-creditworthy firms. In addition, a sample split based on this measure is only appropriate for firms, which have a public rating. Due to the relatively small number of rated firms, the explanatory power of tests based on this classification scheme may then be limited.

A.8. Concentration of ownership: Arguably, a higher concentration of ownership through outside investors may result in a more efficient monitoring of firms' management and therefore to a less restricted access to outside financing, especially through equity (Chirinko and Schaller, 1995; alternatively, Lin et al. (2011) find that firms with broader insider control rights are more financially constrained). This can even be achieved by banks holding a large equity stake or a position in the supervisory board. These monitoring mechanisms may particularly mitigate those problems pointed out in the free cash flow theory by Jensen and Meckling (1976) and Jensen (1986). However, the concentration level may change at irregular intervals over time, making it difficult to incorporate this measure into any research framework, particularly when it also includes firm-specific data, which can yearly change (e.g., information from the balance sheet, income statement and cash-flow statement). Oliner and Rudebusch (1992) find no significant relationship between the investment-cash flow sensitivity and the structure of share holding.

A.9. Relationship to banks: Strong relationships to banks can substantially ease the access to external financing and may even mitigate agency problems due to the detailed monitoring usually applied by banks (Petersen and Rajan, 1994; Elston, 1998; Houston and James, 2001; Audretsch and Elston, 2002). In addition, banks can hold a large equity stake or a position in the supervisory board. This is particularly the case in bank-based financial systems such as most European countries and Japan (Bond et al., 2003; Semenov, 2006). However, close relationships to banks may also have negative implications because banks often require certain amounts of collateral or financial covenants, which are available for securing their given loans. These measures can then prevent other investors to provide funds if these funds are non-

secured and subordinate to bank loans (see Boot (2000) and Bougheas et al. (2006) for an overview). Also, interest rates are generally higher for additional funds without securing mechanisms.

A.10. Group membership: Business groups can mitigate the effects arising from financial constraints in two ways (Hoshi et al., 1991; Chirinko and Schaller, 1995; Campa and Shaver, 2002; Whited, 2006). First, there often exist internal capital markets and cash pooling mechanisms within business groups. This eases the access to intra-group loans for associated firms. Second, group membership can reduce agency problems in that financial intermediaries may look favourably upon the possibility that associated firms can benefit from group-internal funds in the case of financial distress. Moreover, in some countries, large business groups often have very close and stable relationships to banks and other financial institutions. Therefore, this indirect access to external financing additionally eases the credit supply for associated firms. However, measuring the effects particularly resulting from internal capital markets is difficult. It is also questionable whether this measure can provide sufficient insights into the cross-sectional nature of financial constraints because two firms, which are affiliated to the same business group could both be classified as unconstrained, even though one of these firms may be actually constrained due to inefficiencies in the allocation of funds (Ahn and Denis, 2004).

A.11. Foreign-owned firms: Firms with access to foreign capital markets are considered less constrained (Ruiz-Vargas, 2000; Beck at al., 2006; Colombo and Stanca, 2006; Hutchinson and Xavier, 2006; Desai et al., 2007; Blalock et al., 2008). This access exists if a foreign subsidiary or parent company can borrow in a foreign country and, hence, broaden the available funding line. However, there exist little data on foreign subsidiaries of small and privately-held firms (Vachani, 2005). Measuring the effects of financial constraints may also be biased due to a number of problems, which foreign-owned firms could face, e.g., in terms of labour productivity and sales network. Therefore, this indicator may only be appropriate for measuring differences in the financial constraints status between large and geographically diversified firms.

Specifically, there are five aspects, which may exacerbate the use of univariate financial constraints measures. First, it is questionable whether a specific measure is appropriate in precisely distinguishing between constrained and unconstrained firms (Kaplan and Zingales, 2000). Second, some of these indicators could itself be affected

by financial constraints. This would then result in a biased classification scheme due to problems arising from endogeneity (Bond et al., 2003). Moreover, it is difficult to accurately distinguish between different groups of firms based on continuous univariate measures. Several studies apply a centile-based classification scheme (e.g., Almeida et al., 2004; Acharya et al., 2007; Campello and Chen, 2010; Denis and Sibilkov, 2010; Frésard, 2010), which is – at least to some extent – arbitrary and may not fully reflect the nature of financial constraints. Fourth, it has been empirically found that the relationship between some indicators and the financial constraints status can be U-shaped, e.g., for a classification with respect to firm size and age (Hadlock and Pierce, 2010). Lastly, it is noteworthy that some studies apply time-invariant measures of financial constraints. This framework, however, does not take into account the time-varying nature[2] of a firm's financial constraints status, e.g., due to a worsening in its credit rating, changes in firm size or varying dividend pay-out ratios. Therefore, empirical findings based on a static classification scheme could be biased, particularly if the dataset covers a long time period where it is very likely that a firm's financial constraints status fluctuates.

B. Index-based measures

Index-based financial constraints measures are considered a helpful approach in ranking firms according to the outcome of the calculation based on an index. Firms are then classified as constrained (unconstrained) if they belong, for example, to the lower (upper) third of the index outcome. These indices are derived from either a univariate ex-ante classification scheme, a qualitative assessment of firms' financial constraints status or an Euler equation framework.

B.1. KZ index: As a response to the criticisms on the empirical study by Fazzari et al. (1988), Kaplan and Zingales (1997) investigate the impact of financial constraints on firms' financial policy by classifying firms into five groups ranging from "not financially constrained" to "definitely financially constrained" based on business reports. They find that only a small number of firms, which exhibit the lowest dividend pay-out ratios in the Fazzari et al. sample can be considered financially constrained based on the evidence from the annual reports. In addition, for the full sample

[2] Hu and Schiantarelli (1994) suggest applying endogenous switching regression methods to allow for a time-varying separation of firm-year observations. Oliner and Rudebusch (1992) and Kashyap et al. (1994) support the hypothesis that there exists a time-varying nature of financial constraints.

in Fazzari et al., they find that the investment-cash flow sensitivities are the lowest for this subsample. They suggest that neither the dividend pay-out ratio nor investment-cash flow sensitivities are reliable measures of firms' financial constraints status.

Based on this qualitative classification scheme, Lamont et al. (2001) apply a non-linear ordered logit model to estimate the relationship between a firm's financial constraints status and a set of financial variables for the sample of low-dividend firms. A number of subsequent studies have used these coefficient estimates to differentiate between financially constrained and unconstrained firms (Baker et al., 2003; Hennesy and Whited, 2007; Franzoni, 2009; Campello and Chen, 2010; Frésard, 2010; Li, 2011). This research framework may provide a detailed insight into the cross-sectional nature of financial constraints.

However, due to extensive effort in classifying firms according to statements in their annual reports, the number of firms is limited. Therefore, results may be biased when the derived coefficient estimates are applied to a different sample of firms. Another biasing factor might result from problems related to information asymmetries because managers may not fully report all information with respect to firms' financial flexibility and constraints (see Healy and Palepu (2001) for an overview). Also, this classification scheme is subjective and any misinterpretation of specific statements in the business reports can distort the resulting sample separation.

Hadlock and Pierce (2010) re-estimate the KZ index based on an updated sample, which they apply for a different index construction. Compared to the original version, they find that the coefficient estimates are not stable and conclude that the KZ index may be biased because both, dependent and explanatory variables capture – to some extent – the same set of information.

B.2. SA index: Due to this criticism, Hadlock and Pierce (2010) classify a sample of 356 firms based on annual reports according to their financial constraints status. As in Lemont et al. (2001), they estimate an ordered logit model but use a different set of exogenous variables. They find that size and age exhibit the highest predictive accuracy. Due to the suggested U-shaped nature of financial constraints, they estimate a size-age index with a squared component consisting of firm size, size-squared and firm age. This index is also applied in Li (2011), Cornaggia et al. (2014) and Hann et

al. (2013). However, the same criticisms with respect to the ex-ante classification scheme apply for using the SA index as they do for the KZ index.

B.3. WW index: Whited and Wu (2006) base their index on a reduced form Euler equation, thus mitigating the weakness of the Euler equation test (Whited, 1992), which does not provide an applicable classification measure. Therefore, they empirically estimate the Euler equation and relate its outcome to a set of explanatory variables, which are assumed to capture information on firms' financial constraints status. The index then consists of the resulting coefficient estimates. An application of this index can be found in Hennesy and Whited (2007), Franzoni (2009), Frésard (2010), Li (2011) and Hann et al. (2013). Investigating the explanatory power of both, the KZ index and the WW index, Hadlock and Pierce (2010) find that in comparison to the variables used in the KZ index, only the inclusion of firm size makes a marginally additional contribution to the predictive accuracy.

B.4. MDA index: Cleary (1999) applies a multiple discriminant analysis in order to implement a linear relationship between the financial constraints status and a set of explanatory variables based on items from the balance sheet and income statement. In this research design, the financial constraints status is determined by changes in firms' dividend pay-out behaviour. Accordingly, firms are classified as unconstrained when they increase dividend payments in one year, and vice versa. Firms with no change in their payment behaviour are not incorporated into the analysis. This index is also applied in Moyen (2004), Hennessy and Whited (2007) and Franzoni (2009). However, any ex-ante classification of firms may be biased. Also, the dividend pay-out behaviour might be subject to firms' overall financial policy, thus mitigating its explanatory power when used as an ex-ante classification scheme.

B.5. Multivariate Measure: Maestro et al. (2001) suggest a dichotomous separation model, which can be considered a decision tree with respect to various univariate measures. Basically, this classification scheme consists of two complementary elements. First, firms are classified into financially constrained and unconstrained firms according to specified yes/no paths within the separation model. Second, some firms cannot be classified because the respective path does not capture a sufficient degree of information to reliably assign a firm to one of both mutually exclusive groups. Therefore, Maestro et al. estimate a logit model based on the previous classification of financially constrained and unconstrained firms and seven variables used in the finan-

cial constraints model to separate both groups of firms. However, they check the validity of this separation model by only comparing the differences between a simple logit model and the aggregate classification of the financial constraints model and the re-estimated logit model. They conclude that the differences in the classification patterns between both approaches are due to the higher discriminatory power of the financial constraints model, which is supposed to require additional and more accurate separation criteria. A similar approach is applied by Musso and Schiavo (2008), Bellone et al. (2010) and Silva (2011) who rank firms according to several financial constraints-related variables.

Whited and Wu (2006) and Hadlock and Pierce (2010) provide evidence on the correlation between the KZ index, the SA index and the WW index. Whited and Wu find that the correlation between the KZ index and the WW index is negligible. In addition, Hadlock and Pierce calculate the correlation between the SA index and the KZ index (approximately 0), between the SA index and the WW index (significant) and between an updated version of the KZ index and the original KZ index (approximately 0). This evidence casts doubt on the usefulness and reliability of all of these index-based financial constraints measures because it remains unclear, which of them provides an appropriate insight into the cross-sectional nature of financial constraints. Moreover, Whited and Wu point out that the application of index parameters to different sets of firms and time periods may bias the classification scheme. However, many studies directly apply these index coefficients to their own samples without any adjustments.

C. Sensitivity measures/Euler equation

Fazzari et al. (1988) have been the first to investigate the effects of financial constraints on firms' investment behaviour based on a standard investment model incorporating Tobin's Q (Brainard and Tobin, 1968; Tobin, 1969). The rationale behind this research design is to estimate the sensitivity of firms' investment on cash flows separately for constrained and unconstrained firms after controlling for Q, which should capture all future information on investment in frictionless capital markets such as growth opportunities. A significantly positive relationship between investment and cash flow indicates that investment additionally depends on financing and liquidity restrictions. This allows directly measuring the effects of financial constraints on firms' financial policy.

C.1. Investment-cash flow sensitivity: The investment-cash flow sensitivity has first been investigated by Fazzari et al. (1988). For a small number of U.S. manufacturing firms[3], they find that the cash flow sensitivity of investment is substantially lower for firms with a high dividend pay-out ratio indicating that these firms are less constrained than firms with lower dividend pay-outs. This approach has widely been applied by a large number of studies, e.g., Gilchrist and Himmelberg (1995), Chapman et al. (1996), Hadlock (1998), Bond et al. (2003) and Guariglia (2008).

The findings and the related interpretation by Fazzari et al. (1988) have strongly been criticised by Kaplan and Zingales (1997). They argue that a classification scheme based on the pay-out ratio may be biased due to firms' financial policy and a precautionary savings motive (Opler et al., 1999; Almeida et al., 2004). Therefore, they assess the financial constraints status of the low-dividend paying firms in the Fazzari et al. U.S. sample based on statements in their business reports and key financial ratios. They re-classify these firms into five groups ranging from "not financially classified" to "definitely financially constrained" and estimate the investment-cash flow sensitivity for these subgroups.

Basically, they find a non-monotonic relationship between the financial constraints status and the investment-cash flow sensitivity. Therefore, they conclude that this sensitivity test is a poor proxy for measuring the degree of financial constraints. Kadapakkam et al. (1998), Cleary (1999), Almeida and Campello (2001) and Cleary (2006) support their criticisms. Gatchev et al. (2010) apply a dynamic multi-equation model, which jointly takes into account firms' financing and investment decisions where the sources of cash must equal the uses of cash. They find only little evidence for the relationship between investment and financial constraints. A large number of studies have meanwhile investigated different aspects of this sensitivity measure. In addition to the dependence of the results on univariate financial constraints measures and related problems such as endogeneity (Bond et al., 2003) and misclassification (Cleary et al., 2007; Musso and Schiavo, 2008), there are three main criticisms.

First, some studies have corroborated the evidence in Kaplan and Zingales that the relationship between investment and cash flow may be non-monotonic/U-shaped with respect to the classification scheme (Povel and Raith, 2002; Cleary et al., 2007; Das-

[3] Chirinko and Schaller (1995) note that investigating the impact of financial constraints based on manufacturing firms may bias the empirical findings due to their specific type of assets.

gupta and Sengupta, 2007; Lyandres, 2007; Guariglia, 2008).[4] Similarly, Hovakimian (2009) and Hovakimian and Hovakimian (2009) classify firms ex-post based on different levels of investment-cash flow sensitivities. They find a non-monotonic relationship with respect to different firm characteristics and non-binding financial constraints in high-cash flow firm-years, respectively.

Second, these models control for investment opportunities usually measured through Q. However, empirical studies apply average Q (market value of existing capital) because marginal Q (market value of new additional capital) cannot be easily observed. This results in a potential mismeasurement of Q and to violations in a number of assumptions, thus weakening the validity of the empirical results derived from these models (Hayashi, 1982; Gomes, 2001).

Third, it is likely that cash flow itself contains information on future investment opportunities, particularly for firms with high uncertainties such as growth firms. This implies that both, Q and cash flow control for investment opportunities. Therefore, the investment-cash flow sensitivity may be biased and does not exclusively measure the impact of financial constraints on investment (Erickson and Whited, 2000; Alti, 2003; Cummings et al., 2006). Additionally, several studies estimate the investment-cash flow sensitivity using fixed-effects regression models. However, due to the likely correlation of Q with the idiosyncratic portion of the error term, some studies (e.g., Hayashi and Inoue, 1991; Blundell et al., 1992) suggest a generalised method of moments or instrumental variable approach (see Brown and Petersen (2009) and Chen and Chen (2012) for both, fixed-effects and GMM models).

C.2. Cash-cash flow sensitivity: Due to the strong criticisms on the aforementioned concept, Almeida et al. (2004) modify the rationale behind the investment-cash flow sensitivity and hypothesise that the effects of financial constraints should be most evident in the cash-cash flow sensitivity, i.e., constrained firms will save more cash out of their recurrent cash flows than unconstrained firms in order to preserve a sufficient level of liquidity. Unconstrained firms, however, do less rely on retained cash because their access to outside financing is not restricted. Also, they argue that – contrary to standard investment models – this research design will avoid any problems

[4] This finding has been challenged by Allayannis and Mozumdar (2004) who argue that specific observations (Kaplan and Zingales, 1997) and firms with negative cash flows (Cleary, 1999) may bias the empirical evidence.

arising from a mismeasurement of Q and endogeneity problems between investment and cash flows if the latter capture some future information on investment. Therefore, the cash flow sensitivity of cash should more accurately reflect the effects of financial constraints on firms' financial policy. Their findings are corroborated by several studies, e.g., Han and Qiu (2007), Lin (2007) and Baum et al. (2011). Based on the theoretical relationship between financial constraints and the hedging motive proposed in Froot et al. (1993), Acharya et al. (2007) also argue that hedging needs in terms of the correlation between operating cash flows and investment opportunities are significant in explaining cross-sectional differences within the financially constrained group of firms. Constrained firms with high hedging needs tend to retain these cash flows in order to finance their investments in the future. Contrariwise, when hedging needs are low, cash flows are used to reduce debt and, hence, strengthen firms' debt capacity. However, there is mixed empirical evidence on the explanatory power of the cash-cash flow sensitivity because some studies have found that – irrespectively of the differentiation between constrained and unconstrained firms – it is always significantly positive (e.g., Pal and Ferrando, 2009).[5]

C.3. Euler equation: The Euler equation model is a parametric approach, which tests whether a number of parameter restrictions hold for a parametric relationship between investment and several factors relating to adjustment costs (Whited, 1992). As for cash flow sensitivity measures, this test is applied to different subsamples, which are classified ex-ante according to their financial constraints status, e.g., based on univariate measures (Hubbard and Kahyap, 1992; Bond and Meghir, 1994; Haramillo et al., 1996; Love, 2003). As for the cash-cash flow sensitivity, this framework is advantageous over the investment-cash flow sensitivity because it avoids problems particularly arising from a measurement of Q with error. Also, most data items needed for this test are readily available from firms' balance sheet and income statement. However, this test is highly parameterised and the parameter restrictions are subject to a number of narrow assumptions (Forbes, 2007; Coad, 2010). Additionally, any ex-ante classification scheme may be biased, thus weakening the explanatory power of this test. Moreover, it does not provide a fixed estimation outcome, which

[5] A third strand of the literature investigates the relationship between firm growth as measured through growth in book total assets, turnover or number of employees and cash flows as a proxy for the financial constraints status. This framework has been applied in a small number of studies (e.g., Carpenter and Petersen, 2002; Fagiolo and Luzzi, 2006; Oliveira and Fortunato, 2006).

can be subsequently used to differentiate between financially constrained and unconstrained firms.

III Credit ratings

There is a growing literature on different aspects of credit ratings with respect to their effects on firms' financial policy. Most of the studies dealing with these issues find a significant relationship between credit ratings and capital structure and financing choices. The information captured by credit ratings can be related to corporate financing behaviour in several ways, e.g., through the level of credit ratings, changes in credit ratings or additional information related to credit ratings such as the rating outlook or watch status. Moreover, the extent to which credit ratings affect capital structure decisions can be estimated directly or embedded into traditional capital structure theories.

A. Credit ratings and capital structure

Several survey studies have found that CFOs of listed and privately-held companies consider credit ratings highly relevant when they undertake financing decisions. Not surprisingly, this holds particularly for debt-based financing choices (Graham and Harvey, 2001; Bancel and Mittoo, 2004; Brounen et al., 2006).

There are an increasing number of empirical studies investigating the impact of credit ratings and credit rating changes on capital structure decisions (Kisgen, 2006; Kisgen, 2009; Hovakimian et al., 2009; Agha, 2011; Michelsen and Klein, 2011; Hess and Immenkötter, 2014). Basically, they find that credit ratings issued by external rating agencies are significant in explaining firms' capital structure behaviour as well as individual financing choices such as debt issuance and redemption. There are two basic concepts.

First, these studies investigate the impact of likely or already materialised credit rating changes. They argue that firms whose ratings are likely to be downgraded or have already been downgraded seek to strengthen their capital structure by adapting their financial policy. Contrariwise, firms with a (likely) improving credit rating might de-

cide to benefit from lower cost of capital and better access to external financing, thus carrying more debt.

Second, credit ratings are often separated into investment grade and speculative grade ratings. As described above, firms with an investment grade rating may particularly benefit from lower cost of capital due to the exponentially decreasing probability of default associated with these ratings, and from a substantially less restricted access to financial markets due to regulatory and investors' internal requirements. Most studies bring these two concepts together and investigate the effects of (expected) credit rating changes and rating levels simultaneously. Moreover, credit ratings can be incorporated into traditional capital structure tests where they can provide additional explanatory power with respect to the pecking order theory and the trade-off theory (Kisgen, 2006; Jong et al., 2011).

There are only a small number of studies, which question the relevance of credit ratings for capital structure decisions (e.g., Kemper and Rao, 2013a/2013b). However, they do not fully negate any influencing effects of credit ratings but rather point out that the interpretation of the empirical findings may not be fully appropriate.

B. Credit ratings and financial constraints

As described in the previous section, several studies apply credit ratings for differentiating between financially constrained and unconstrained firms. The results are similar across these studies with respect to the discriminatory power of this measure. Clearly, the relationship between credit ratings and financial constraints is twofold. First, the sole existence of a credit rating eases the access to external financing. Moreover, a good credit rating is required for some sorts of financial instruments, thus enabling the access to additional types of outside financing such as commercial papers. Second, the cost of external financing significantly decreases with higher credit ratings due to the exponential distribution of probabilities of default with respect to different rating categories. However, the use of external credit ratings in a financial constraints framework has a number of drawbacks.

First, most of the studies classify firms according to the rated/non-rated or the investment grade/non-investment grade criteria. They do not take into account the ordinal nature of ratings and, hence, do not classify firms according to different rating levels within the investment grade/speculative grade criteria. Therefore, some information might not be captured (Kliger and Sarig, 2000; Tang, 2009). The empirical findings

based on one of these two classification schemes may only allow an approximation of the structural effects and particularly the magnitude of the effects of financial constraints because firms, which are likely to differ in their access to outside financing and the cost of capital are uniformly classified.

Second, credit ratings through external rating agencies are generally obtained by large (publicly listed) firms, which can typically be considered less constrained according to the firm size financial constraints measure. Thus, most firms are classified as fully constrained due to the absence of any credit rating. This implies that even firms with a below-investment grade rating belong to the financially unconstrained group of firms, while non-rated firms, which, if rated, could have an investment grade rating would be classified as financially constrained (Faulkender and Petersen, 2006). However, there may exist bank-internal ratings or credit risk assessments conducted through institutional investors, which are approved by regulatory authorities as an alternative to external credit ratings. Therefore, the sole absence of a publicly available rating may not necessarily indicate that this firm is indeed financially constrained.

Third, due to the limited number of firms, which have obtained a credit rating, an empirical framework applying the investment grade/non-investment grade classification scheme lacks some explanatory power because the interpretation cannot be extrapolated to a non-rated sample universe. However, as most firms do not have a credit rating, the results are not universally valid (a similar criticism is stated in Whited and Wu (2006)).

Fourth, several studies classify firms according to either the existence of a credit rating or the rating status at the beginning of the estimation period. Not surprisingly, the creditworthiness of a firm may change over time and so does the credit rating. Also, rated firms may stop obtaining a credit rating over time, e.g., because they have fully repaid an outstanding bond, while non-rated firms plan to issue a bond and, therefore, require a credit rating within the estimation period of empirical studies. Any one-period classification scheme will then be biased if the existence or the status of a firm's credit rating changes over time.

Lastly, most studies apply credit ratings related to specific financial instruments such as bonds or commercial papers. These ratings may not represent the actual creditworthiness of the issuers (firms) of these financial instruments. The issuers' ratings can be

above or below the financial instruments' ratings because an issuer rating generally refers to a senior unsecured level while financial instruments may differ in terms of seniority and collateral (May, 2010). This is particularly relevant when the issuer rating would be investment grade but the instrument rating is speculative grade, e.g., due to a lower level of seniority. In this case, the issuer would be misclassified. Also, these differences may prevent studies from applying an ordinal credit rating classification scheme because the rating level of the issuer and the financial instrument can differ.

C. Credit ratings as financial constraints measure

In a survey study, Campello et al. (2010) state that "Of the archival-type measures of constraint that we examine in the paper, credit ratings come closest to replicating the patterns we find for the behavior of financially constrained and unconstrained firms during the crisis" (p. 477). Nevertheless, there are only a small number of empirical studies, which estimate the effects of financial constraints based on a time varying ordinal credit rating classification scheme. Basically, the main reason for this might be the limited number of credit ratings for a sufficiently homogeneous group of firms. However, it is difficult to draw any direct conclusions from such estimates because the results are not universally valid and the separation into two mutually exclusive groups of firms cannot capture all information related to the financial constraints status. Therefore, it is questionable whether credit ratings conducted through external rating agencies may be a useful measure of firms' financial constraints status.

There is, however, increasing evidence that bank-internal ratings or external credit risk assessments through financial service providers besides credit rating agencies may be appropriate measures of financial constraints. In recent years, several studies have applied a credit rating index provided by CeBi. CeBi (Centrale dei Bilanci, CeBi-CERVED) is an Italian company, which is privately-held by a number of major Italian banks. Amongst other things, it provides credit rating indices of limited liability firms in Italy. Bottazzi et al. (2014) note that due to CeBi's strong institutional role in the Italian banking system, their index is acknowledged as an official credit rating in the Italian financial markets. They provide a comprehensive study on the effects of financial constraints on firm growth. Their findings suggest that firm size and age systematically differ between different groups of limited liability firms in the manufacturing industries in Italy with respect to their financial constraints status. Basically,

their findings corroborate the results in Hadlock and Pierce (2010) in terms of the information captured in firm size and age with respect to firms' financial constraints status. However, contrary to the classification scheme applied in Hadlock and Pierce and also contrary to other univariate financial constraints measures, they classify firms according to the credit rating index provided by CeBi. They argue that, contrary to other financial constraints measures, credit ratings implicitly incorporate firms' credit risk assessment through financial intermediaries and outside investors, which ultimately decide on the allocation of funds to these firms. Moreover, the use of these credit rating indices avoids the disadvantages of applying external credit ratings conducted through credit rating agencies. First, these indices are available for a large set of firms. Therefore, the estimation results built on this classification scheme are not biased because they are based on a substantially larger number of firms. Second, the CeBi rating focuses on the overall creditworthiness of a firm instead of the credit risk of a specific financial instrument issued by this firm. In addition, Panetta et al. (2009) and Guiso et al. (2010) find that there exists a significant relationship between the CeBi rating and the cost of debt financing and the supply of credit, respectively. Further studies provide similar evidence on the CeBi credit rating index, e.g., Sangalli (2013) and Secchi et al. (2014).

Czarnitzki (2006) estimates the impact of financial constraints on R&D investment of German firms. Contrary to similar studies, his dataset contains small and medium enterprises (SME). To test the direct impact of external financial constraints, Czarnitzki applies a firm-level credit score. This credit score is provided by German enquiry agency Creditreform and captures quantitative and qualitative information on firms' creditworthiness applying a highly standardised approach. Therefore, it is not equivalent to a credit rating provided by an external credit rating agency, which is based on an analyst-driven approach. While the results in similar studies only suggest a weak relationship between financial constraints and R&D investment in Germany, he finds a significant relationship for firms in West Germany, applying a cross-sectional regression framework. R&D investment of firms in East Germany is not dependent on external financial constraints. He argues that R&D subsidies play an important role in firms' R&D investment behaviour. Differences to the previous studies may also arise from the inclusion of non-R&D-performing firms, i.e., firms without any expenditure on R&D investment, and SME firms. It is important to note that

his results on the significance of the financial constraints measure are consistent throughout a number of robustness tests. Similarly, Egeln et al. (1997), Müller and Zimmermann (2009) and Czarnitzki and Hottenrott (2011) provide further evidence on the significant relationship between credit risk assessments provided by Creditreform and financial constraints.

The findings in these studies suggest that credit scores or bank-internal ratings may be considered a reliable proxy for classifying firms according to their financial constraints status. However, there exist only a small number of further studies, which apply credit risk assessments as a proxy for firms' access to external financing (e.g., Garmaise (2008) and Rice and Strahan (2010) use credit scores from Dun and Bradstreet, and the sorting mechanism in Gatchev et al. (2010) is based on the Shumway (2001) risk of default estimation). In two recent studies, Drobetz and Heller (2014a, 2014b) provide evidence that the coefficient estimates of firms' capital structure decisions with respect to model-driven credit ratings, which highly correlate with genuine credit ratings conducted through credit rating agencies exhibit comparable and stable results across different empirical frameworks.

Measuring the degree of access to outside financing through such types of credit risk assessments might then be advantageous over traditional measures based on credit ratings. First, they are available for a large number of firms, both publicly listed and privately-held, thus improving the explanatory power and validity of any coefficient estimates based on this classification scheme. Additionally, this allows fully taking into account the ordinal nature of credit scores because each risk category is likely to have a sufficiently large number of firm-year observations. Third, credit risk is inversely related to firms' liquidity and financial flexibility, which directly capture information on their demand of external financing. Fourth, the time-varying nature of credit scores can easily be implemented because these data are generally available and updated on a yearly basis. Fifth, credit scores are particularly assigned to issuers instead of financial instruments, thus appropriately reflecting the risk related to them and their restrictions on the access to external financing. Lastly, as stated above, financial intermediaries and investors may also base their lending and investment decisions on bank-internal ratings or investors' internal credit risk assessments if they comply with regulatory requirements.

IV Conclusions

Since Fazzari et al. (1988), measuring firm-level financial constraints and their effects on firms' financial policy has become a substantial and stand-alone strand of economic research. There exist a wide variety of variables, which are supposed to capture significant information on firms' financial constraints status and used to classify firms into mutually exclusive groups of financially constrained and unconstrained firms. These univariate measures are mainly related to agency problems, risk of default and firms' internal cash generating ability. In addition, some studies apply econometric approaches with which the relationship between financial constraints and proxies for firm-level financial policy can be investigated. Applying these index-based measures is supposed to refine the classification scheme due to their multivariate nature. Investigating the effects of financial constraints on financial policies and simultaneously assessing the accuracy of a classification scheme is mainly based on sensitivity and Euler equation models.

However, their results depend – to a great extent – on the validity of the respective classification mechanism. There is increasing evidence that estimation results can significantly vary with respect to different classification procedures or may even be opposite. Therefore, it is crucial to find precise and unbiased measures of financial constraints, which are also appropriate to mitigate the aforementioned drawbacks related to different financial constraints indicators.

In recent years, several studies have investigated the relationship between credit ratings conducted through external credit rating agencies and capital structure decisions. They have found that credit ratings are significant in explaining firms' financial policy, regardless of how they are incorporated into the empirical research design. Thus, credit ratings may also be a reliable proxy for measuring financial constraints. However, it can be argued that credit ratings also exhibit some shortcomings, which particularly stem from the relatively low number of available credit ratings compared to the total number of firms across different economies. It should therefore be asked whether any derivatives of external credit ratings may provide an appropriate and objective measure of financial constraints.

A small number of studies apply bank-internal ratings or credit risk assessments of financial service providers, which are not regulatorily registered as external credit

rating agencies. Their empirical findings suggest that these risk assessments may capture information, which is substantially related to the degree of access to outside financing. Additionally, there are some major advantages over external credit ratings. Coefficient estimates based on this classification mechanism may be more valid because credit risk assessments are available for a larger number of publicly listed and privately-held firms as well as for different risk classes. The yearly updates of risk assessments allow taking into account the time-varying nature of financial constraints. Also, they are assigned to firms on an issuer-level instead of a financial instrument-level. Lastly, it can be shown that due to regulatory requirements, investors and financial intermediaries also base their decisions on the allocation of external capital to firms on such types of risk assessments.

It may therefore be necessary to go beyond traditional measures of financial constraints, which have not empirically been proven to sufficiently capture information on firms' access to external financing and might solely be valid from theoretical considerations. Thus, measuring financial constraints may particularly be based on simultaneously measuring the firm-level supply and demand of external financing, which both may be captured through credit risk assessments.

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Chapter 2

International Evidence on Financial Constraints, Investment, and the Value of Cash

with Wolfgang Drobetz

Abstract

We investigate the effect of corporate governance regimes and financial market development on the value of cash holdings and investments, and the relationship between the investment activity and liquid funds in the context of financial constraints. Specifically, we find that the market value of cash is not positively correlated to the financial constraints status in poorly governed or less developed countries. Moreover, differences in the relationship between investment activity and liquid funds are not solely explainable by country specifics and financial constraints. Finally, poor corporate governance or a weak financial market development can have detrimental effects on the market value of investments, and this is more pronounced for constrained firms.

Keywords: Financial constraints, cash holdings, investment, value of cash, corporate governance, financial market development

JEL classification codes: G32, O16

I Introduction

Following the publication of Fazzari et al.'s (1988) seminal paper, financial constraints have been of growing importance in the Corporate Finance literature. Constrained firms are considered to rely more on internal finance (i.e., cash holdings and cash flows) than unconstrained firms. While cash flows might serve as an immediate source of funding, e.g., for accounts payable, cash holdings could be used to finance long-term and future investment projects. As Myers and Majluf (1984) show in the pecking order theory, funding requirements, which cannot or shall not be met by internal funds must be financed by raising capital from external lenders or investors. The extent to which a company is able to raise external financing might depend on a number of characteristics such as publicity, creditworthiness, industry and country. Also, for some firms, there could exist a trade-off between raising external funds and using cash reserves. This is referred to as the trade-off theory (e.g., Shyam-Sunder and Myers, 1999; Fama and French, 2002; Frank and Goyal, 2008). An alternative explanation for why firms might raise debt and simultaneously hold cash is suggested by the free cash flow theory (Jensen, 1986), which suggests that firms are investing in negative net present value projects.

This paper expands the framework presented in Denis and Sibilkov (2010) and provides international evidence on the relationship between firm value, liquid funds and investment behaviour for countries with highly developed financial markets or strong corporate governance regimes, and for countries with poor corporate governance systems or less developed financial markets in the context of financial constraints.

According to Denis and Sibilkov (2010), financially constrained firms rely more on internal funds than unconstrained firms do because they tend to have restricted access to external financing as a result of firm-level determinants such as creditworthiness, management behaviour or investment opportunities. Furthermore, financial constraints might also be determined by the degree of financial market development, the quality of corporate governance or the natural patterns of industries and organisational structures across different countries.

Specifically, we find that the market value of cash is not positively correlated to the financial constraints status in poorly governed/less developed countries. Moreover, differences in the relationship between investment activity and liquid funds are not

solely explainable by country specifics and financial constraints. Finally, poor corporate governance or a weak financial market development can have detrimental effects on the market value of investments, and this is more pronounced for constrained firms.

The rest of this paper is organised as follows: The next section presents our hypotheses and reviews the related literature. Section III describes the data and our empirical methodology. The empirical results are reported and discussed in section IV. And section V concludes.

II Hypotheses and related literature

A. Testable hypotheses

While holding cash may be valuable for firms (e.g., due to a precautionary motive), the degree of this relationship might differ due to differences in firms' access to external financing as well as cross-country differences in the financial market development and the corporate governance regime. Prior studies document that the degree to which firms are financially constrained impacts the market value of cash holdings (Faulkender and Wang, 2006; Chan et al., 2013). Therefore, internally generated liquidity reserves might be more valuable for constrained firms because it allows them to undertake investment projects, which might otherwise be bypassed when no external financing is available or becomes too costly. This firm-level evidence might also be influenced by cross-country differences. For example, in highly developed financial markets, banks and investors are able to extensively monitor the activities and decisions of their portfolio firms and have sufficient insights into the associated risks. In contrast, in countries with less developed markets, banks may be unable to mitigate the adverse selection problem and to differentiate between "good" and "bad" firms (Diamond, 1991; Roe, 1994; Levine, 1997; García-Marco and Ocaña, 1999; Cebula, 2011). Furthermore, in some countries, banks and outside investors could be prevented from allocating funds to companies due to poor corporate governance structures (e.g., La Porta et al., 2000a; Denis and McConnell, 2003; Dittmar et al., 2003) where the quality of public institutions and the legal investor protection is weak, or investors

might face an expropriation risk through public authorities. As a result, our first hypothesis is:

Hypothesis 1*: Cash holdings are more valuable for constrained than for unconstrained firms. This relationship is more pronounced in countries with higher developed financial markets or better corporate governance structures.*

The rationale behind these valuation patterns may be that firms are able to finance investment projects, which might otherwise be bypassed due to a lack of external financing by using their liquid funds (Campello et al., 2010; Kolb, 2010). As a result, the investment expenditures of constrained companies depend more on cash holdings than for unconstrained firms. The differences between constrained and unconstrained firms may be less pronounced in countries with a low financial market development and a poor corporate governance environment because the access to external finance is generally more restricted in these countries (Claessens, 2006, Ginglinger and Saddour, 2007). Taken together, our second hypothesis is:

Hypothesis 2*: Cash holdings are used to invest, and this relationship is stronger for constrained than for unconstrained firms. A low financial market development or poor corporate governance systems may weaken this relationship.*

Even if cash holdings allow constrained firms to invest more than they could without internally generated liquidity, it is not ensured that the undertaken investment projects are more valuable for constrained than for unconstrained companies. Arguably, shareholders may look favourably upon investments undertaken by constrained firms due to a greater marginal profitability of investments. Their investments should signal to market participants that they are made in anticipation of future profitable growth opportunities (Denis and Sibilkov, 2010). In contrast, managers of firms in countries with poor corporate governance regimes may invest their cash in negative present value projects, i.e., value-destroying projects. Highly developed financial markets are required for financial intermediaries and outside investors to be able to search for firms with good investment opportunities and reliable investment behaviour. All in all, our third hypothesis is:

Hypothesis 3: *Investments are more valuable for constrained than for unconstrained firms. This relationship might be less pronounced in countries with less developed financial markets or poor corporate governance systems.*

B. Related literature

Hypothesis 1 Recent empirical studies have investigated the marginal value of cash holdings from different perspectives. Jensen (1986), Dittmar et al. (2003), Dittmar and Marth-Smith (2007), Kalcheva and Lins (2007) and Harford et al. (2008), among others, test how corporate governance impacts firm value. They document that poor corporate governance systems can have a negative impact on the value of internal funds because managers are prone to overinvest and to waste funds at their discretion. Similarly, Pinkowitz et al. (2006) report that the relationship between cash holdings and firm value is weaker when investor protection is poor. Faulkender and Wang (2006) analyse the marginal value of cash holdings under different financial policies, i.e., distributing cash, raising cash, or servicing debt obligations for U.S. firms. Their findings suggest that cash reserves, debt, access to capital markets and dividend payments are negatively related to the market value of cash holdings. They estimate that the marginal market value of cash is 94 U.S.-¢. Pinkowitz and Williamson (2007) study the relationship between firm value and cash holdings with respect to firm-level determinants. They find that the market value of an additional dollar in cash is 97 U.S.-¢. Furthermore, the marginal value of cash increases when firms have better growth opportunities, face less financial distress and their investment behaviour exhibits more uncertainty. However, contrary to previous findings, cash is valued higher for firms with a better access to capital markets. Denis and Sibilkov (2010) expand Faulkender and Wang's (2006) methodology and further document that cash holdings are more valuable for firms with restricted access to capital markets. Drobetz et al. (2010) study the relationship between the value of cash and information asymmetry, and document that higher information asymmetry decreases the marginal value of cash because the benefits of avoiding costly external financing are outweighed by moral hazard problems. Finally, Tong (2011) studies the effect of firm diversification on the value of cash holdings. He reports evidence that firm diversification reduces the value of cash due to agency problems; this observation holds for both constrained and unconstrained firms.

Hypothesis 2 Almeida et al. (2004) investigate the cash flow sensitivity of cash. They study the portion of cash flow that firms save as cash and observe that this portion is significantly higher for constrained firms than for unconstrained firms. Appropriate cash management, thus, allows firms to balance the trade-off between current and future investments. This precautionary motive is also investigated in Opler et al. (1999), Bates et al. (2009) and Denis and Sibilkov (2010). Their findings suggest that firms build up cash reserves to mitigate potential negative shocks, especially when they have higher external financing costs and when value-increasing investment projects might otherwise be bypassed. Lian et al. (2010) study the cash adjustment behaviour of listed firms in China, where the precautionary motive helps to explain that firms with highly volatile cash flows accelerate their adjustment speed of cash reserves towards a target level. Bank lines of credit are investigated in Sufi (2009) as a possible source of external financing. He finds that access to lines of credit is restricted to firms, which exhibit a sufficient operating performance and, thus, are able to meet the financial covenants often associated with those lines of credit. As a result, less profitable companies need to build up cash reserves in order to finance their investment projects. Haushalter et al. (2007) and Frésard (2010) study the rationale for holding cash of manufacturing firms in competitive product markets measured via the Herfindahl index. They suggest that cash reserves allow firms to take strategic advantages because they can avoid losing market shares, or invest when growth opportunities are high and rivals are financially constrained. Investigating U.S. multinational firms, Foley et al. (2007) suggest a different motive for corporate cash holdings. They focus on tax costs associated with repatriating income from foreign subsidiaries. Multinational firms mainly hold cash in those subsidiaries to avoid tax burdens, particularly when they are less financially constrained and more technology-intensive.

Cross-country studies provide evidence that cash holdings are sensitive to investor protection and the respective legal system of each country.[6] Dittmar et al. (2003) find that cash holdings are higher for firms in countries with weak shareholder protection, and that holding cash reserves depends less on factors such as investment opportunities and information asymmetry, as compared to countries with strong shareholder

[6] This strand of research is based on the research design in La Porta et al. (1997, 1998, 1999, 2002) and expanded in Fisman (2001) as well as Nee and Opper (2009). These studies analyse the legal protection of investors, the quality of law enforcement and accounting standards in several countries and legal origins.

protection. Chan et al. (2007) focus on the development of China's capital market. They document that most firms have restricted access to external financing and, thus, cash reserves are necessary for ensuring a sufficient level of liquidity. Love (2003) shows that improved financial market development may weaken financial constraints and increase economic growth. Frye and Shleifer (1997) and Shleifer and Vishny (1998) differentiate between "helping hand" and grabbing hand" governments. The helping hand government can strengthen capital markets and lower financial constraints through sufficient and prudent policies and regulations. In contrast, in a grabbing hand environment, firms may reduce liquid funds through investments to avoid government expropriation (Chen et al., 2010). Similarly, Caprio et al. (2013) suggest that the portion of cash held in corporate balance sheets and relative to property, plant and equipment as well as inventory is lower for firms in countries with a higher risk of political extraction.

Hypothesis 3 Only few papers have documented the relationship between firm value and net investments in an international context or under the assumption of financial constraints. Using a U.S. sample, Denis and Sibilkov (2010) document that investments are value-increasing, and that this pattern is more pronounced for constrained firms. Drobetz et al. (2010) adopt the methodology in Pinkowitz et al. (2006). Their valuation model contains the change in non-cash assets for both the current year and the following year, and their estimates are independently applied to developed and emerging markets. Their findings suggest that investments are less valued for firms in emerging markets. Similarly, Tong (2011) documents that the coefficient on the change in net assets is lower for constrained firms in the U.S. For a set of Chinese listed firms, Chiou et al. (2010) apply Faulkender and Wang's (2006) framework for privately controlled and state-owned firms. They suggest that the change in non-cash assets is valued more positively for firms that are controlled by private or institutional investors than for firms with state ownership control.

III Data and empirical methodology

A. Data description

Our data is taken from Standard & Poor's Compustat Global, Standard & Poor's RatingsXpress and Thomson Reuter's Datastream databases. The initial dataset includes publicly listed firms in 104 countries over the period from 1988 to 2009. We omit firms in the financial (SIC 6000-6799) and utility (SIC 4910-4939) sectors. In addition, we exclude firm-years with non-positive values for total book assets or cash holdings, negative values for capital expenditures, total book assets less than 25 million U.S.-$ in 1998 dollars and not fully consolidated firm-years. Our initial dataset contains 29,757 active and inactive firms with a total of 279,455 firm-year observations. Throughout this paper, we trim all variables at the 1% and 99% levels.

B. Measures of financial constraints

Our analysis requires a reliable measure for the degree of access to capital markets in order to determine which firms belong to the constrained group and which to the unconstrained, assuming that the latter group is likely not to face restrictions in obtaining external financing. Based on prior literature, we use four different classification criteria (Almeida et al., 2004; Acharya et al., 2007; Campello and Chen, 2010; Denis and Sibilkov, 2010):

B.1. Pay-out ratio: Higher pay-out ratios indicate sufficient internal resources or a good access to capital markets. The pay-out ratio is measured as total dividends plus stock repurchases over operating income, where a firm-year is classified as constrained (unconstrained) when the pay-out ratio is below or equal (above or equal) the bottom (top) three deciles. Firm-years with positive dividend payments or stock repurchases but negative operating income are classified as unconstrained.

B.2. Size: Larger firms are better known (with less pronounced information asymmetry) and benefit from economies of scale in external financing costs. Therefore, larger firms are considered less constrained. We measure firm size by total book assets. A firm-year is classified as constrained (unconstrained) when the book total assets are below or equal (above or equal) the bottom (top) three deciles.

B.3. Long-term credit rating (rated/not rated): A credit rating is often required to raise debt from banks or public debt markets. Even with a credit rating below invest-

ment grade, firms often have better access to external financing than without any rating. Therefore, each firm is classified as unconstrained when an Standard & Poor's long-term credit rating is available at least in one sample year; the remaining firms are classified as constrained. When a long-term credit rating is not available but the firm can nevertheless raise 5% of the previous year's outstanding long-term debt or above in that year, this firm-year is also classified as unconstrained.

B.4. Long-term credit rating (investment grade rating/non-investment grade rating): Along with the rationale behind credit ratings, investment grade rated companies (BBB- and better) often have a significantly better access to external financing and the cost for external debt decreases with higher ratings. Accordingly, a firm is classified as unconstrained when it is rated investment grade at least in one sample year. The remaining firms with a sub-investment grade rating are classified as constrained.

C. Measures of financial market development and corporate governance

In our cross-country analysis, we need to differentiate between countries with a strong financial market development and those with a weak financial market development, and between countries with sufficient corporate governance regimes and those with poor corporate governance systems. Following previous studies (Pinkowitz et al., 2006; Drobetz et al., 2010), we use five index-based measures, which refer to legal investor protection, public expropriation and financial market development:

C.1. Anti-director rights index: Shareholder protection relates to shareholder voting rights (right to vote by mail, right to call an extraordinary meeting holding only a low percentage of share capital and right to vote without depositing shares) and minority protection (pre-emptive rights, proportional representation on the board of directors and legal remedies in case of oppression). The index was first documented in La Porta et al. (1996) and ranges from zero to six, where six indicates the highest level of shareholder protection.[7] Countries are classified as high- or low-index countries when the index value is above or below the median index value, respectively.

C.2. Rule of law index: The quality of public institutions and the legal investor protection is measured by the rule of law index. The index captures the protection for reliance on existing law and the extent to which the bureaucracy and courts are impartial. The index range is from -2.5 to 2.5, and higher index values indicate better corpo-

[7] The index is provided on http://faculty.tuck.dartmouth.edu/rafael-laporta/research-publications

rate governance structures. Countries are classified as high- or low-index countries when the index value is above or below the median index value in year 1998, respectively. The index is provided on the Worldbank website.[8]

C.3. Corruption index: The corruption index measures the degree at which firms and investors might face expropriation through public institutions. Again, the index range is from -2.5 to 2.5, where lower index values indicate a weaker corporate governance infrastructure. Countries are classified as high- or low-index countries when the index value is above or below the median index value for year 1998, respectively. The index is provided on the Worldbank website.[9]

C.4. Stock market capitalisation to GDP: The stock market capitalisation to GDP ratio equals the market value of listed shares in a country divided by its gross domestic product. A country's financial and capital market development is more advanced with greater values, and these firms generally tend to be less constrained. The sample is split according to the ratio's median value in year 1998, where data is taken from Beck et al. (2000).[10]

C.5. Private bond market capitalisation to GDP: The private bond market capitalisation to GDP ratios is measured through outstanding debt securities issued by private firms in a country over its gross domestic product. Again, higher values indicate more developed financial markets and less pronounced financial constraints. Based on the data in Beck et al. (2000), the sample is split according to the median value for the year 1998.[11]

D. Empirical methodology

Hypothesis 1 We adopt the basic framework in Denis and Sibilkov (2010) to test our hypotheses. The starting point is the valuation model in Faulkender and Wang (2006). They estimate the marginal value of cash holdings and the impact of leverage and the level of cash reserves. Following Denis and Sibilkov (2010), we include an interaction term between the change in cash holdings and a financial constraints dummy to estimate the differences between constrained and unconstrained companies. We estimate the following model:

[8] See http://info.worldbank.org/governance/wgi/index.aspx#home
[9] See http://info.worldbank.org/governance/wgi/index.aspx#home
[10] The ratio is provided on http://faculty.haas.berkeley.edu/ross_levine/papers.htm
[11] The ratio is provided on http://faculty.haas.berkeley.edu/ross_levine/papers.htm

$$[M1] \qquad EXRET_{it} =$$

$$\beta_0 + \beta_1 \frac{\Delta C_{it}}{MV_{it-1}} + \beta_2 \left(FD_{it} \frac{\Delta C_{it}}{MV_{it-1}} \right) + \beta_3 \frac{\Delta E_{it}}{MV_{it-1}} + \beta_4 \frac{\Delta RD_{it}}{MV_{it-1}} + \beta_5 \frac{\Delta I_{it}}{MV_{it-1}} + \beta_6 \frac{\Delta D_{it}}{MV_{it-1}} +$$

$$\beta_7 \frac{\Delta F_{it}}{MV_{it-1}} + \beta_8 \frac{C_{it-1}}{MV_{it-1}} + \beta_9 Lev_{it} + \beta_{10} \left(\frac{\Delta C_{it}}{MV_{it-1}} \frac{C_{it-1}}{MV_{it-1}} \right) + \beta_{11} \left(\frac{\Delta C_{it}}{MV_{it-1}} Lev_{it} \right) +$$

$$\beta_{12} FD_{it} + \varepsilon_{it},$$

where *C* denotes cash holdings; *E* is earnings before interest, deferred tax credits and extraordinary items; *RD* is expenditures for research and development purposes; *I* is interest expense; *D* is common dividends paid; *F* is net financing measured as equity issuance minus stock repurchases minus change in debt; *Lev* denotes total debt over total debt plus the market value of equity; *MV* is the market value of equity; and *FD* is a financial constraints dummy, which takes the value one if a firm-year is classified as constrained by one of the firm-specific financial constraints criteria, and zero otherwise. The dependent variable is the excess return defined as the stock return for firm *i* minus the return on a local MSCI index. When there is no MSCI index available for a particular country, we use the return of the median value across all MSCI indices.

According to Faulkender and Wang (2006), the coefficient on the change in cash (β_1) is the estimated marginal value of cash for a firm with zero cash and no leverage. A negative sign on the interaction term between the level of cash and the change in cash (β_{10}) can be interpreted as the difference in the value of cash between two firms holding different amounts of cash reserves. This indicates that the value of cash decreases as a firm's cash position improves. Similarly, a negative sign on the interaction term between the change in cash and leverage (β_{11}) indicates that the marginal value of cash is greater for an all-equity financed firm because some part of the value of an additional dollar of cash accrues to debt holders. The most important coefficient is the coefficient on the interaction term between the change in cash and the financial constraints dummy (β_2), where a positive coefficient indicates that cash holdings are more valuable for constrained firms than for unconstrained firms.

Hypothesis 2 As we are interested in whether internally generated funds allow financially constrained firms to finance their investment projects and to avoid potential underinvestment problems, we test the sensitivity of holding cash on future net investments. We follow the methodology used in Denis and Sibilkov (2009) and estimate a three-stage least squares simultaneous equation model (3SLS), where cash is

exogenously instrumented. The rationale behind this is to account for a potential simultaneous determination of net investment and cash holdings by future investment opportunities. That is, cash reserves can be built up either to support future operating capital needs or to fund future investments. Specifically, we estimate the following model:

$$[M2] \qquad \frac{NI_{it+1}}{AT_{it}} =$$

$$\beta_0 + \beta_1 \frac{C_{it}}{AT_{it}} + \beta_2 \frac{OCF_{it}}{AT_{it}} + \beta_3 log(S_{it} - S_{it-2}) + \beta_4 \frac{MV_{it}}{AT_{it}} + \beta_5 D_{SIC2d} + \beta_6 D_Y + \varepsilon_{it},$$

where cash is exogenously instrumented through:

$$\frac{C_{it}}{AT_{it}} =$$

$$\delta_0 + \delta_1 log(MV_{it}) + \delta_2 \frac{MV_{it}}{AT_{it}} + \delta_3 \frac{D_{it}}{AT_{it}} + \delta_4 \text{median}_{SIC2d}\big(std(ICF_{it} - ICF_{it-1})\big) +$$

$$\delta_5 CC_{it} + \delta_6 \frac{OCF_{it}}{AT_{it}} + \delta_7 ZSCORE_{it} + \delta_8 \Delta R_{it} + \delta_9 log(\Delta IP_{it}) + \delta_{10} D_{SIC2d} + \varepsilon_{it},$$

where *OCF* denotes operating cash flow as measured by income before extraordinary items plus depreciation; *S* is total revenues; *AT* is total book assets; D_{SIC2d} is the two-digit SIC code; and D_Y is a calendar-year dummy. The dependent variable is net investment, which is defined as capital expenditures minus depreciation. Cash is instrumented by a subset of explanatory variables where *ICF* is operating income before depreciation and amortisation; *CC* denotes the cash cycle and is measured as the average inventory age plus the average collection period minus the average payment period; *ZSCORE* is Altman's z-score[12]; ΔR is the spread between the return on investment for firm *i* and the return on a local risk-free interest rate. When data on Treasury bills or comparable benchmarks is not available for a particular country, we use the median return across all countries. *IP* is industrial production as measured by local indices. Again, we use the median index value as a proxy when data is not available for a particular country. The remaining variables are the same as defined in M1.

We are primarily interested in the coefficient on cash (β_1) in M2, where a greater coefficient indicates a stronger relationship between net investment and liquid funds. We estimate our model separately for constrained companies and unconstrained com-

[12] We use the original z-score bankruptcy model, which is defined as 0.012•(working capital / total assets) + 0.014•(retained earnings / total assets) + 0.033•(EBIT / total assets) + 0.006•(market value of equity / total liabilities) + 0.999•(sales / total assets) (Altman, 1968).

panies and test whether the difference between both groups of firms is significantly positive.

Hypothesis 3 When holding cash and financing investments are interrelated, we might expect that investing is more valuable for constrained than for unconstrained firms. Without cash reserves, constrained companies would otherwise bypass some value-creating projects. We include two additional variables in our first model to test this hypothesis, where investment is defined as the change in non-cash assets, which takes into account cumulated depreciation and amortisation, and changes of the working capital. We estimate the following model:

$$[M3] \qquad EXRET_{it} =$$

$$\beta_0 + \beta_1 \frac{\Delta C_{it}}{MV_{it-1}} + \beta_2 \left(FD_{it} \frac{\Delta C_{it}}{MV_{it-1}}\right) + \beta_3 \frac{\Delta NA_{it}}{MV_{it-1}} + \beta_4 \left(FD_{it} \frac{\Delta NA_{it}}{MV_{it-1}}\right) + \beta_5 \frac{\Delta E_{it}}{MV_{it-1}} +$$

$$\beta_6 \frac{\Delta RD_{it}}{MV_{it-1}} + \beta_7 \frac{\Delta I_{it}}{MV_{it-1}} + \beta_8 \frac{\Delta D_{it}}{MV_{it-1}} + \beta_9 \frac{\Delta F_{it}}{MV_{it-1}} + \beta_{10} \frac{C_{it-1}}{MV_{it-1}} + \beta_{11} Lev_{it} +$$

$$\beta_{12} \left(\frac{\Delta C_{it}}{MV_{it-1}} \frac{C_{it-1}}{MV_{it-1}}\right) + \beta_{13} \left(\frac{\Delta C_{it}}{MV_{it-1}} Lev_{it}\right) + \beta_{14} FD_{it} + \varepsilon_{it},$$

where *NA* is non-cash assets. All remaining variables are the same as described in M1.

The interaction term between the change in non-cash assets and the financial constraints dummy (β_4) then indicates whether investing is significantly more valuable for firms with limited access to external financing.

IV Empirical results

In the first part of this section, we test our hypotheses separately for firms in the U.S. and firms in countries excluding the U.S. Table 1 presents descriptive statistics on various key financial ratios and firm size for the U.S. and global samples. Generally, constrained firms and unconstrained firms show characteristic differences. Unconstrained firms are larger, have a greater portion of tangible fixed assets, are more profitable and invest more. Similar patterns have also been found in Cleary (2005), Pál and Ferrando (2010) and Denis and Sibilkov (2010). The portion of liquid funds is lower for unconstrained firms in the U.S. but it has mixed patterns in the global sam-

Table 1 - Descriptive statistics across financial constraints criteria (U.S. and world)

		Financial constraint criteria											
		Pay-out ratio			Size			Rating (r/n.r)			Rating (IG/NIG)		
		Uncon.	Constr.		Uncon.	Constr.		Uncon.	Constr.		Uncon.	Constr.	
		(A)	(B)		(A)	(B)		(A)	(B)		(A)	(B)	
						USA							
Size	No obs	21,977	24,472		17,907	17,917		33,014	27,397		13,392	10,502	
	Mean	2,483	783	***	4,948	82	***	2,638	489	***	5,199	1,382	***
	Median	529	191	***	2,361	70	***	703	182	***	2,330	608	***
PPE	No obs	22,148	24,366		18,185	18,061		33,017	27,301		13,752	10,262	
	Mean	0.303	0.251	***	0.346	0.221	***	0.293	0.277	***	0.342	0.344	
	Median	0.249	0.180	***	0.301	0.158	***	0.230	0.223	***	0.293	0.295	
Cash holdings	No obs	22,298	24,162		18,326	17,859		33,183	27,241		13,856	10,361	
	Mean	0.154	0.219	***	0.091	0.265	***	0.170	0.166	**	0.089	0.108	***
	Median	0.076	0.123	***	0.046	0.184	***	0.080	0.081		0.044	0.051	***
Total debt	No obs	22,590	24,898		18,512	18,521		33,833	27,787		13,980	10,521	
	Mean	0.211	0.226	***	0.294	0.152	***	0.230	0.228		0.261	0.377	***
	Median	0.191	0.172	***	0.276	0.070	***	0.210	0.192	***	0.255	0.370	***
Cash flow	No obs	22,142	24,122		18,288	17,669		33,061	27,084		13,797	10,343	
	Mean	0.069	0.004	***	0.080	-0.003	***	0.061	0.037	***	0.091	0.051	***
	Median	0.088	0.054	***	0.085	0.062	***	0.082	0.076	***	0.095	0.065	***
Net investment	No obs	21,977	23,773		17,943	17,688		32,578	26,776		13,644	9,950	
	Mean	0.011	0.014	***	0.017	0.010	***	0.016	0.014	***	0.017	0.020	***
	Median	0.003	0.001	***	0.007	0.000	***	0.004	0.003	***	0.007	0.004	***
						World							
Size	No obs	71,930	86,550		63,631	63,401		107,387	106,726		12,769	3,778	
	Mean	1,371	759	***	3,500	57	***	1,709	603	***	8,599	2,938	***
	Median	254	139	***	1,372	54	***	258	174	***	4,476	1,206	***
PPE	No obs	72,086	86,361		64,443	64,031		107,847	106,403		13,866	3,746	
	Mean	0.329	0.333	***	0.359	0.303	***	0.334	0.330	***	0.398	0.410	***
	Median	0.302	0.301		0.332	0.273	***	0.306	0.304		0.366	0.400	***
Cash holdings	No obs	71,841	86,171		64,532	63,563		107,639	106,169		13,835	3,741	
	Mean	0.145	0.140	***	0.122	0.162	***	0.146	0.136	***	0.115	0.117	
	Median	0.109	0.093	***	0.095	0.110	***	0.106	0.100	***	0.088	0.079	***
Total debt	No obs	73,025	88,196		65,347	65,348		109,668	108,167		14,038	3,820	
	Mean	0.199	0.258	***	0.275	0.202	***	0.236	0.240	***	0.271	0.355	***
	Median	0.181	0.242	***	0.267	0.172	***	0.226	0.219	***	0.264	0.357	***
Cash flow	No obs	67,711	80,268		59,662	56,861		99,139	94,803		12,686	3,526	
	Mean	0.082	0.034	***	0.074	0.046	***	0.063	0.062	**	0.090	0.060	***
	Median	0.078	0.052	***	0.069	0.069		0.068	0.067	***	0.085	0.064	***
Net investment	No obs	61,661	72,265		52,660	51,521		89,760	83,552		10,802	3,152	
	Mean	0.019	0.020	***	0.020	0.020		0.026	0.015	***	0.018	0.031	***
	Median	0.005	0.002	***	0.006	0.002	***	0.007	0.002	***	0.008	0.008	

The financial constraints criteria are dividend pay-out ratio, firm size, long-term credit rating (rated/not rated) and long-term credit rating (investment grade rating/non-investment grade rating). Pay-out ratio: Dividend pay-out ratio is measured as total dividends plus stock repurchases over operating income, where a firm-year is classified as constrained (unconstrained) when the pay-out ratio is below or equal (above or equal) the bottom (top) three deciles. Firm-years with positive dividend payments or stock repurchases but negative operating income are classified as unconstrained. Size: Firm size is measured by book total assets. A firm-year is classified as constrained (unconstrained) when book total assets are below or equal (above or equal) the bottom (top) three deciles. Rating (r/n.r): Each firm is classified as unconstrained when a Standard & Poor's long-term credit rating is available at least in one year. The remaining firms are classified as constrained. When a long-term credit rating is not available but the firm can raise five per cent of the previous year's outstanding long-term debt or above in that particular year, this firm-year is also classified as unconstrained. Rating (IG/NIG): A firm is classified as unconstrained when it is rated investment grade at least in one year. The remaining companies are classified as constrained. Data is taken from Standard &Poor's Compustat Global, Standard & Poor's RatingsXpress and Thomson Reuter's Datastream databases. The dataset includes publicly listed firms in 104 countries over the period from 1988 to 2009. We exclude companies in the financial (SIC 6000-6799) and utility (SIC 4910-4939) sectors. Additionally, we exclude firm-years with non-positive values for total book assets or cash holdings, negative values for capital expenditures or total book assets less than twenty-five million U.S.-$ in 1998 dollars and not fully consolidated firm-years. Our initial dataset contains 29,757 active and inactive companies with a total of 279,455 firm-year observations. Size is book total assets; PPE denotes property, plant, and equipment over book total assets; cash holdings is cash holdings deflated by book total assets; total debt is long-term and short-term debt over book total assets; cash flow is income before extraordinary items plus depreciation over book total assets; and net investment is capital expenditures minus depreciation deflated by book total assets. All variables are trimmed at the 1% and 99% levels. ***, **, and * denote the significance at the 1, 5 and 10% levels.

ple. However, constrained and unconstrained companies show only slight differences. The differences in leverage mainly depend on the classification for financial constraints. Similar characteristics have been reported in Korajczyk and Levy (2003) and Acharya et al. (2007).

The above findings indicate that there might exist significant differences between constrained and unconstrained companies. While similar patterns have been found in previous studies, most of them have focused on the investment-cash flow sensitivity to differentiate between the two groups of firms. This strand of the literature mainly aims to provide evidence on whether investment-cash flow sensitivities can serve as an indicator for external financial constraints (e.g., Fazzari et al., 1988; Hoshi et al., 1991; Calomiris and Hubbard, 1995; Gilchrist and Himmelberg, 1995; Boyle and Guthrie, 2003).

Hypothesis 1 One would expect that firms with insufficient access to external financing rely more on internal financing. While cash flows can be seen as an intermediate source of financing activities throughout the year, built-up cash reserves can have a smoothing effect in case of negative cash flow shocks or in case of extraordinary investment opportunities, when debt or equity capital is not available. Thus, cash holdings should be value-creating as firms must forego positive net present value projects in case of insufficient financial resources. In Table 2, the methodology of Faulkender and Wang (2006) and Denis and Sibilkov (2010) is adapted to our research design for the U.S. and world samples. We focus on the coefficients on the change in cash and the interaction term between the change in cash and the financial constraints dummy. To estimate the overall value of a marginal dollar, the interaction terms between the change in cash and lagged cash and the change in cash and leverage are also reported. For the U.S., our results are similar to those reported in Faulkender and Wang (2006), Dittmar and Mahrt-Smith (2007) and Denis and Sibilkov (2010), while their data stems from a broad U.S. sample. Our coefficients are larger in magnitude as compared to the latter study but similar as compared to the former two studies. Contrary to the findings in Faulkender and Wang (2006), the marginal value of cash to shareholders[13] is slightly above one (ranging from 1.154 to 1.241 U.S.-$ for unconstrained firms and

[13] See Faulkender and Wang (2006) for a detailed description of the calculation of the marginal value of cash.

Table 2 - Marginal value of cash holdings across financial constraints criteria (U.S. and world)

	Financial constraint criteria			
	Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
		USA		
Change in cash	1.538***	1.668***	1.606***	1.428***
Constrained•change in cash	0.405***	0.434***	0.203***	0.083
Change in cash•lagged cash	-1.052***	-1.206***	-0.968***	-0.503*
Change in cash•leverage	-0.866***	-0.995***	-0.954***	-0.701**
No obs	22,996	17,873	30,459	12,967
R-sq	0.19	0.19	0.18	0.21
		Marginal value of cash		
Constrained firms	1.573	1.675	1.435	1.237
Unconstrained firms	1.168	1.241	1.232	1.154
		World		
Change in cash	0.651***	0.720***	0.755***	0.862***
Constrained•change in cash	0.212***	0.061	0.005	0.098
Change in cash•lagged cash	-0.294***	-0.206***	-0.272***	-0.190
Change in cash•leverage	-0.677***	-0.711***	-0.687***	-0.971***
No obs	47,009	35,224	60,082	5,772
R-sq	0.16	0.15	0.15	0.13
		Marginal value of cash		
Constrained firms	0.595	0.519	0.484	0.620
Unconstrained firms	0.383	0.458	0.479	0.522

The financial constraints criteria are dividend pay-out ratio, firm size, long-term credit rating (rated/not rated) and long-term credit rating (investment grade rating/non-investment grade rating). We estimate model 1 [M1] separately for the U.S. and global samples. *C* denotes cash holdings; *E* is earnings before interest, deferred tax credits and extraordinary items; *RD* is expenditures for research and development purposes; *I* is interest expense; *D* is common dividends paid; *F* is net financing measured as equity issuance minus stock repurchases minus change in debt; *Lev* denotes total debt over total debt plus the market value of equity; *MV* is the market value of equity; and *FD* is a financial constraints dummy, which takes the value one if a firm-year is classified as constrained by one of the aforementioned firm-specific measures of constraints and zero otherwise. The dependent variable is the excess return defined as the stock return for firm *i* minus the return on a local MSCI index. When a MSCI index is not available for a particular country, we use the return of the median value across all MSCI indices. We only report the results for the change in cash, the interaction between the change in cash and financial constraints dummy, the interaction between the change in cash and lagged cash and the interaction between the change in cash and leverage. The model is estimated using OLS and the standard errors are robust against heteroscedasticity and autocorrelation. ***, **, and * denote the significance at the 1, 5 and 10% levels.

from 1.237 to 1.675 U.S.-$ for constrained firms). Note that while they use data for the period 1972 to 2001, our period is from 1998 to 2009. Dittmar and Mahrt-Smith (2007) find that a marginal dollar is on average worth 1.090 U.S.-$ (with 1.620 U.S.-$ for well governed firms and 0.420 U.S.-$ for poorly governed firms). Their estimation period ranges from 1990 to 2003. The interaction term between the change in cash and the financial constraints dummy is between 0.083 and 0.434, indicating that the marginal value of cash is between 8.3 and 43.4 U.S.-¢ higher for constrained firms. The coefficient estimates in Denis and Sibilkov (2010) range from 0.137 to 0.511, where the interaction term is statistically significant across all financial constraints criteria. Cash reserves are, hence, more valuable for constrained firms due to their inability to finance their investments with external sources of financing.

In our global sample, cash is only more valuable for constrained firms when they are classified through dividend pay-out. The marginal value of cash for unconstrained companies is between 0.383 and 0.522 U.S.-$, and it is only slightly greater for constrained firms ranging from 0.484 to 0.620 U.S.-$. Similar values have been reported in Drobetz et al. (2010).

Hypothesis 2 It is, however, a moot point whether cash reserves are held by companies to finance their investment projects. We adopt the methodology in Denis and Sibilkov (2010) and estimate the relationship between net investment, cash holdings and operating cash flows. In Table 3, results are presented separately for constrained and unconstrained companies in the U.S. and globally, where only the coefficients on cash and cash flow for the investment equation are reported. Our results are consistent with those in Denis and Sibilkov (2010) for the U.S. Cash holdings are significantly positively related to net investment for both, constrained and unconstrained firms, and this evidence is stronger for constrained firms for three of the four financial constraint criteria. However, this does not hold for the classification on firm size where the coefficient on cash is greater for unconstrained firms but at a lower significance level. Additionally, the coefficient on cash flow is significantly positive throughout all clas sification criteria for constrained and unconstrained companies and greater for constrained firms, indicating that both cash reserves and cash flows are used to finance investment projects, and that constrained firms benefit more from internal sources of funds.

Table 3 - Relationship between net investment and cash holdings across financial constraints criteria (U.S. and world)

Financial constraint criteria	Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
		USA		
		Constrained firms		
Cash	0.044***	0.036***	0.049***	0.134***
Cash flow	0.076***	0.066***	0.080***	0.093***
No obs	13,620	9,182	16,428	6,399
		Unconstrained firms		
Cash	0.023***	0.058***	0.031***	0.061***
Cash flow	0.058***	0.084***	0.068***	0.067***
No obs	14,640	11,727	20,816	8,744
p-value for difference in the coefficients on cash	0.00	0.03	0.00	0.00
		World		
		Constrained firms		
Cash	0.033***	0.026***	0.052***	0.275***
Cash flow	0.060***	0.063***	0.070***	0.087***
No obs	32,140	18,707	40,470	1,673
		Unconstrained firms		
Cash	0.000	-0.035***	-0.044***	0.062***
Cash flow	0.070***	0.079***	0.074***	0.065***
No obs	35,106	33,320	50,940	5,973
p-value for difference in the coefficients on cash	0.00	0.00	0.00	0.00

The financial constraints criteria are dividend pay-out ratio, firm size, long-term credit rating (rated/not rated) and long-term credit rating (investment grade rating/non-investment grade rating). We estimate model 2 [M2] separately for the U.S. and global samples. *OCF* denotes operating cash flow as measured by income before extraordinary items plus depreciation; *S* is total revenues; *AT* is total book assets; D_{SIC2d} is the two-digit SIC code; and D_Y is a calendar-year dummy. The dependent variable is net investment, which is defined as capital expenditures minus depreciation. Cash is instrumented by a subset of explanatory variables where *ICF* is operating income before depreciation and amortisation; *CC* denotes the cash cycle and is measured as the average inventory age plus the average collection period minus the average payment period; *ZSCORE* is Altman's z-score; ΔR is the spread between the return on investment for firm *i* and the return on a local risk-free interest rate. When data on Treasury bills or comparable benchmarks is not available for a particular country, we use the median return across all countries. *IP* is industrial production as measured by local indices. Again, we use the median index value as a proxy when data is not available for a particular country. The remaining variables are the same as defined in M1. We only report the results for cash and cash flow from the first equation. The model is estimated using a three-stage least squares simultaneous equation model (3SLS) where cash is exogenously instrumented. ***, **, and * denote the significance at the 1, 5 and 10% levels.

We find similar patterns in the global samples; however, some coefficients differ in sign and magnitude. While the coefficients are positively significant for constrained firms, they become non-significant or negatively significant for unconstrained firms. That said, cash has a more supportive function for constrained companies.

Hypothesis 3 The use of cash is related to net investment. However, investments might not generally be value-increasing. Moreover, one might expect that investments are more valuable for constrained firms because they have fewer funds to finance their investment projects and the marginal profitability might be greater. In Table 4, results for the coefficients on the change in cash and the change in non-cash assets are reported for the U.S. and world samples. Additionally, the differences between constrained and unconstrained firms are estimated for both, cash holdings and investment. For the U.S., the coefficients on cash and investment are significantly positive indicating that both, cash holdings and net investments are value-increasing. Additionally, the interaction term between the change in non-cash assets and the financial constraints dummy is significantly positive across three of the four financial constraints criteria. Investments are, hence, more valuable for constrained than for unconstrained companies. Again, our findings are consistent with those reported in Faulkender and Wang (2006), Dittmar and Mahrt-Smith (2007) and Denis and Sibilkov (2010). The results for the marginal value of cash are similar to the aforementioned findings for both, constrained and unconstrained firms. Thus, cash reserves are more valuable for constrained firms due to their inability to finance their investments with external sources. Moreover, investments are value-increasing, and this evidence is stronger for constrained firms because they might then forego problems arising from underinvestment and reduced growth.

The results for the change in cash for firms in countries excluding the U.S. are similar to those reported in Table 2. As in the U.S., investments are value-increasing but constrained companies do not benefit more from investments. The coefficients on the interaction term between the change in non-cash assets and the financial constraints dummy are non-significant or negatively significant.

Obviously, there exist some remarkable differences between companies in the U.S. and outside the U.S. As the use of liquid funds and investments might be determined by different corporate governance regimes and financial market development across

Table 4 - Marginal value of cash holdings and investment across financial constraints criteria (U.S. and world)

	Financial constraint criteria			
	Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
	USA			
Change in cash	1.521***	1.633***	1.585***	1.443***
Constrained•change in cash	0.457***	0.549***	0.286***	0.111
Change in non-cash assets	0.249***	0.229***	0.281***	0.275***
Constrained•change in non-cash assets	0.117***	0.281***	0.094***	0.003
No obs	22,795	17,705	30,140	12,848
R-sq	0.19	0.20	0.18	0.21
	Marginal value of investments			
Constrained firms	0.366	0.510	0.375	0.278
Unconstrained firms	0.249	0.229	0.281	0.275
	World			
Change in cash	0.658***	0.718***	0.740***	0.859***
Constrained•change in cash	0.208***	0.060	0.021	0.099
Change in non-cash assets	0.162***	0.149***	0.183***	0.157***
Constrained•change in non-cash assets	0.013	0.002	-0.067***	0.025
No obs	46,661	34,994	59,592	5,714
R-sq	0.16	0.16	0.15	0.13
	Marginal value of investments			
Constrained firms	0.175	0.151	0.366	0.182
Unconstrained firms	0.162	0.149	0.183	0.157

The financial constraints criteria are dividend pay-out ratio, firm size, long-term credit rating (rated/not rated) and long-term credit rating (investment grade rating/non-investment grade rating). We estimate model 3 [M3] separately for the U.S. and global samples. *C* denotes cash holdings; *E* is earnings before interest, deferred tax credits and extraordinary items; *RD* is expenditures for research and development purposes; *I* is interest expense; *D* is common dividends paid; *F* is net financing measured as equity issuance minus stock repurchases minus change in debt; *Lev* denotes total debt over total debt plus the market value of equity; *MV* is the market value of equity; *NA* is non-cash assets; and *FD* is a financial constraints dummy, which takes the value one if a firm-year is classified as constrained by one of the aforementioned firm-specific measures of constraints and zero otherwise. The dependent variable is the excess return defined as the stock return for firm *i* minus the return on a local MSCI index. When a MSCI index is not available for a particular country, we use the return of the median value across all MSCI indices. We only report the results for the change in cash, the interaction between the change in cash and financial constraints dummy, the change in non-cash assets and the interaction between the change in non-cash assets and the financial constraints dummy. The model is estimated using OLS and the standard errors are robust against heteroscedasticity and autocorrelation. ***, **, and * denote the significance at the 1, 5 and 10% levels.

countries, i.e., managers could waste cash or invest in negative present value projects or firms are more constrained due to a weaker market development, we split our world sample into countries with either a solid corporate governance infrastructure (anti-director rights index, rule of law index or corruption index above median) or a strong financial market development (stock to GDP or bond to GDP above median). Countries with values below median are classified as representing either poor corporate governance systems or a weak financial market development.

Hypothesis 1 As reported in Pinkowitz and Williamson (2004) and Pinkowitz et al. (2006), cash is less valuable for firms in countries with poor minority shareholder rights. Moreover, Dittmar et al. (2003) and Dittmar and Mahrt-Smith (2007) suggest that the value of cash holdings is weakened by poor corporate governance structures. Our results in Table 5 provide some evidence for this view. The marginal value of cash is greater for firms in countries with a solid corporate governance infrastructure. Also, liquid funds of constrained firms are valued higher in these countries, while – to some extent – they are valued slightly lower for unconstrained firms. This might indicate that constrained firms do benefit more from being headquartered in strongly governed countries than unconstrained companies. The value of cash holdings is primarily higher for constrained firms than for unconstrained firms in these countries. In countries with poor corporate governance systems, the cash position of constrained companies is equally or even less valued as compared to unconstrained firms. These findings support our view that insufficient corporate governance structures may lower the market value of liquid funds. Also, the additional value that arises from holding cash reserves for constrained companies might be relaxed by weak or even missing monitoring activities or by disadvantageous discretionary decisions. When the sample split is based upon financial market development, the market value of cash for companies in highly developed countries is below that in less developed countries for stock market capitalisation to GDP (except the classification on investment grade/non-investment grade ratings). Arguably, developed countries facilitate the allocation of funds from investors to firms and, hence, companies are not required to have extensive cash holdings. Moreover, cash is more valuable for constrained firms only in the dividend pay-out and size criteria. Contrary to that, cash is valued higher in countries with a greater ratio of bond market capitalisation to GDP. We interpret

Table 5 - Marginal value of cash holdings across financial constraints criteria (world - sample split)

Anti-director rights index

	Financial constraint criteria: Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
High				
Change in cash	0.565***	0.650***	0.662***	0.979***
Constrained•change in cash	0.320***	0.034	0.025	0.305*
Change in cash•lagged cash	-0.080	-0.011	-0.090	0.219
Change in cash•leverage	-0.775***	-0.746***	-0.748***	-1.655***
No obs	20,398	17,015	28,623	3,078
R-sq	0.16	0.16	0.15	0.14
Low				
Change in cash	0.593***	0.565***	0.586***	0.639***
Constrained•change in cash	-0.003	0.014	-0.006	-0.382**
Change in cash•lagged cash	-0.473***	-0.248*	-0.322***	-0.575
Change in cash•leverage	-0.245	-0.364**	-0.285**	0.148
No obs	9,625	7,571	12,127	1,385
R-sq	0.13	0.13	0.13	0.12
Marginal value of cash				
All firms	0.058	0.063	0.027	0.119
Constrained firms	0.255	0.073	0.042	0.657
Unconstrained firms	-0.068	0.053	0.011	-0.030

Rule of law index

	Financial constraint criteria: Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
High				
Change in cash	0.646***	0.723***	0.725***	0.954***
Constrained•change in cash	0.224***	0.076*	0.043	0.179
Change in cash•lagged cash	-0.277***	-0.183***	-0.242***	-0.063
Change in cash•leverage	-0.668***	-0.697***	-0.654***	-1.191***
No obs	38,986	29,834	49,946	4,989
R-sq	0.16	0.17	0.16	0.14
Low				
Change in cash	0.654***	0.830***	0.961***	0.349
Constrained•change in cash	0.126	-0.175	-0.295***	-0.063
Change in cash•lagged cash	-0.342*	-0.412**	-0.508***	-0.662
Change in cash•leverage	-0.723***	-0.892***	-0.953***	0.219
No obs	8,020	5,387	10,131	783
R-sq	0.16	0.14	0.15	0.15
Marginal value of cash				
All firms	0.012	0.103	0.027	0.344
Constrained firms	0.081	0.224	0.205	0.537
Unconstrained firms	-0.017	-0.027	-0.133	0.295

Corruption index

	Financial constraint criteria: Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
High				
Change in cash	0.644***	0.708***	0.735***	0.974***
Constrained•change in cash	0.244***	0.121***	0.044	0.206*
Change in cash•lagged cash	-0.258***	-0.180**	-0.242***	-0.056
Change in cash•leverage	-0.688***	-0.720***	-0.697***	-1.345***
No obs	37,887	29,006	48,629	4,889
R-sq	0.17	0.17	0.16	0.13
Low				
Change in cash	0.682***	0.807***	0.846***	0.302
Constrained•change in cash	0.064	-0.280**	-0.203**	-0.327
Change in cash•lagged cash	-0.529***	-0.394**	-0.467***	-0.736*
Change in cash•leverage	-0.529***	-0.601***	-0.624***	0.982
No obs	9,119	6,215	11,448	883
R-sq	0.14	0.14	0.14	0.15
Marginal value of cash				
All firms	0.060	0.150	0.054	0.204
Constrained firms	0.163	0.342	0.181	0.603
Unconstrained firms	-0.017	-0.059	-0.066	0.070

Table 5 - Marginal value of cash holdings across financial constraints criteria (world - sample split; cont'd)

Stock/GDP

	High				Low				
Change in cash	0.605***	0.665***	0.683***	0.874***	Change in cash	0.719***	1.013***	1.105***	0.731**
Constrained•change in cash	0.196***	0.099**	0.027	0.147	Constrained•change in cash	0.257**	-0.160	-0.168*	0.180
Change in cash•lagged cash	-0.251***	-0.143**	-0.199***	-0.054	Change in cash•lagged cash	-0.218	-0.313	-0.537***	-1.110
Change in cash•leverage	-0.597***	-0.632***	-0.600***	-1.051***	Change in cash•leverage	-1.028***	-1.249***	-1.273***	-0.559
No obs	37,364	29,120	48,131	5,032	No obs	7,481	4,815	9,441	611
R-sq	0.16	0.16	0.15	0.13	R-sq	0.18	0.15	0.16	0.18

	Marginal value of cash			
	High-Low	High-Low	High-Low	High-Low
All firms	-0.121	-0.026	-0.110	0.151
Constrained firms	-0.111	0.093	-0.008	0.16
Unconstrained firms	-0.050	-0.166	-0.203	0.193

Bond/GDP

	High				Low				
Change in cash	0.656***	0.711***	0.754***	0.965***	Change in cash	0.567***	0.724***	0.777***	0.400*
Constrained•change in cash	0.253***	0.119**	0.031	0.123	Constrained•change in cash	0.139*	-0.110	-0.141**	0.189
Change in cash•lagged cash	-0.297***	-0.153**	-0.233***	0.105	Change in cash•lagged cash	-0.205	-0.267*	-0.346***	-0.614
Change in cash•leverage	-0.618***	-0.642***	-0.628***	-1.235***	Change in cash•leverage	-0.755***	-0.793***	-0.817***	-0.320
No obs	31,450	24,815	41,078	4,520	No obs	12,539	8,487	15,512	1,060
R-sq	0.17	0.17	0.16	0.14	R-sq	0.15	0.13	0.14	0.13

	Marginal value of cash			
	High-Low	High-Low	High-Low	High-Low
All firms	0.106	0.183	0.106	0.399
Constrained firms	0.188	0.345	0.195	0.369
Unconstrained firms	0.074	0.036	0.023	0.435

The global sample is split according to the anti-director rights index, the rule of law index, the corruption index, the stock market capitalisation to GDP and the private bond market capitalisation to GDP. Anti-director rights index: The index ranges from zero to six, where six indicates the highest level of shareholder protection. Countries are classified as high-(low-)index countries when the index value is above (below) the median index value. Rule of law index: The index range is from -2.5 to 2.5. Higher index values indicate better corporate governance structures. Countries are classified as high-(low-)index countries when the index value is above (below) the median index value in year 1998. Corruption index: The index range is from -2.5 to 2.5, where lower index values indicate a weaker corporate governance infrastructure. Countries are classified as high-(low-)index countries when the index value is above (below) the median index value for year 1998. Stock market capitalisation to GDP: The stock market capitalisation to GDP ratio equals the market value of listed shares in a country divided by its gross domestic product. A country's financial and capital market development is more pronounced with greater values and firms generally tend to be less constrained. The sample is split according to the median value in 1998. Private bond market capitalisation to GDP: The private bond market capitalisation to GDP ratios is measured through outstanding debt securities issued by private domestic corporates in a country over its gross domestic product. Higher values indicate more developed financial markets and lower-level financial constraints. The sample is split according to the median value for the year 1998. The financial constraints criteria are dividend pay-out ratio, firm size, long-term credit rating (rated/not rated) and long-term credit rating (investment grade rating/non-investment grade rating). We estimate model 1 [M1] separately for each sample split. C denotes cash holdings; E is earnings before interest, deferred tax credits and extraordinary items; RD is expenditures for research and development purposes; I is interest expense; D is common dividends paid; F is net financing measured as equity issuance minus stock repurchases minus change in debt; Lev denotes total debt over total debt plus the market value of equity; MV is the market value of equity; and FD is a financial constraints dummy which takes the value one if a firm-year is classified as constrained by one of the aforementioned firm-specific measures of constraints and zero otherwise. The dependent variable is the excess return defined as the stock return for firm i minus the return on a local MSCI index. When a MSCI index is not available for a particular country, we use the return of the median value across all MSCI indices. We only report the results for the change in cash, the interaction between the change in cash and financial constraints dummy, the interaction between the change in cash and lagged cash and the interaction between the change in cash and leverage. The model is estimated using OLS and the standard errors are robust against heteroscedasticity and autocorrelation. ***, **, and * denote the significance at the 1, 5 and 10% levels.

this finding with respect to investor protection and information asymmetry. Pinkowitz et al. (2006) suggest that less developed countries might have a weak investor protection, which could then dilute the market value of cash. Leland and Pyle (1977) and Drobetz et al. (2010) argue that information asymmetry could be less distinctive in bank-based and, hence, less developed countries because banks might have better access to information than bondholders or shareholders, where cash is less needed to serve as a capital buffer. In less developed countries, cash is more valuable for constrained firms in the pay-out criteria but significantly lower for the ratings (rated/not rated) criteria, and equally valued in the remaining criteria. These two opposite results for stock and bond market capitalisation to GDP may arise from two different focus points, where the sample split on stock to GDP could emphasise the firms' access to the capital market, while the bond to GDP ratio highlights possible differences between fixed-income investors and banks.

Hypothesis 2 Similarly to the U.S., cash reserves allow constrained firms to increase investments in countries with strong corporate governance systems or financial market development (Table 6). They also benefit more from holding cash than unconstrained companies. These firms, on their part, exhibit coefficients, which are lower in magnitude or statistically not significant, with two coefficients being negative, indicating that their investment activities depend less on internal funds. In less developed or poorly governed countries, this evidence becomes even more pronounced. Specifically, the coefficient on cash holdings is either non-significant or negative for unconstrained companies, while the relationship between investment and cash is more heterogeneous for constrained firms, changing signs from negative to positive, and becoming statistically insignificant to some extent. However, they still benefit more from saving cash than unconstrained firms. Moreover, the coefficient on cash is generally lower in magnitude than in strongly governed and highly developed countries.

While our findings for constrained and unconstrained companies in countries with strong corporate governance regimes or a high financial market development are similar to those reported for the U.S., the results for the second group of countries and the primarily negative or statistically non-significant relationship between investment and liquid funds differ from these patterns in that they are contradictory to our general hypothesis that cash reserves help companies finance their future investment projects.

Table 6 - Relationship between net investment and cash holdings across financial constraints criteria (world - sample split)

Financial constraint criteria	Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)	Financial constraint criteria	Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
Anti-director rights index									
	High					Low			
	Constrained firms					Constrained firms			
Cash	0.011	-0.006	0.016**	0.173***	Cash	0.029*	0.071***	0.056***	-0.024
Cash flow	0.060***	0.085***	0.075***	0.137***	Cash flow	0.056***	0.036***	0.062***	0.144***
No obs	10,714	10,404	23,315	826	No obs	7,083	3,204	7,292	465
	Unconstrained firms					Unconstrained firms			
Cash	0.005	-0.036***	-0.063***	0.048***	Cash	-0.004	0.008	0.006	0.021
Cash flow	0.069***	0.056***	0.070***	0.083***	Cash flow	0.049***	0.088***	0.059***	0.024
No obs	22,964	18,900	27,704	3,642	No obs	5,015	6,432	8,673	1,124
p-value for difference in the coefficients on cash	0.72	0.00	0.00	0.00	*p*-value for difference in the coefficients on cash	0.01	0.01	0.00	0.81
						Coefficient on cash			
						High-Low	High-Low	High-Low	High-Low
					Constrained firms	-0.018	-0.077	-0.040	0.197
					Unconstrained firms	0.009	-0.044	-0.069	0.027
Rule of law index									
	High					Low			
	Constrained firms					Constrained firms			
Cash	0.032***	0.030***	0.065***	0.236***	Cash	-0.077***	-0.121***	-0.019	-0.127
Cash flow	0.053***	0.053***	0.060***	0.103***	Cash flow	0.084***	0.114***	0.087***	0.135*
No obs	22,821	15,655	33,900	1,279	No obs	9,307	3,049	6,565	393
	Unconstrained firms					Unconstrained firms			
Cash	0.021***	0.009	0.004	0.038**	Cash	-0.179***	-0.241***	-0.286***	-0.163
Cash flow	0.058***	0.055***	0.055***	0.062***	Cash flow	0.076***	0.098***	0.135***	0.066**
No obs	30,989	27,734	40,720	5,221	No obs	4,110	5,578	10,202	751
p-value for difference in the coefficients on cash	0.13	0.01	0.00	0.00	*p*-value for difference in the coefficients on cash	0.00	0.00	0.00	0.68
						Coefficient on cash			
						High-Low	High-Low	High-Low	High-Low
					Constrained firms	0.109	0.151	0.084	0.363
					Unconstrained firms	0.200	0.250	0.290	0.201
Corruption index									
	High					Low			
	Constrained firms					Constrained firms			
Cash	0.020***	0.024***	0.060***	0.220***	Cash	0.013	0.002	0.046***	0.023
Cash flow	0.055***	0.057***	0.064***	0.095***	Cash flow	0.054***	0.062***	0.065***	0.136*
No obs	20,422	14,273	31,213	1,239	No obs	11,706	4,431	9,252	433
	Unconstrained firms					Unconstrained firms			
Cash	0.020***	0.008	0.003	0.045***	Cash	-0.100***	-0.158***	-0.193***	-0.313**
Cash flow	0.061***	0.060***	0.057***	0.066***	Cash flow	0.063***	0.091***	0.113***	0.072***
No obs	29,872	26,118	38,164	5,079	No obs	5,227	7,194	12,758	893
p-value for difference in the coefficients on cash	0.97	0.07	0.00	0.00	*p*-value for difference in the coefficients on cash	0.00	0.00	0.00	0.08
						Coefficient on cash			
						High-Low	High-Low	High-Low	High-Low
					Constrained firms	0.007	0.022	0.014	0.197
					Unconstrained firms	0.120	0.166	0.196	0.358

Table 6 - Relationship between net investment and cash holdings across financial constraints criteria (world - sample split; cont'd)

Stock/GDP

High					Low				
	Constrained firms					Constrained firms			
Cash	0.047***	0.051***	0.071***	0.250***	Cash	-0.082***	-0.109***	-0.026	-0.822**
Cash flow	0.061***	0.060***	0.067***	0.086***	Cash flow	0.082***	0.107***	0.090***	0.256***
No obs	22,339	14,884	33,336	1,265	No obs	8,511	2,922	5,866	297
	Unconstrained firms					Unconstrained firms			
Cash	0.017***	0.005	-0.001	0.049***	Cash	-0.159***	-0.246***	-0.273***	-0.209
Cash flow	0.065***	0.074***	0.065***	0.065***	Cash flow	0.066***	0.085***	0.125***	0.104**
No obs	30,139	28,078	39,834	5,372	No obs	3,500	4,475	9,219	507
p-value for difference in the coefficients on cash	0.00	0.00	0.00	0.00	*p*-value for difference in the coefficients on cash	0.00	0.00	0.00	0.09

	Coefficient on cash			
	High-Low	High-Low	High-Low	High-Low
Constrained firms	0.129	0.160	0.097	1.072
Unconstrained firms	0.176	0.251	0.272	0.258

Bond/GDP

High					Low				
	Constrained firms					Constrained firms			
Cash	0.030***	0.031***	0.061***	0.163***	Cash	-0.007	-0.030*	0.043**	0.232
Cash flow	0.052***	0.057***	0.061***	0.116***	Cash flow	0.067***	0.077***	0.073***	0.087
No obs	17,248	12,219	29,145	1,038	No obs	12,759	5,255	9,351	474
	Unconstrained firms					Unconstrained firms			
Cash	0.023***	0.006	0.007	0.031**	Cash	-0.090***	-0.166***	-0.203***	-0.391***
Cash flow	0.059***	0.061***	0.055***	0.059***	Cash flow	0.068***	0.098***	0.132***	0.062***
No obs	26,900	24,780	34,393	4,855	No obs	6,124	7,091	13,657	975
p-value for difference in the coefficients on cash	0.37	0.00	0.00	0.01	*p*-value for difference in the coefficients on cash	0.00	0.00	0.00	0.00

	Coefficient on cash			
	High-Low	High-Low	High-Low	High-Low
Constrained firms	0.037	0.061	0.018	-0.069
Unconstrained firms	0.113	0.172	0.210	0.422

The global sample is split according to the anti-director rights index, the rule of law index, the corruption index, the stock market capitalisation to GDP and the private bond market capitalisation to GDP. The financial constraints criteria are dividend pay-out ratio, firm size, long-term credit rating (rated/not rated) and long-term credit rating (investment grade rating/non-investment grade rating). We estimate model 2 [M2] separately for each sample split. *OCF* denotes operating cash flow as measured by income before extraordinary items plus depreciation; *S* is total revenues; *AT* is total book assets; D_{SIC2d} is the two-digit SIC code; and D_y is a calendar-year dummy. The dependent variable is net investment, which is defined as capital expenditures minus depreciation. Cash is instrumented by a subset of explanatory variables where *ICF* is operating income before depreciation and amortization; *CC* denotes the cash cycle and is measured as the average inventory age plus the average collection period minus the average payment period; *ZSCORE* is Altman's z-score; ΔR is the spread between the return on investment for firm *i* and the return on a local risk-free interest rate. When data on Treasury bills or comparable benchmarks is not available for a particular country, we use the median return across all countries. *IP* is industrial production as measured by local indices. Again, we use the median index value as a proxy when data is not available for a particular country. The remaining variables are the same as defined in M1. We only report the results for cash and cash flow from the first equation. The model is estimated using a three-stage least squares simultaneous equation model (3SLS) where cash is exogenously instrumented. ***, **, and * denote the significance at the 1, 5 and 10% levels.

Seemingly, they invest when cash reserves are low and decrease their investment activity when cash holdings improve. We interpret these findings in the context of the corporate life cycle hypothesis pointed out by Hovakimian (2009). He investigates the investment-cash flow sensitivity of manufacturing firms in the U.S. and finds that this relationship is negative for some firms. He suggests that these companies exhibit high growth opportunities but low cash flows and few cash reserves in the early stages. They are able to raise external financing, though, because investors might expect a strong future profitability from their investment projects. In subsequent years, they have positive cash inflows and can build up liquid funds while they become more mature and their investment opportunities are less attractive to investors. Therefore, we test whether this explanatory approach for the investment-cash flow sensitivity might also help to explain the negative relationship between investment and cash holdings. We classify firm-years with respect to their growth opportunities and re-estimate the relationship between investment and cash holdings. Particularly, we assign firm-years to the high (low) growth subgroup when they have a prior year market-to-book ratio, a 3-year past sales growth (compound annual growth rate) or a 3-year future sales growth (compound annual growth rate) above or equal (below or equal) the top (bottom) three deciles. Presumably, the coefficient on cash is positive for companies with low growth opportunities and non-significant or negative for high growth firms because they have better access to external funds due to the expected profitability and can – to a certain extent – mitigate restrictions, which arise from financial constraints. Our results in Table 7 support the corporate life cycle hypothesis. Cash is positively related to investments for companies with low growth opportunities in highly developed/strongly governed countries, while this relationship becomes weaker for high growth firms, indicating that they have little less restrictions in accessing funds from banks and investors. The results are more pronounced in countries with poor corporate governance regimes or a weak financial market development. For firms with high growth opportunities, the coefficient on cash is generally negative. This indicates that they are even less financially constrained because external funds are supplied when growth opportunities are ample and firms need to invest but have little internal financial flexibility. The results for low growth companies are two-fold. First, the relationship between investment and cash is – to some extent – positive or non-significant, and this is particularly the case for firms in countries with a weak

Table 7 - Growth opportunities and the relationship between net investment and cash holdings (world - sample split)

Financial constraint criteria	Market/ Book	Past sales growth	Future sales growth
Anti-director rights index			
High			
High growth opportunities			
Cash	-0.023**	-0.121***	-0.018
Cash flow	0.050***	0.077***	0.083***
No obs	12,315	11,109	5,633
Low growth opportunities			
Cash	-0.003	0.043***	-0.056***
Cash flow	0.074***	0.038***	0.056***
No obs	16,867	15,528	26,974
p-value for difference in the coefficients on cash	0.05	0.00	0.01
Low			
High growth opportunities			
Cash	0.009	0.037*	0.007
Cash flow	0.066***	0.095***	0.088***
No obs	4,044	4,252	2,295
Low growth opportunities			
Cash	0.077***	0.083***	0.006
Cash flow	0.044***	0.020***	0.047***
No obs	5,493	3,662	8,078
p-value for difference in the coefficients on cash	0.00	0.01	0.80
Coefficient on cash			
	High-Low	High-Low	High-Low
High growth opportunities	-0.032	-0.158	-0.025
Low growth opportunities	-0.080	-0.040	-0.062
Rule of law index			
High			
High growth opportunities			
Cash	0.022***	0.007	0.029**
Cash flow	0.049***	0.079***	0.082***
No obs	18,130	16,872	8,639
Low growth opportunities			
Cash	0.049***	0.049***	0.020***
	0.053***	0.025***	0.036***
No obs	24,175	21,416	40,050
p-value for difference in the coefficients on cash	0.00	0.00	0.27
Low			
High growth opportunities			
Cash	-0.176***	-0.210***	-0.258***
Cash flow	0.107***	0.104***	0.212***
No obs	6,204	6,822	3,426
Low growth opportunities			
Cash	-0.158***	-0.034	-0.212***
Cash flow	0.096***	0.073***	0.096***
No obs	3,559	2,974	9,023
p-value for difference in the coefficients on cash	0.65	0.00	0.01
Coefficient on cash			
	High-Low	High-Low	High-Low
High growth opportunities	0.198	0.217	0.287
Low growth opportunities	0.207	0.083	0.232
Corruption index			
High			
High growth opportunities			
Cash	0.017**	-0.003	0.017
Cash flow	0.052***	0.079***	0.083***
No obs	17,747	15,638	7,874
Low growth opportunities			
Cash	0.052***	0.044***	0.020***
Cash flow	0.054***	0.028***	0.039***
No obs	20,985	20,120	37,383
p-value for difference in the coefficients on cash	0.00	0.00	0.78
Low			
High growth opportunities			
Cash	-0.125***	-0.129***	-0.145***
Cash flow	0.088***	0.099***	0.161***
No obs	6,587	8,056	4,191
Low growth opportunities			
Cash	-0.051**	0.053**	-0.126***
Cash flow	0.078***	0.037***	0.075***
No obs	6,749	4,270	11,690
p-value for difference in the coefficients on cash	0.01	0.00	0.08
Coefficient on cash			
	High-Low	High-Low	High-Low
High growth opportunities	0.142	0.126	0.162
Low growth opportunities	0.103	-0.009	0.146

Table 7 - Growth opportunities and the relationship between net investment and cash holdings (world - sample split; cont'd)

Stock/GDP

High				Low			
	High growth opportunities				High growth opportunities		
Cash	0.031***	0.011	0.020	Cash	-0.177***	-0.210***	-0.263***
Cash flow	0.060***	0.089***	0.089***	Cash flow	0.105***	0.100***	0.203***
No obs	17,951	16,405	8,505	No obs	5,726	6,394	3,070
	Low growth opportunities				Low growth opportunities		
Cash	0.047***	0.053***	0.015***	Cash	-0.153***	-0.081**	-0.214***
Cash flow	0.053***	0.030***	0.047***	Cash flow	0.092***	0.072***	0.097***
No obs	23,491	21,059	38,997	No obs	2,955	2,372	8,315
p-value for difference in the coefficients on cash	0.03	0.00	0.64	*p*-value for difference in the coefficients on cash	0.67	0.00	0.00

	Coefficient on cash		
	High-Low	High-Low	High-Low
High growth opportunities	0.208	0.221	0.283
Low growth opportunities	0.200	0.134	0.229

Bond/GDP

High				Low			
	High growth opportunities				High growth opportunities		
Cash	0.033***	0.022**	0.038**	Cash	-0.133***	-0.152***	-0.106***
Cash flow	0.051***	0.073***	0.091***	Cash flow	0.090***	0.124***	0.140***
No obs	15,333	13,387	6,845	No obs	7,754	8,800	4,429
	Low growth opportunities				Low growth opportunities		
Cash	0.049***	0.053***	0.022***	Cash	-0.051*	0.045**	-0.144***
Cash flow	0.055***	0.029***	0.036***	Cash flow	0.066***	0.041***	0.083***
No obs	20,562	18,876	34,024	No obs	5,586	4,281	12,377
p-value for difference in the coefficients on cash	0.09	0.00	0.06	*p*-value for difference in the coefficients on cash	0.01	0.00	0.42

	Coefficient on cash		
	High-Low	High-Low	High-Low
High growth opportunities	0.166	0.174	0.144
Low growth opportunities	0.100	0.008	0.166

The global sample is split according to the anti-director rights index, the rule of law index, the corruption index, the stock market capitalisation to GDP and the private bond market capitalisation to GDP. Investment opportunities are measured by the prior year market-to-book ratio, the 3-year past sales growth (compound annual growth rate) and the 3-year future sales growth (compound annual growth rate). Firm-years are assigned to the high (low) growth subgroup when they have a prior year market-to-book ratio, a 3-year past sales growth or a 3-year future sales growth above or equal (below or equal) the top (bottom) three deciles. We estimate model 2 [M2] separately for each sample split. *OCF* denotes operating cash flow as measured by income before extraordinary items plus depreciation; S is total revenues; *AT* is total book assets; D_{SIC2d} is the two-digit SIC code; and D_Y is a calendar-year dummy. The dependent variable is net investment, which is defined as capital expenditures minus depreciation. Cash is instrumented by a subset of explanatory variables where *ICF* is operating income before depreciation and amortisation; *CC* denotes the cash cycle and is measured as the average inventory age plus the average collection period minus the average payment period; *ZSCORE* is Altman's z-score; ΔR is the spread between the return on investment for firm *i* and the return on a local risk-free interest rate. When data on Treasury bills or comparable benchmarks is not available for a particular country, we use the median return across all countries. *IP* is industrial production as measured by local indices. Again, we use the median index value as a proxy when data is not available for a particular country. The remaining variables are the same as defined in M1. We only report the results for cash and cash flow from the first equation. The model is estimated using a three-stage least squares simultaneous equation model (3SLS) where cash is exogenously instrumented. ***, **, and * denote the significance at the 1, 5 and 10% levels.

corporate governance infrastructure. Second, firms in countries with a poor financial market development exhibit generally negative coefficients. These patterns might also be interpreted with respect to the corporatisation hypothesis by Gugler and Peev (2010). They suggest that soft budget constraints of state-owned commercialised firms (transition firms) could cause a negative investment-cash flow sensitivity due to overinvestment by loss-makers, underinvestment by potential profit-makers and asset-stripping. This evidence is supported by Fan et al. (2007) and might particularly be true for less developed/poorly governed countries because most of them can be classified as transition countries for our sample period (Pistor et al., 2000; Bonin et al., 2005). A third but not exclusive interpretation for our findings could come from an industry perspective. A greater part of these countries can also be referred to as emerging markets where growth rates have substantially been higher in the previous years as compared to highly developed/well governed countries (Durnev and Kim, 2007; Drobetz et al., 2010). Moreover, the percentage of manufacturing companies and, hence, capital-intensive firms is relatively low (40-48% vs. 51-56%) and firms are usually older (7.7-8.5 vs. 6-7.8 years on average) in the latter group of countries. Some research studies suggest that different industry characteristics can have a determining impact on investment-cash flow sensitivities. As one would expect, industries show considerable differences with respect to firm size and capital structure (Ganley and Salmon, 1997; Hayo and Uhlenbrock, 2000; Peersman and Smets, 2004; Dedola and Lippi, 2005). These differences can significantly determine the financing and investment behaviour as well as dominate possible differences across countries (Peersman and Smets, 2004; Dedola and Lippi, 2005). This supports our interpretation based on the life cycle hypothesis because the relationship between investment and cash is most negative where firms are younger, have a more distinctive need for capital or exhibit higher growth opportunities and is less negative, non-significant or positive where companies are older or have low growth opportunities and where the portion of manufacturing firms is lower. Therefore, the patterns reported for the second hypothesis might be determined by the states of corporate governance and financial market development but also through investment opportunities and industry characteristics.

Hypothesis 3 In Table 8, we repeat our estimation from Table 5 but include an inter-

Table 8 - Marginal value of cash holdings and investment across financial constraints criteria (world - sample split)

	Financial constraint criteria					Financial constraint criteria			
	Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)		Pay-out ratio	Size	Rating (r/n.r)	Rating (IG/NIG)
Anti-director rights index									
	High					Low			
Change in cash	0.574***	0.646***	0.638***	0.988***	Change in cash	0.590***	0.554***	0.578***	0.621***
Constrained•change in cash	0.333***	0.044	0.053	0.309*	Constrained•change in cash	-0.012	-0.010	-0.003	-0.408**
Change in non-cash assets	0.146***	0.134***	0.153***	0.176***	Change in non-cash assets	0.151***	0.123***	0.156***	0.108***
Constrained•change in non-cash assets	-0.011	-0.006	-0.066***	-0.006	Constrained•change in non-cash assets	-0.040*	-0.030	-0.071***	0.026
No obs	20,268	16,908	28,396	3,063	No obs	9,549	7,526	12,036	1,370
R-sq	0.16	0.16	0.15	0.14	R-sq	0.13	0.13	0.13	0.12
						Marginal value of investments			
						High-Low	High-Low	High-Low	High-Low
					Constrained firms	0.024	0.035	0.002	0.036
					Unconstrained firms	-0.005	0.011	-0.003	0.068
Rule of law index									
	High					Low			
Change in cash	0.654***	0.726***	0.711***	0.959***	Change in cash	0.667***	0.777***	0.952***	0.364
Constrained•change in cash	0.223***	0.077*	0.058*	0.161	Constrained•change in cash	0.098	-0.197	-0.274***	-0.048
Change in non-cash assets	0.174***	0.154***	0.191***	0.182***	Change in non-cash assets	0.070***	0.139***	0.153***	0.023
Constrained•change in non-cash assets	0.006	0.032***	-0.058***	0.039	Constrained•change in non-cash assets	0.090***	-0.208***	-0.123***	0.079
No obs	38,701	29,638	49,545	4,943	No obs	7,957	5,353	10,042	771
R-sq	0.17	0.17	0.16	0.14	R-sq	0.16	0.15	0.15	0.16
						Marginal value of investments			
						High-Low	High-Low	High-Low	High-Low
					Constrained firms	0.020	0.255	0.103	0.119
					Unconstrained firms	0.104	0.015	0.038	0.159
Corruption index									
	High					Low			
Change in cash	0.652***	0.713***	0.720***	0.980***	Change in cash	0.686***	0.752***	0.833***	0.267
Constrained•change in cash	0.242***	0.122***	0.058*	0.185	Constrained•change in cash	0.047	-0.305***	-0.175**	-0.271
Change in non-cash assets	0.171***	0.154***	0.191***	0.172***	Change in non-cash assets	0.091***	0.135***	0.150***	0.117***
Constrained•change in non-cash assets	0.019*	0.044***	-0.054***	0.048	Constrained•change in non-cash assets	0.027	-0.177***	-0.129***	-0.014
No obs	37,610	28,815	48,242	4,845	No obs	9,048	6,176	11,345	869
R-sq	0.17	0.17	0.16	0.14	R-sq	0.14	0.14	0.14	0.15
						Marginal value of investments			
						High-Low	High-Low	High-Low	High-Low
					Constrained firms	0.072	0.240	0.116	0.117
					Unconstrained firms	0.080	0.019	0.041	0.055

Table 8 - Marginal value of cash holdings and investment across financial constraints criteria (world - sample split; cont'd)

Stock/GDP

	High				Low				
Change in cash	0.613***	0.666***	0.670***	0.875***	Change in cash	0.728***	0.953***	1.087***	0.754**
Constrained•change in cash	0.196***	0.099**	0.042	0.135	Constrained•change in cash	0.234**	-0.169	-0.138	0.215
Change in non-cash assets	0.165***	0.145***	0.177***	0.162***	Change in non-cash assets	0.070**	0.155***	0.190***	0.032
Constrained•change in non-cash assets	0.003	0.027**	-0.046***	0.029	Constrained•change in non-cash assets	0.116***	-0.214***	-0.200***	0.062
No obs	37,094	28,933	47,735	4,986	No obs	7,418	4,773	9,357	603
R-sq	0.16	0.16	0.15	0.13	R-sq	0.18	0.15	0.16	0.18

	Marginal value of investments			
	High-Low	High-Low	High-Low	High-Low
Constrained firms	-0.018	0.231	0.141	0.097
Unconstrained firms	0.095	-0.010	-0.013	0.130

Bond/GDP

	High				Low				
Change in cash	0.668***	0.714***	0.738***	0.973***	Change in cash	0.566***	0.686***	0.767***	0.395
Constrained•change in cash	0.254***	0.125**	0.048	0.089	Constrained•change in cash	0.129*	-0.103	-0.117*	0.241
Change in non-cash assets	0.166***	0.144***	0.184***	0.167***	Change in non-cash assets	0.113***	0.148***	0.158***	0.072*
Constrained•change in non-cash assets	0.021*	0.041***	-0.052***	0.038	Constrained•change in non-cash assets	0.023	-0.105***	-0.096***	0.010
No obs	31,213	24,654	40,730	4,490	No obs	12,455	8,433	15,392	1,040
R-sq	0.17	0.17	0.16	0.14	R-sq	0.15	0.14	0.14	0.13

	Marginal value of investments			
	High-Low	High-Low	High-Low	High-Low
Constrained firms	0.051	0.142	0.070	0.123
Unconstrained firms	0.053	-0.004	0.026	0.095

The global sample is split according to the anti-director rights index, the rule of law index, the corruption index, the stock market capitalisation to GDP and the private bond market capitalization to GDP. The financial constraints criteria are dividend pay-out ratio, firm size, long-term credit rating (rated/not rated) and long-term credit rating (investment grade rating/non-investment grade rating). We estimate model 3 [M3]. *C* denotes cash holdings; *E* is earnings before interest, deferred tax credits and extraordinary items; *RD* is expenditures for research and development purposes; *I* is interest expense; *D* is common dividends paid; *F* is net financing measured as equity issuance minus stock repurchases minus change in debt; *Lev* denotes total debt over total debt plus the market value of equity; *MV* is the market value of equity; *NA* is non-cash assets; and *FD* is a financial constraints dummy, which takes the value one if a firm-year is classified as constrained by one of the aforementioned firm-specific measures of constraints, and zero otherwise. The dependent variable is the excess return defined as the stock return for firm *i* minus the return on a local MSCI index. When a MSCI index is not available for a particular country, we use the return of the median value across all MSCI indices. We only report the results for the change in cash, the interaction between the change in cash and financial constraints dummy, the change in non-cash assets and the interaction between the change in non-cash assets and the financial constraints dummy. The model is estimated using OLS and the standard errors are robust against heteroscedasticity and autocorrelation. ***, **, and * denote the significance at the 1, 5 and 10% levels.

action term between the change in non-cash assets and the financial constraints dummy to test whether investments are more valuable for constrained firms than for unconstrained firms. The results for the marginal value of cash reserves are comparable to those reported above. They also exhibit similar patterns with respect to differences between constrained and unconstrained companies and between highly developed/well governed and less developed/poorly governed countries. Investments are valuable across all four financial constraints criteria in the first group of countries. The coefficient on the interaction term between investments and the financial constraints dummy is non-significant or significantly positive indicating that investments are valued higher for constrained firms but constrained companies do not necessarily benefit more from investments in states of strong monitoring, less information asymmetry or open capital markets. When the classification is based upon the ratings (rated/not rated) criteria, however, the interaction term becomes negative. Possibly, it is a negative signal to investors when companies do not have their outstanding debt rated. While holding cash might then be still more valuable for those firms, investments are assumed to be more risky because of weaker monitoring. Investments through firms in countries with a poor corporate governance infrastructure or a weak financial market development are also positively valued but the coefficient on the change in non-cash assets is, for some cases, not significant or only marginally significant. Moreover, investments are primarily less or equally valuable for constrained companies. This might indicate that investors could detect an expropriation risk where the returns from investments will not materialise (La Porta et al., 2000b). Specifically, this risk is more assigned to constrained firms in poorly governed/less developed countries because they might be less monitored by outside investors (especially non state-owned banks). Also, the management could attempt to undertake riskier investment projects to weaken the negative effects of lower earnings or growth opportunities, which arise from financial constraints.

V Conclusions

We investigate the effect of corporate governance regimes and financial market development on the value of cash holdings and investments and the relationship between investment activity and liquid funds in the context of financial constraints.

We test three hypotheses. First, according to previous studies, cash holdings are expected to be more valuable for constrained firms than for unconstrained firms, and this could be more pronounced in countries with a strong corporate governance infrastructure or a high financial market development. Second, constrained firms may benefit more from holding cash for their investment activity, and corporate governance regimes or financial market development could affect this relationship. Third, the market value of investments is greater for constrained firms, while weak corporate governance or a poor financial market development might have detrimental effects. To test our hypotheses, we replicate the methodology provided in Denis and Sibilkov (2010). Our dataset includes 29,757 publicly listed firms in 104 countries over the period from 1988 to 2009.

Our results indicate that the market value of cash reserves and investments depend on financial constraints and on differences in corporate governance structures and the financial market development between countries but the relationship between the investment activity and holding cash might also be affected by a firm's growth opportunities. Specifically, we find that the market value of cash is greater for constrained firms in the U.S. and in strongly governed/highly developed countries but this relationship is weakened through insufficient financial market development or a weak corporate governance infrastructure. Constrained firms might benefit from holding cash because they can undertake investment projects, which would otherwise be bypassed. While this relationship is supported for the U.S. and other strongly governed and highly developed countries, we find that for the remaining countries, this relationship becomes non-significant or negative for both, constrained and unconstrained firms. Primarily, we interpret this finding in the context of the life cycle hypothesis provided by Hovakimian (2009) and argue, that, along with some other aspects, growth opportunities may affect the investment-cash sensitivity. However, a poor corporate governance infrastructure or a weak financial market development still have detrimental effects on this relationship, and this is more pronounced for constrained

firms because they could be less monitored by banks and outside investors or could undertake riskier investment projects. This view is supported by our findings on the market value of investments, which is lower for constrained firms in weakly governed/less developed countries while it is greater for the U.S. and the remaining countries.

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Chapter 3

What Factors Drive Corporate Credit Ratings? Evidence from German SMEs and Large Corporates

with Wolfgang Drobetz

Abstract

Rating agencies have currently been strongly criticised for what role they have played before and during the 2008 global financial crisis. One implication was that rating agencies operating in the European Union must now be registered by the European Securities and Markets Authority (ESMA). They are required to disclose the methodologies used for rating decisions. Rating agencies, however, generally point out that they apply an analyst-driven process where the resulting credit rating is mainly based on the opinion of their rating analysts and not exclusively based on mathematically derived models. But then, regulatory requirements might not be completely fulfilled and some transparency could still be lacking. This study aims to provide some insights into how credit ratings might be derived with respect to financial risk and business risk factors. Our results indicate that qualitative information is significant in explaining credit ratings, and that the pure financial information is – at least to some extent – predominated by soft facts. This must be taken into account by supervising authorities in order to define appropriate reporting requirements.

Keywords: Corporate rating, creditworthiness, rating agencies, determinants, financial risk, business risk

JEL classification codes: G24, G32

I Introduction

Rating agencies have currently been strongly criticised for what role they have played before and during the 2008 global financial crisis. National and international authorities have accused them of wrong assessments and inaccurate credit ratings, essentially with respect to structured finance products, e.g., mortgage-backed securities (MBSs) or collateralised debt obligations (CDOs), and sovereigns. An increasing number of politicians, researchers and practitioners have, thus, asked for stronger regulations on rating agencies and for a greater transparency of credit ratings and methodological approaches. One implication was that rating agencies operating in the European Union must now be registered by the European Securities and Markets Authority (ESMA) according to the Regulations No 1060/2009 and 513/2011 (see ESMA (2012) for the regulatory framework). Their activities are closely monitored and several reporting issues are required. Additionally, they are requested to disclose the methodologies used for rating decisions. While the description and explanation of processes is relatively straightforward, it might be less intuitive to give a technical documentation on methodologies because rating agencies generally point out that – at least for corporate and sovereign ratings – they apply an analyst-driven process, and that ratings are not exclusively based upon mathematical or statistical models. Additionally, they argument that there exist no predefined weights of individual factors and no predefined breakup between financial and qualitative information. But then, regulatory requirements might not be completely fulfilled and some transparency could – to some extent – still be lacking.

This study aims to provide some insights into how rating agencies might evaluate firms' creditworthiness with respect to financial risk and business risk factors. With financial data of large corporates and small and medium sized companies (both, stock listed and privately-held firms) in Germany and qualitative information taken from the corresponding rating reports of two rating agencies, we are able to investigate the "hard" and "soft" determinants of corporate ratings across different specifications where agency-specific characteristics might be relaxed. Specifically, our results indicate that qualitative information is significant in explaining credit ratings, and that the pure financial information is – at least to some extent – predominated by soft facts. Financial ratios are seemingly more important for non-investment grade ratings. Ad-

ditionally, only a few aspects of the business risk profile seem to be considered by rating agencies.

The rest of this paper is organised as follows: The next section presents our hypotheses and reviews the related literature. Section 3 describes the data and our empirical methodology. The empirical results are reported and discussed in section 4. Section 5 concludes.

II Theoretical background and related literature

A. Theoretical background

Previous studies have focused on two different strands of research. First, the factors driving analysts' forecasts of stock prices and related company performance indicators have been investigated (see Ramnath et al. (2008) for an overview). This strand of the literature has a long history and the primary factors are well documented. They include market and industry characteristics and firm-specific criteria and refer to financial factors and qualitative aspects. Second, prior research has shed some light on sovereign ratings and their determining factors (Bissoondoyal-Bheenick, 2005; Mellios and Paget-Blanc, 2006; Hill et al., 2010). Because of several reasons, one cannot draw, however, any immediate conclusions for the underlying effects of corporate credit ratings. Security analysts' estimates might be restricted to an opportunity-oriented perspective, i.e., they are focused on upside chances and primarily do not examine those factors, which take into account potential default events. The methodologies, which are used for rating sovereigns might differ in several ways from those used for rating companies because they take into account country-specific macroeconomic indicators, the political and judicial environment, the local structural and industrial environment and further aspects, which might not necessarily be directly transferable to a firm's creditworthiness. There exist a number of studies, which build up models to forecast corporate ratings and rating transitions. Most of them, however, use superordinate rating categories (e.g., AAA, AA, A, BBB, BB, B) and, thus, cannot be directly compared to studies incorporating the full set of rating classes (e.g., AA+, AA, AA-). In addition, research often is model-driven and the underlying fac-

tors (mainly financial ratios) might not be the primary basis for decision-making. And there exists only little evidence on qualitative aspects in the context of corporate (and sovereign) ratings.

To understand how ratings are performed and to assess their information and statements, it is therefore crucial to know about financial data and qualitative characteristics, which may drive corporate credit ratings. We suggest a rating model, which shall give evidence on the explanatory factors and might help to improve standardised rating models. First, only those financial data are included, which are noted to be important in the description of methodology from two rating agencies (Standard & Poor's [S&P's], 2008; Euler Hermes [EH], 2014). They are assumed to capture information on the creditworthiness and probability of default and have generally been accepted in previous research studies. They can be categorised into margins and returns, capital structure, debt coverage and interest coverage. Furthermore, it might be important to take into account several interactions between the selected financial variables to model dependencies between the levels of two variables, which can be connected through their underlying components (e.g., both, EBITDA margin and EBITDA interest coverage ratio are based on the EBITDA, while the first ratio refers to company performance and the latter relates to debt service obligations and, hence, more to creditworthiness).

While financial analysis could indeed explain most of the ratings performed in our sample, qualitative characteristics, which refer to company characteristics and exogenous impacts might be significant in approximating the estimated ratings to the corresponding agency ratings. However, it is questionable which factors determine the ratings and to what extent they are used in assessments by rating agencies. In prior research, non-financial aspects related to security analysis have been found in the context of company characteristics, industry characteristics and leadership characteristics. The evidence on the specific factors is yet likely to be somewhat biased with respect to the focus on company performance and upside chances rather than on creditworthiness and downside risks. Standard & Poor's (2008) and Euler Hermes (2014) provide information on business risk factors but they do not point out neither the relevance of specific aspects nor the contribution of those factors to the final rating. We, hence, incorporate a set of qualitative factors (e.g., opportunities and threats with respect to a firm's strategy, the management of financial and operational risks, current and ex-

pected market conditions) in our rating model, which we expect to capture the most significant information on creditworthiness. Overall, company, industry and leadership characteristics might play an important role but in a different manner to what security analysts may consider.

B. Related literature

The first studies, which have focused on predicting corporate ratings and examining their key drivers mainly have aimed at providing evidence on whether accounting data are generally reliable in predicting bond ratings, or whether a market-based approach might be superior (Horrigan, 1966 ; West, 1970; Kaplan and Urwitz, 1979).

This strand of the literature has meanwhile been extended by various aspects such as the relationship between capital structure decisions and credit ratings (Hovakimian et al., 2009; Kisgen, 2009; Kisgen and Strahan, 2010; Baghai et al., 2014), the relationship between ratings and the probability of default (Hilscher and Wilson, 2013; Löffler, 2013), rating transitions (Altman and Rijken, 2004/2005; Du and Suo, 2005; Friedman et al., 2011), bank-internal credit rating systems (Carey and Hrycay, 2001; Crouhy, 2001; Krahnen and Weber, 2001), numerous methodological approaches (Han and Shin, 2001; Bhattacharya and Kumar, 2006; Metz, 2007; Altman et al., 2010b; Bohrmann und Löffler, 2011), and different sets of quantitative and qualitative drivers for corporate ratings.

While financial ratios have rather extensively been investigated by previous studies, there exists little evidence on qualitative criteria, which might essentially been recognised by external rating agencies. Some studies (Brunner et al., 2000; Lehmann, 2003; Grunert et al., 2005) have focused on the relationship between bank-internal ratings and qualitative factors. However, their results are not directly transferable to external corporate ratings because bank-internal credit risk assessments are more standardised, apply a point-in-time approach (contrary to a trough-the-cycle approach of external credit ratings) and their criteria might be more subject to bank regulations (Treacy and Carey, 2000; Löffler, 2004; Kiff et al., 2013).

Kisgen (2006) studies the relationship between corporate ratings and capital structure decisions. He finds that firms whose rating is likely to be upgraded or downgraded issue less debt relative to equity as compared to firms with ratings less likely to be

changed. His findings are based, amongst others, on a credit score, which incorporates the log of total assets, EBITDA to total assets and debt to total capitalisation.

Gray et al. (2006) investigate the financial determinants of credit ratings for Australian listed firms. Their results suggest that EBIT and EBITDA interest coverage ratios, long-term debt leverage and the operating margin are the key drivers for corporate ratings, while the return on capital and industry concentration are less important predictors. Cash-flow coverage ratios, total debt leverage and industry beta are not statistically significant. Additionally, they find that financial ratios are less reliable in distinguishing between the highest rating categories. However, their sample solely consists of investment grade rated companies with BBB ratings and above and they do not incorporate notch values.

Similarly, Tanthanongsakkun and Treepongkaruna (2008) investigate whether a market-based (Merton) model or an accounting-based model can better explain corporate ratings for Australian companies. They extend the rating scales used in Gray et al. (2006) and include a BB/B rating category. They find that the predictive accuracy of a rating model including a market-derived default likelihood indicator, the market capitalisation and the book-to-market ratio is greater than that of an accounting-based rating model, which is derived from the results in Gray et al. (2006) and solely incorporates long-term debt leverage and EBIT interest coverage.

Frey (2013) studies the extent to which corporate ratings comprise patent information for U.S. firms. He finds that future benefits associated with patents and – to a lower extent – the number of countries where a patent has been filed (family size indicator) positively affect a credit rating, while the number of citations a patent receives (forward citations indicator) is negatively related to corporate ratings, possibly due to the greater technological significance and, hence, a higher risk for patent lawsuits. Based on an ordered probit regression, he estimates three models. The first model only incorporates financial ratios of which the return on assets, net interest to net debt, sales and a dummy for the subordination status of debt are statistically significant, while leverage, cash-flow coverage and the portion of short-term debt do not significantly affect ratings. The second model is extended by R&D flows and patent flows, where only the latter is statistically significant. The third model also includes the family size and forward citations indicators, and both are statistically significant.

Blume et al. (1998) study whether the credit quality of corporate debt in the U.S. has declined over time between 1973 and 1992, or whether corporate rating standards have become more stringent. They suggest that – at least part of – the observed downgrades can be linked to more stringent rating standards. The most important variables in their ordered probit model with respect to the notch change in ratings are long-term debt leverage, the CPI deflated market equity, the residual standard deviation from the market model and a dummy for the subordination status of debt.

Similarly, Alp (2012) investigates whether credit rating standards have changed over time for the period 1985 to 2007. His findings suggest that, between 1985 and 2002, credit rating standards have become more stringent for investment grade firms but they have weakened for non-investment grade companies. Additionally, rating standards have tightened between 2002 and 2007 for both, investment grade and speculative grade firms. He estimates an ordered probit model, which identifies a number of financial and structural variables to be significant in explaining corporate ratings. With respect to the notch change in ratings with a one standard deviation increase for a particular variable, interest coverage, long-term debt and total debt leverage, the portion of retained earnings, a dividend payer dummy, idiosyncratic risk and the NYSE market capitalisation percentile affect most credit ratings. While the coefficient on long-term debt is positive, total debt is, however, negatively related to corporate ratings. In a second step, the model is estimated separately for investment grade and non-investment grade firms. The results for the first group of firms are comparable to the whole sample estimation. The latter group exhibits some remarkable differences. The most important variables are interest coverage, the NYSE market capitalisation percentile and idiosyncratic risk. Long-term debt leverage is not statistically significant but total debt leverage is negatively related to credit ratings. Alp concludes that the creditworthiness of below-investment grade firms might, hence, be differently assessed by rating agencies.

Brunner et al. (2000) investigate the extent to which bank-internal credit ratings rely on qualitative factors using data from three German commercial banks. Their findings suggest that soft facts are significant in explaining bank-internal ratings and generally improve the overall rating. Additionally, they document that there exist differences between internal rating systems for banks, which apply preset weightings to their systems and banks where the weighting is expert individual, i.e., the frequency of ad-

justments to the rating caused by qualitative factors and the probability of rating changes is higher for the first group of banks.

Lehmann (2003) studies the effect of soft facts on default prediction for German SMEs. Her findings confirm that the inclusion of qualitative information significantly improves model performance with respect to different classification measures.

Similarly, the relationship between qualitative factors and the predictive accuracy of default in bank-internal credit ratings for German corporates has been investigated in Grunert et al. (2005). They find evidence that the combination of financial ratios and qualitative factors is superior in predicting default events. Their results are also valid in an out-of-sample test and for current year's and future year's default events. Their model, however, includes only the two qualitative factors management quality and market position and they do not report the coefficient estimates on the independent financial and non-financial variables.

Finally, Altman et al. (2010a) study the effect of event data and qualitative information on default prediction for UK small and medium sized firms. They re-estimate the Altman and Sabato (2007) SME model, which has been estimated for U.S. firms. Additionally, they estimate a reduced model, which solely incorporates financial ratios that can be built up from "abridged accounts". Both models are extended by a set of event data and qualitative factors. Their findings support the evidence that qualitative information can indeed improve the explanatory power for default risk, and that this might also be valid for different sets of financial variables and different firm characteristics.

III Data and empirical methodology

A. Financial ratios and qualitative factors

Our set of financial variables covers several common ratios, which have been widely used in previous studies and are pointed out in the description of methodology in S&P's (2008) and EH (2014). We focus on those variables for which three-year average medians are published by S&P's (2007, 2008, 2009, 2010, 2011) for EMEA in-

dustrial companies, and which do not incorporate items on the cash-flow statement.[14] Medians for missing notch categories are equally distributed between rating classes. Additionally, when we build a ratio from aggregated items taken from the balance sheet or the income statement, we rearrange some individual items to partly replicate the adjustments described in S&P's (2008) and EH (2014) (see Appendix A for a detailed description).[15] The rationale behind these adjustments is to give an economically reasonable view on the capital structure and the operating performance of a company and to be in some way more conservative than companies usually are. The following variables are used in our financial ratios model:

1)	Leverage (*Lev*) = (Debt - cash) / [(Debt - cash) + equity]	[%]
2)	EBITDA interest coverage (*EA_ic*) = EBITDA / Interest expenses	[-]
3)	Cash-flow coverage (*CF_c*) = (Debt - cash) / EBITDA	[-]
4)	Return on capital employed (*Roce*) = EBIT / [(Debt - cash) + equity]	[%]
5)	Firm size (*FrmSz*) = Liabilities + equity	[m€]

As our intention is to estimate the economic impact of the above set of financial ratios on corporate credit ratings, we must ensure that our model incorporates – at least approximately – a rating agency's view, i.e., the basic framework based on which rating analysts assign a credit rating to firms. One implication is that we must incorporate into our model an appropriate evaluation for each ratio, which we can expect to be similarly applied by both agencies. Thus, we score each variable with respect to the published three-year average medians for industrial corporates in the EMEA (Table 1).[16] In order to model the genuine rating with a smoothed influence of underlying macroeconomic fluctuations, the three-year average medians are averaged over the

[14] We do not have reliable cash-flow data for a substantial number of privately-held firms. However, we do not expect a biasing effect on our results because cash flow may show a relatively high correlation to EBITDA.

[15] However, due to missing data and different adjustment methodologies between the two rating agencies, we cannot fully adjust our financial ratios; e.g., off-balance lease obligations are not available through S&P's Compustat Global.

[16] As no median value is available from S&P's for firm size, we construct three-year average median values for each rating category from an additional S&P's EMEA rating dataset.

Table 1 - Mean of three-year average medians by rating class					
			Variable		
Rating class	Lev [%]	EA_ic [-]	CF_c [-]	Roce [%]	FrmSz [m€]
AAA	≤ 21.21	23.27	≤ 0.45	26.01	139,283
AA-	21.21	20.55	0.45	24.09	114,198
AA	24.64	17.82	0.74	22.18	89,113
AA+	28.07	15.09	1.03	20.27	64,028
A-	31.49	12.37	1.31	18.35	38,943
A	34.92	9.64	1.60	16.44	13,858
A+	38.13	8.56	1.87	15.28	13,036
BBB+	41.35	7.48	2.13	14.12	12,214
BBB	44.56	6.40	2.40	12.96	11,392
BBB-	46.77	5.83	2.55	12.63	10,111
BB+	48.99	5.27	2.71	12.29	8,829
BB	51.20	4.70	2.86	11.96	7,548
BB-	58.85	3.91	3.67	10.75	5,436
B+	66.51	3.11	4.47	9.53	3,325
B	74.16	2.32	5.28	8.32	1,213
B-	81.81	1.53	6.09	7.11	607
CCC/C	89.47	≤ 1.53	6.89	≤ 7.11	≤ 607

The three-year average medians for leverage, EBITDA interest coverage, cash-flow coverage and return on capital employed are reported in S&P's (2007, 2008, 2009, 2010, 2011) for EMEA industrial companies over the period 2004 to 2010. As no median value is available from S&P's for firm size, we construct three-year average median values for each rating category from an additional EMEA rating dataset. Medians for missing notch categories are equally distributed between rating classes. The three-year average medians are averaged over the entire period.

entire period from 2004 to 2010[17]. Based on that, the score of each variable is assessed.

To account for possible interdependencies between the levels of cash-flow coverage and interest coverage as well as leverage and firm size, we include two interaction terms between those financial ratios. The interaction between cash-flow coverage and interest coverage can be seen as the ability to meet current debt-servicing obligations, while the interaction between leverage and firm size might be related to the general access to external financing for undertaking investments or refunding maturing debt, as described in the previous literature on financial constraints (Campello et al., 2010; Denis and Sibilkov, 2010).

To test the effect of qualitative aspects on credit ratings and similar to Groysberg et al. (2011), we introduce a set of variables, which are based on qualitative criteria. They are pointed out in the business risks description provided in the rating methodologies by S&P's (2008) and EH (2014). We assign a score between 1 and 5 to each criterion based on comments in the rating reports, where 1 denotes the most negative characteristic and 5 is the most positive characteristic (see Appendix B for a detailed description). The following criteria are evaluated:

	Financial planning
1)	Financial planning (*RFP*)
2)	Opportunities and threats: future availability of lines of credit, leasing and factoring, and future relationships to banks and investors (*OTCB*)
	Market and competitors
3)	Future development of key markets (*DM*)
4)	Opportunities and threats: judicial, political and economic conditions, and price trends of raw materials (*OTCP*)
5)	Cyclicality of the market (*CM*)
6)	Competitive position and pricing pressure through customers (*CP*)
	Strategy
7)	Strategic objectives (*RFS*)

[17] Before 2004, median ratios are solely published for the U.S.

8)	Opportunities and threats: strategic planning, and dependencies from suppliers and customers (*OTPD*)
	Management
9)	Management board (*EM*)
10)	Internal risk management systems (*ARM*)
11)	Internal planning and controlling systems (*APC*)

These criteria are considered to capture the most relevant business risks, which might have an effect on corporate decisions and performance and, thus, may influence corporate ratings. We estimate several sets of qualitative criteria because some of them might outweigh others and some criteria could exclusively be driven by others.

B. Empirical methodology

According to previous studies (Altman and Rijken, 2004; Ashbaugh-Skaife, 2006), our analysis of key quantitative and qualitative factors is based on an ordered logit regression model.[18] This model accounts for the ordinal structure of rating notations as well as for non-linear dependencies between the final rating and the underlying financial ratios and qualitative criteria. The rating notations are, hence, scaled to the equivalent ordinal scheme:

Rating notation	Ordinal rating notation
AAA	16
AA+	15
AA	14
AA-	13
A+	12
A	11
A-	10

[18] For an overview of ordered logit models, see Greene and Hensher (2010).

BBB+	9
BBB	8
BBB-	7
BB+	6
BB	5
BB-	4
B+	3
B	2
B-	1
CCC/C	0

The two quantitative models M1 and M1' solely incorporate the set of key financial variables without and with interaction terms, respectively. In the combined models, the set of qualitative criteria is additionally included. This research design allows us to separate the effect of qualitative information on corporate ratings. The two OLR models M1 and M1'

$$[\mathrm{M1}] \quad \mathrm{logit}\left(R_{0\ldots i/i+1\ldots 16;jt}|\mathbf{X}\right) = \log\frac{P\left(R_{jt}>i|\mathbf{X}\right)}{P\left(R_{jt}\leq i|\mathbf{X}\right)} =$$

$$= \alpha_i - \beta_1 Lev_{jt-1} - \beta_2 EA\_ic_{jt-1} - \beta_3 CF\_c_{jt-1} - \beta_4 Roce_{jt-1} - \beta_5 FrmSz_{jt-1}$$

$$[\mathrm{M1'}] \quad \mathrm{logit}\left(R_{0\ldots i/i+1\ldots 16;jt}|\mathbf{X}\right) = \log\frac{P\left(R_{jt}>i|\mathbf{X}\right)}{P\left(R_{jt}\leq i|\mathbf{X}\right)} =$$

$$= \alpha_i - \beta_1 Lev_{jt-1} - \beta_2 EA\_ic_{jt-1} - \beta_3 CF\_c_{jt-1} - \beta_4 Roce_{jt-1} - \beta_5 FrmSz_{jt-1}$$
$$- \beta_6 CF\_c_{jt-1} \bullet EA\_ic_{jt-1} - \beta_7 Lev_{jt-1} \bullet FrmSz_{jt-1}$$

are estimated, where *R* denotes the genuine credit rating. *i* is the ordinal rating category ranging from 0 to 16. X_k denote the financial ratios, and β_k are the corresponding regression coefficients. α_i is the cut-off point for rating category *i*. The combined

models Q1 to Q5 are consistently based on M1' and additionally incorporate the following sets of qualitative criteria:

		Q1	Q2	Q3	Q4	Q5
1)	RFP	β_8			β_8	β_8
2)	OTCB	β_9	β_8	β_8	β_9	
3)	DM	β_{10}	β_9		β_{10}	β_9
4)	OTCP	β_{11}	β_{10}	β_9	β_{11}	
5)	CM	β_{12}	β_{11}		β_{12}	β_{10}
6)	CP	β_{13}	β_{12}		β_{13}	β_{11}
7)	RFS	β_{14}	β_{13}		β_{14}	β_{12}
8)	OTPD	β_{15}	β_{14}	β_{10}	β_{15}	
9)	EM	β_{16}	β_{15}		β_{16}	β_{13}
10)	ARM	β_{17}	β_{16}			
11)	APC	β_{18}	β_{17}			

Q1 incorporates the full set of qualitative criteria. Financial planning (RFP) is excluded in Q2 because this may be a more quantitatively derived factor. Q3 tests whether the sole inclusion of criteria relating to opportunities and threats is sufficiently appropriate in predicting corporate credit ratings. Q4 excludes the two management-related criteria ARM and APC and, hence, tests whether the overall assessment of the management already captures this information. Reversing the test in Q3, Q5 excludes all criteria with respect to opportunities and threats, and additionally excludes the management-related sub-criteria.

All models are estimated using maximum likelihood and variance estimates are calculated via the observed information matrix. The quantitative and qualitative drivers of corporate ratings are then determined by the magnitudes and significance levels of the regression coefficients as well as the marginal effects for individual variables and their interactions. Additionally, we conduct two measures for the explanatory power

of our models, i.e., the in-sample predictive accuracy and the average hold-out sample predictive accuracy. The ordered logit model yields a specific probability for each rating category due to the different cut-off points while the coefficient estimates do not differ between these categories. Therefore, for each firm-year, a probability is assigned to each rating category with respect to the coefficient estimates and the firm-year data for each variable. The predicted rating is then calculated by weighting each category with its corresponding probability (Mora, 2006). The predictive accuracy is finally measured by comparing the predicted rating and the genuine credit rating for each firm-year and dividing the number of firm years with a specific deviation (e.g., 1 notch) by the total number of firm-year observations.

C. Data description

Our data are taken from several databases. Financial data for S&P's-rated companies are taken from S&P's Compustat Global[19] and the ratings are taken from S&P's RatingsXpress. Financial data and ratings from EH-rated companies are taken from EH's database. The qualitative factors are evaluated based on the rating reports from S&P's and EH. Our dataset includes rated publicly listed firms and privately-held companies in Germany over the period from 2000 to 2010, and all ratings are issuer (corporate) ratings. We exclude companies in the financial (SIC 6000-6799, NACE K) and utility (SIC 4910-4939, NACE D) sectors.[20] Additionally, we exclude firm-year observations for which the mean of the leverage- and EBITDA-based financial ratios significantly deviates from the genuine rating by +/- 7 or more notches, i.e., more than two superordinate rating categories.[21] Each aggregated item on the balance sheet and the income statement is verified by its underlying items, and firm-years with incorrect data items are excluded. We only allow for one rating per year, i.e., changes in the rating over a one-year period are not taken into account. A rating, which is compiled in the

[19] Some data are taken from EH's database for non-listed companies.

[20] The NACE code refers to the "Statistical Classification of Economic Activities" in the European Community (Nomenclature Statistique des Activités Economiques dans la Communauté Européenne) and is used as the industry classification scheme in the Euler Hermes database.

[21] Suppose a firm-year with the following characteristics: genuine rating = A-, ordinal rating notation = 10; score(Lev) = 3; score(EA_ic) = 1; score(CF_c) = 2; mean[score(Lev, EA_ic, CF_c)] = 2; we would exclude this firm-year observation due to the substantial deviation (= 8) between financial ratios and the genuine rating. Rating reports generally point out the factors driving these substantial deviations. They may, for example, be related to firm-specific characteristics or structural changes in the market environment. However, we assume that these deviations cannot be sufficiently modelled due to either absent concrete information or specific information, which is not comparable or transferable to other companies and cannot be captured by a standardised framework. In bank-internal rating systems, this may be related to overruling procedures.

last month of the fiscal year is assigned to that fiscal year, else it is assigned to the previous fiscal year's accounting data. This ensures that credit ratings and the information on the balance sheet and the income statement timely coincide. Our final dataset contains 162 rated companies in Germany (S&P's: 65, EH: 97) with a total of 347 firm-year observations[22] (S&P's: 198, EH: 149).

IV Empirical results – financial ratios

A. Data description

In Table 2, we present descriptive statistics across the five quantitative variables, based on the initial dataset of 347 firm-year observations. Some firm-years have substantially high or low values, which do not, however, bias our results because the score evaluation for a single variable is cut at 0 and 16 and thus independent from the original value. We therefore report the Q10 and Q90 percentiles. The financial ratios exhibit almost all possible outcomes indicating that our dataset covers a relatively heterogeneous sample. The distribution of firm-years across different rating categories is provided in Table 3. It is noteworthy that a large number of firm-years is rated BBB and BB. Also, with respect to the superordinate rating classes, about two-third of the firm-years is assigned a rating ranging from BBB+ to BBB- and from BB+ to BB-. Similar patterns have been reported in previous studies while they generally apply ratings from S&P's for stock listed firms in the U.S. The rating categories A and BBB exhibit the highest number of firm-years in Kisgen (2006). About half of the firm-years is rated BBB or BB in Hovakimian et al. (2009) and Baghai et al. (2014) and B has the greatest number of firm-year observations in the latter study. As there is no observation for rating category AA+, we henceforth use a combined rating category AAA/AA+ (ordinal rating notation: 15).

As we apply score evaluations for the single variables to our OLR estimates instead of using the raw values of each variable, multicollinearity might bias our estimation re-

[22] Most companies, even large and stock listed firms, do not have a full rating history, and some companies were only rated once by the respective rating agency. Therefore, the number of firm-years is substantially lower than the number of companies times the 10-year period.

Table 2 - Descriptive statistics across financial ratios					
			Variable		
Statistics	Lev [%]	EA_ic [-]	CF_c [-]	Roce [%]	FrmSz [m€]
N	347	347	347	347	347
Q10	2.6	1.9	0.1	4.8	26.4
Mean	52.0	17.7	5.7	17.2	18545.6
Median	48.1	5.8	2.0	17.4	1314.8
Q90	85.7	16.1	5.6	34.2	50860.0
SD	42.4	162.0	29.9	16.6	42257.6

Lev is leverage and is defined as net debt over net debt plus equity. EA_ic is EBITDA interest coverage and is defined by EBITDA over interest expenses. CF_c is cash-flow coverage and is defined as net debt over EBITDA. Roce is the return on capital employed as defined by EBIT over net debt plus equity. FrmSz is firm size and is defined as liabilities plus equity. See Appendix A for a detailed description.

Table 3 - Ordinal rating notation			
Rating notation	Ordinal rating notation	# firm-years [abs]	# firm-year [rel]
AAA	16	1	0.003
AA+	15	0	0.000
AA	14	3	0.009
AA-	13	9	0.026
A+	12	12	0.035
A	11	26	0.075
A-	10	22	0.063
BBB+	9	39	0.112
BBB	8	48	0.138
BBB-	7	31	0.089
BB+	6	27	0.078
BB	5	50	0.144
BB-	4	24	0.069
B+	3	24	0.069
B	2	15	0.043
B-	1	11	0.032
CCC/C	0	5	0.014
		347	1.000

The absolute and the relative number of firm-years are presented by rating notation and the corresponding ordinal rating notation based on the initial dataset with 347 firm-year observations. As there is no observation for rating category AA+, we use a combined rating category AAA/AA+ (ordinal rating notation: 15).

sults. The pairwise correlations presented in Panel A of Table 4 exhibit relatively great values because Lev and CF_c are both constructed from items on debt, and EA_ic, CF_c and Roce are constructed from either EBITDA or EBIT. To provide further evidence on whether our estimation results might be affected by problems arising from multicollinearity, the variance inflation factor and the condition index are calculated separately for both, model M1 and M1' in Panel B. Our threshold values for VIF and CI are 10 and 30, respectively.[23] The VIF exceeds 10 only in M1' due to the CF_C•EA_ic interaction term. The CI does not exceed 30 neither in M1 nor in M1'. Therefore, we do not expect our estimation results to be substantially biased by multicollinearity.

B. OLR estimates

Table 5 presents the results of the OLR estimates from models M1 and M1'.[24] Leverage and the interest coverage ratio are statistically significant in both models. The positive sign on the Lev coefficient indicates that greater leverage ratios lower the corporate rating. The EBITDA interest coverage is economically most significant. This is consistent with the view that rating agencies focus more on the ability to meet financial obligations rather than on the level of external financing. The cash-flow coverage ratio is not statistically significant neither in M1 nor in M1'. However, the interaction term between cash-flow coverage and interest coverage is statistically significant in M1'. Arguably, rating agencies examine more the interdependencies between financial ratios, which are related to ongoing financial obligations (i.e., interest payment and debt redemption) rather than the single outcome of each ratio. The negative sign of the interaction term must be interpreted with respect to the aggregate effect of cash-flow coverage, EBITDA interest coverage and the interaction term between both financial ratios (see section *D. Marginal Effects*). The return on capital is not statistically significant neither in M1 nor in M1'. This is consistent with S&P's (2006) comment that profitability measures may not necessarily correlate with rating classes. Firm size is statistically and economically significant in M1 but not in M1'. The interaction term between leverage and firm size is, however, statistically signifi-

[23] For a theoretical derivation of VIF and CI and the respective critical values, see Hill and Adkins (2003).
[24] Our results are qualitatively the same when the OLR estimates are based on the superordinate rating categories AAA/AA, A, BBB, B and CCC/C.

Table 4 - Test for multicollinearity (financial ratios)

Panel A - Correlation matrix

	Lev	EA_ic	CF_c	Roce	FrmSz	CF_c•EA_ic	Lev•FrmSz
Lev	1						
EA_ic	0.497***	1					
CF_c	0.797***	0.662***	1				
Roce	0.303***	0.542***	0.654***	1			
FrmSz	0.239***	0.446***	0.282***	0.180***	1		
CF_c•EA_ic	0.676***	0.916***	0.804***	0.607***	0.354***	1	
Lev•FrmSz	0.525***	0.464***	0.484***	0.251***	0.830***	0.519***	1

Panel B: Variance inflation factor and condition index

	Results without interaction terms	Results with interaction terms		Results without interaction terms	Results with interaction terms
	VIF	VIF		CI	CI
Lev	3.55	4.47	1	1.00	1.00
EA_ic	2.14	10.54	2	3.23	2.91
CF_c	6.08	6.36	3	4.71	4.69
Roce	2.35	2.45	4	5.27	5.16
FrmSz	1.26	5.44	5	6.56	6.47
CF_c•EA_ic		15.66	6	13.71	10.60
Lev•FrmSz		6.21	7		15.79
			8		21.84

The correlation matrix for the five quantitative variables and the two interaction terms is presented in Panel A. Panel B presents the variance inflation factor for the five quantitative variable and the two interaction terms as well as the condition index for the six/eight Eigenvalues. Our threshold values for VIF and CI are, respectively, 10 and 30. ***, **, and * denote the significance at the 1, 5 and 10% levels.

Table 5 - OLR estimates (financial ratios)		
	Results without interaction terms	*Results with interaction terms*
	Rating	Rating
Lev	0.160***	0.149***
EA_ic	0.291***	0.480***
CF_c	0.040	0.059
Roce	-0.036	-0.026
FrmSz	0.102***	-0.038
CF_c•EA_ic		-0.015**
Lev•FrmSz		0.015***
chi2	313.0	325.8
Prob > chi2	0.000	0.000
No. Obs.	347	347

The results are estimated using an ordered logit model and the initial dataset with 347 firm-year observations. The first model [M1] (without interaction terms) includes the five quantitative variables, the second model [M1'] (with interaction terms) additionally includes the two interaction terms. The models are estimated using maximum likelihood, and variance estimates are calculated via the observed information matrix. The dependent variable is the corporate rating for the respective firm-year according to the ordinal rating notation. ***, **, and * denote the significance at the 1, 5 and 10% levels.

cant in M1'. Larger firms are considered to have better access to capital markets and, hence, can more easily refinance maturing debt. The interaction term might therefore be economically more significant because it takes into account future needs of external financing and access to external funds. Again, this must be interpreted with respect to the aggregate effect of leverage, firm size and the interaction term (see section *D. Marginal Effects*). Our results are generally consistent with previous findings (Gray et al., 2006; Alp, 2012), while it must be taken into account that we do not incorporate market-related variables but instead include the two theoretically derived interaction terms.

C. Predictive accuracy

To assess the explanatory power of both models, we first calculate the in-sample predictive accuracy for both, model M1 and M1' in Table 6 using the entire dataset and the OLR estimates from Table 5. The last column ("within 2 notches") presents the overall performance of M1 and M1', where the portion of the estimated ratings with a difference of +/- 0, +/- 1 and +/- 2 notches to the corporate rating is calculated. The predictive accuracy of M1' is 82.1% and exceeds that of M1 by 1.1 per cent points (pps). While the predictive accuracy for the +/- 0 notch category is comparable but at a relatively low level (ranging from 17.3 to 17.9%), the +/- 1 notch category is considerably better predicted by M1' (40.3 vs. 36.9%). This supports our hypothesis that interdependencies between key financial ratios are significant for rating agencies. Therefore, we expect this model to have a greater explanatory power and to be more reliable in examining the most significant financial ratios.

The hold-out sample predictive accuracy (Table 7) is calculated by holding out thirty per cent of the corporate ratings, re-estimating M1 and M1' and estimating the ratings in the hold-out sample. It is repeated five times and the predictive accuracy for each category is then averaged. As expected, the overall predictive accuracy is slightly lower than the in-sample estimates. The predictive accuracy for M1 (79.6%) is again 1.6 pps lower than that of M1' (81.2%) indicating that our conclusions are also valid in an out-of-sample context. The +/- 0 notch category lowers to 15.1 and 15.8%. The "within 1 notch" category remains relatively stable for M1 but decreases for M1' to 37.7%.

Table 6 - In-sample predictive accuracy (financial ratios)			
Results without interaction terms			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.179	0.369	0.262	0.810
Results with interaction terms			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.173	0.403	0.245	0.821

The in-sample predictive accuracy is calculated using the initial dataset with 347 firm-year observations and the coefficient estimates from Table 5. The ordered logit model yields a specific probability for each rating category with respect to the different cut-off points. For each firm-year, a probability is assigned to each rating category with respect to the coefficient estimates and the firm-year data for each variable. The predicted rating is calculated by weighting each category with its corresponding probability. The predictive accuracy is measured by comparing the predicted rating and the genuine credit rating for each firm-year and dividing the number of firm years with the specific deviation by the total number of firm-year observations. The +/- 0 notch classification refers to the hit rate, while the +/-1 notch and +/- 2 notches classifications exhibit a deviation by 1 and 2 notches, respectively, from the original rating. The "within 2 notches" classification is the sum of the three individual classifications.

Table 7 - Average hold-out sample predictive accuracy (financial ratios)

Results without interaction terms

+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.151	0.367	0.278	0.796

Results with interaction terms

+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.158	0.377	0.277	0.812

The average hold-out sample predictive accuracy is calculated by holding out thirty per cent of the initial dataset, re-estimating models [M1] and [M1'] and estimating the ratings in the hold-out sample. The ordered logit model yields a specific probability for each rating category with respect to the different cut-off points. For each firm-year, a probability is assigned to each rating category with respect to the coefficient estimates and the firm-year data for each variable. The predicted rating is calculated by weighting each category with its corresponding probability. The predictive accuracy is measured by comparing the predicted rating and the genuine credit rating for each firm-year and dividing the number of firm years with the specific deviation by the total number of firm-year observations in the hold-out sample. The +/- 0 notch classification refers to the hit rate, while the +/- 1 notch and +/- 2 notches classifications exhibit a deviation by 1 and 2 notches, respectively, from the original rating. The "within 2 notches" classification is the sum of the three individual classifications.

D. Marginal effects

Table 8 provides marginal effects[25] and the respective *p*-values across the five financial ratios by rating category for model M1', where negative marginal effects indicate a decreasing probability of belonging to a particular rating category with an increase in a financial ratio. A positive outcome indicates an increasing probability to fall into that category. We estimate average marginal effects of each variable, where the remaining variables are held constant at the value of the respective rating category. In accordance with the OLR estimates in Table 5, our findings suggest that for low rating categories, an improvement in leverage and EBITDA interest coverage significantly decreases the probability of low rating categories and significantly increases the probability of higher credit ratings, e.g., for rating category 3, the marginal effect is -0.01156 for leverage and -0.01663 for the EBITDA interest coverage; for rating category 11, it is 0.00997 and 0.01614, respectively. Additionally, the interest coverage ratio exhibits greater marginal effects across most categories. The marginal effects for CF_c are solely partially significant for rating categories 10 through 13 but with a negative sign (e.g., for rating category 11, the corresponding marginal effect is -0.00524), while the marginal effects of Roce are not statistically significant. Interestingly, even though the coefficient on firm size is not statistically significant in Table 5, a one-unit increase in firm size positively affects the probability of rating outcomes 9 through 14 (e.g., the marginal effect is 0.01050 for rating category 11) but to a lower extent than Lev and EA_ic.

The interaction terms between cash-flow coverage and EBITDA interest coverage as well as between leverage and firm size cannot be assessed by one-dimensional marginal effects because all variables can be increased or decreased simultaneously. We therefore apply a simulation-based estimation of marginal effects according to Zelner (2009). Specifically, for each rating category, we estimate the effect of an increase in EA_ic from "rating category - 1" to "rating category + 1" for a particular rating category across all possible outcomes of CF_c as well as the effect of an increase in Lev from "rating category - 1" to "rating category + 1" for a particular rating category across all possible outcomes of FrmSz. The marginal effects and the respective confidence intervals are then reported graphically in figures 1a and 1b. The x axis denotes

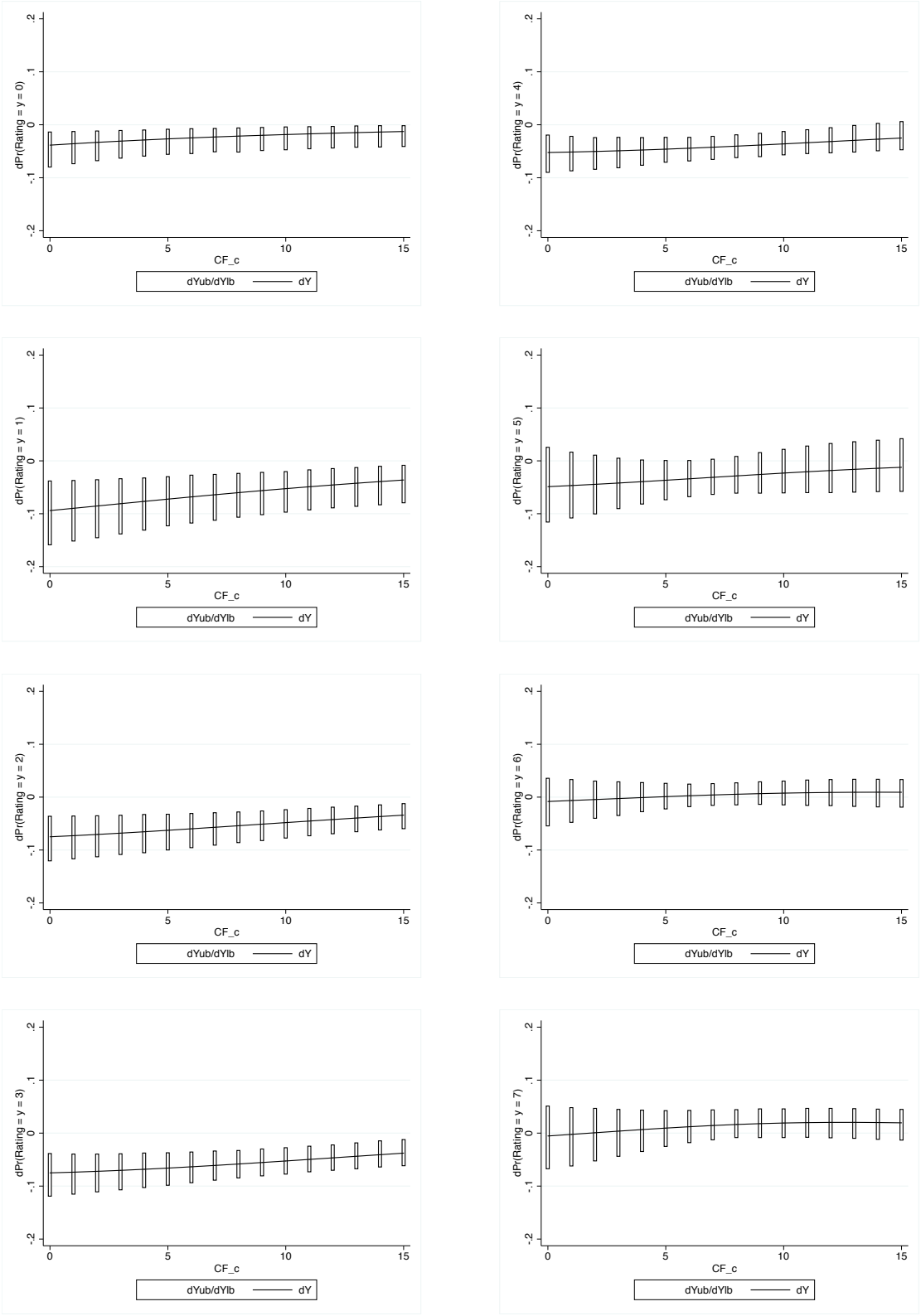
[25] For a detailed description of marginal effects in non-linear models, see Greene and Hensher (2010).

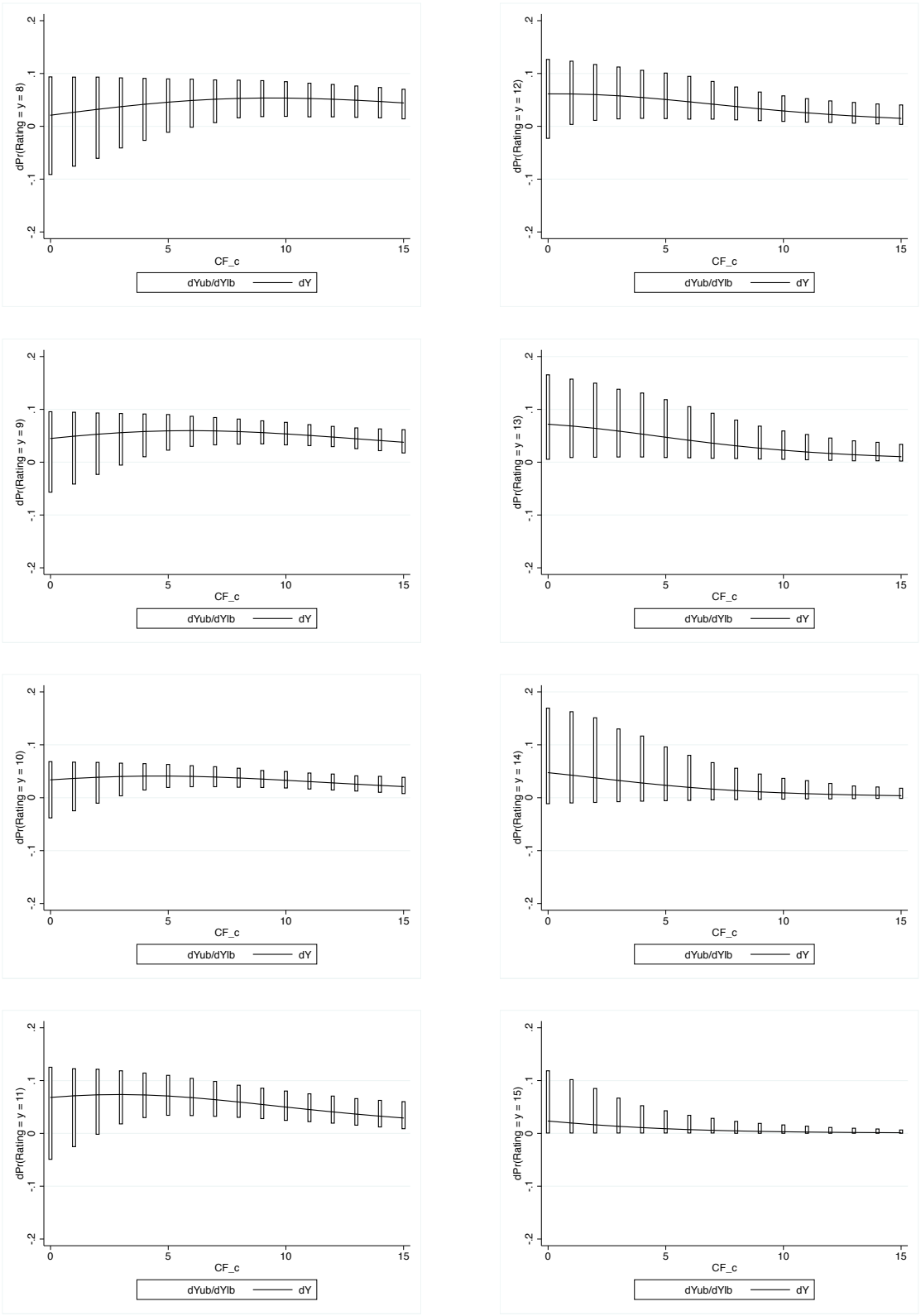
Table 8 - Marginal effects of financial ratios by rating category

	Rating = y															
	0		1		2		3		4		5		6		7	
d(y)/d(Lev)	-0.00621	0.03	-0.00902	0.00	-0.00920	0.00	-0.01156	0.00	-0.00961	0.00	-0.01256	0.00	-0.00360	0.00	-0.00227	0.08
d(y)/d(EA_ic)	-0.00942	0.02	-0.01585	0.00	-0.01570	0.00	-0.01663	0.00	-0.01071	0.00	-0.00976	0.00	-0.00137	0.14	0.00043	0.67
d(y)/d(CF_c)	-0.00355	0.14	-0.00360	0.27	-0.00220	0.52	-0.00117	0.78	0.00011	0.97	0.00132	0.73	0.00079	0.50	0.00126	0.38
d(y)/d(Roce)	0.00279	0.38	0.00277	0.34	0.00213	0.32	0.00217	0.30	0.00163	0.29	0.00195	0.25	0.00068	0.24	0.00081	0.26
d(y)/d(FrmSz)	0.00400	0.47	0.00243	0.58	0.00074	0.81	-0.00049	0.87	-0.00135	0.52	-0.00282	0.21	-0.00121	0.10	-0.00127	0.15
	8		9		10		11		12		13		14		15	
d(y)/d(Lev)	0.00144	0.29	0.00453	0.00	0.00391	0.01	0.00997	0.01	0.01243	0.00	0.01787	0.00	0.01065	0.07	0.00603	0.30
d(y)/d(EA_ic)	0.00572	0.00	0.00924	0.00	0.00772	0.00	0.01614	0.00	0.01375	0.00	0.01356	0.00	0.00630	0.07	0.00338	0.31
d(y)/d(CF_c)	0.00067	0.62	-0.00187	0.12	-0.00190	0.06	-0.00524	0.02	-0.00758	0.01	-0.01359	0.01	-0.01469	0.13	-0.02233	0.33
d(y)/d(Roce)	0.00046	0.46	-0.00065	0.46	-0.00070	0.37	-0.00187	0.31	-0.00232	0.32	-0.00315	0.33	-0.00217	0.38	-0.00171	0.48
d(y)/d(FrmSz)	0.00120	0.50	0.00512	0.01	0.00490	0.00	0.01050	0.00	0.00893	0.00	0.00903	0.00	0.00455	0.07	0.00269	0.30

Average marginal effects are separately estimated for each quantitative variable. The remaining variables are held constant at the value of the respective rating category. For each rating category, the left column presents the average marginal effect and the right column presents the respective *p*-value. A negative marginal effect indicates a decreasing probability of belonging to a particular rating category with an increase in a financial ratio. A positive outcome indicates an increasing probability to fall into that category.

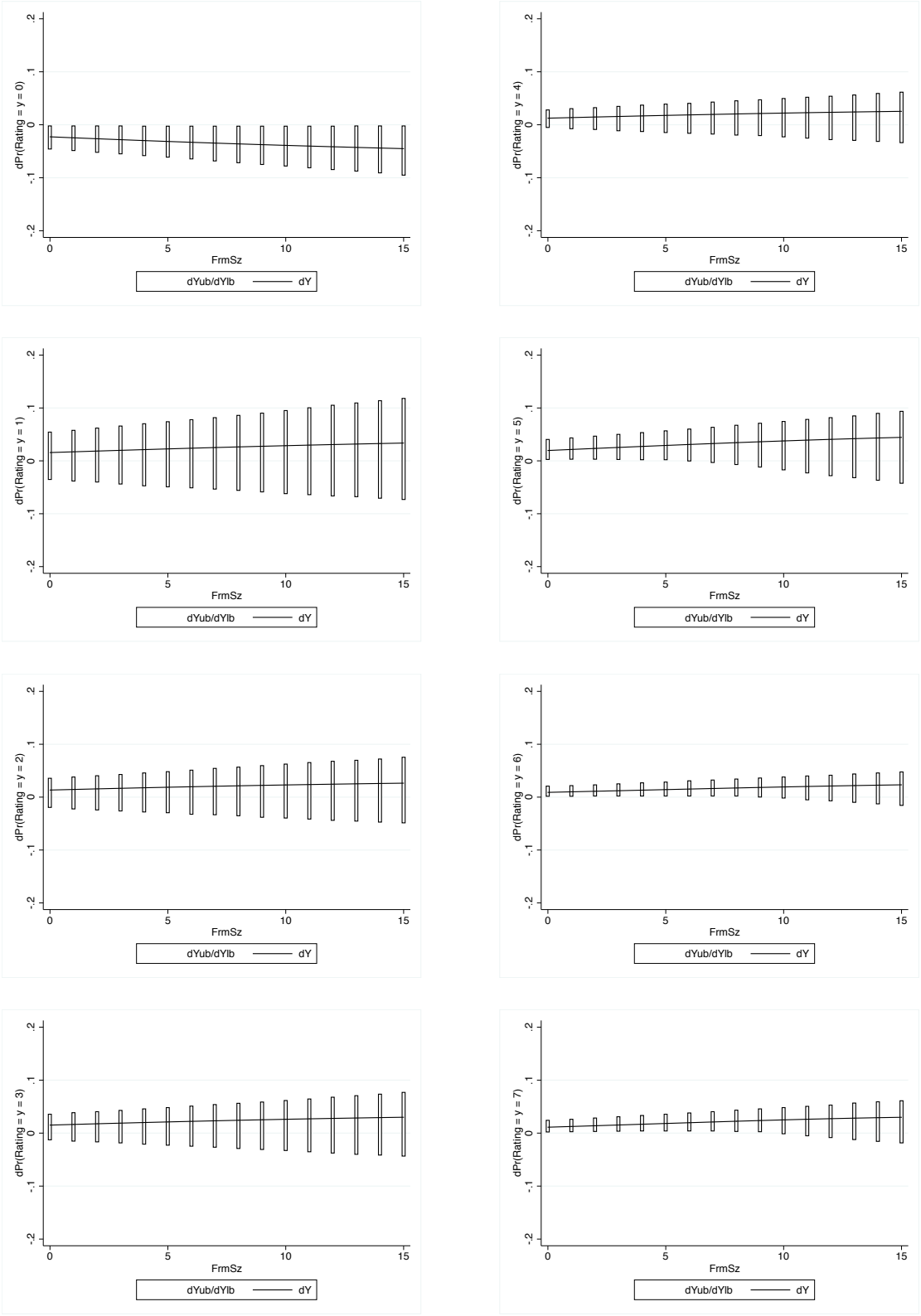
Figure 1a - Marginal effects of interaction terms by rating category (EBITDA interest coverage and cash-flow coverage)

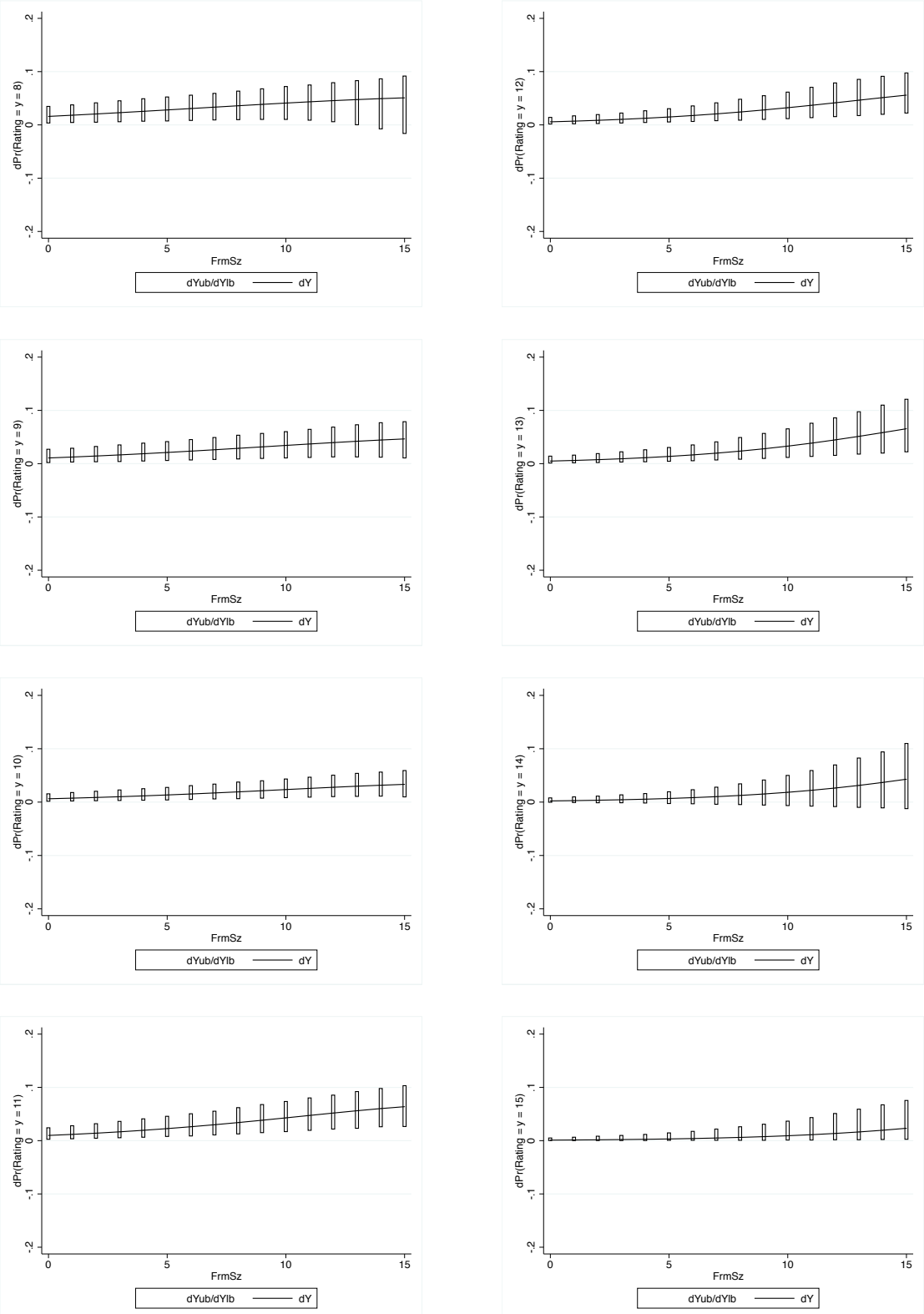




The marginal effects of the interaction term between EBITDA interest coverage and cash-flow coverage are estimated using a simulation-based approach according to Zelner (2009). The marginal effect for each rating category is estimated by an increase in EA_ic from "rating category - 1" to "rating category + 1" across all possible outcomes of CF_c. The graphs present the marginal effects and the respective confidence intervals. The x axis denotes the score of the respective variable (cash-flow coverage and firm size) ranging from 0 to 15. The y axis denotes the change in the probability of belonging to the respective rating category. When the confidence interval contains the zero line, the marginal effect is not statistically significant.

Figure 1b - Marginal effects of interaction terms by rating category (leverage and firm size)





The marginal effects of the interaction term between leverage and firm size are estimated using a simulation-based approach according to Zelner (2009). The marginal effect for each rating category is estimated by an increase in Lev from "rating category - 1" to "rating category + 1" across all possible outcomes of FrmSz. The graphs present the marginal effects and the respective confidence intervals. The x axis denotes the score of the respective variable (cash-flow coverage and firm size) ranging from 0 to 15. The y axis denotes the change in the probability of belonging to the respective rating category. When the confidence interval contains the zero line, the marginal effect is not statistically significant.

the score of the respective variable (cash-flow coverage and firm size) ranging from 0 to 15. The y axis denotes the change in the probability of belonging to the respective rating category. When the confidence interval contains the zero line, the marginal effect is not statistically significant. The results in figure 1a for the interdependency between EA_ic and CF_c are corresponding to the marginal effects of both, EBITDA interest coverage and cash-flow coverage. An increase in EA_ic from "rating category - 1" to "rating category + 1" significantly decreases the probability of low rating categories, and this is more pronounced for lower values of CF_c. For rating categories ranging from 5 to 7, an increase in the EBITDA interest coverage does not significantly affect the probability of belonging to the respective rating category. However, an improvement in EA_ic increases the probability of higher rating categories, especially when cash-flow coverage exhibits values above 4 to 5. The marginal effects of leverage are neither significantly negative nor positive for rating categories 0 to 6 across all possible outcomes of firm size. For higher rating categories, a decrease in leverage does, however, significantly affect the probability to fall into the respective rating category, and this is more pronounced for larger firms.

This again supports our view that the ability to meet financial obligations receives the highest attention by rating agencies in assessing the creditworthiness of companies. Our results suggest that the level of debt held by firms is the second most important factor in deriving a credit rating, while firm size seemingly does only support the accuracy of discrimination in higher rating categories. The profitability measure does not significantly affect the rating assessment.

IV Empirical results – financial ratios and qualitative criteria

A. Data description

Our findings indicate that corporate credit ratings are substantially driven by financial ratios but that rating agencies might focus on interdependencies between several ratios rather than on single factors. However, still a high percentage of ratings is not fully

explainable by models, which incorporate solely a set of financial ratios. Therefore, we expand model M1' by a set of qualitative criteria that we derive from the original rating reports according to the questionnaire presented above.

Descriptive statistics on the score evaluation ranging from 1 to 5 are presented in Table 9. We use a reduced dataset of 266 firm-year observations as compared to the initial dataset because not all rating reports have been available. Mean and median values are similarly distributed across the eleven qualitative criteria. While both measures exhibit values of about 3.0 for most criteria, the score values of OTCP and CM are substantially lower, and considerably greater for CP. Similar to Table 3, most firm-year observations are rated BBB and BB, and about two-third are assigned a rating ranging from BBB+ to BB- (Table 10).

We again test for possible biases resulting from multicollinearity. Pairwise correlations are presented in Panel A of Table 11. Contrary to the correlation matrix containing the seven quantitative variables, the pairwise correlations are lower in magnitude across the eleven qualitative factors. The variance inflation factor and the condition index are calculated for the full set of variables in Panel B. Our threshold values for VIF and CI are, respectively, 10 and 30. While the VIF exceeds 10 only for EA_ic and the interaction term between EA_ic and CF_C, the condition number exceeds 30. However, as it might be difficult to exclude a priori some qualitative criteria, we must allow for any possible issues, which may arise from multicollinearity.

B. OLR estimates

In Table 12, we test five models of which each might capture a unique set of information and may help to cull the most important criteria. Across all model specifications, the coefficient estimates on the financial ratios are comparable to those in Table 5 with only few exceptions. Cash-flow coverage is not statistically significant in any model but the CF_c coefficient switches from positive to negative. The coefficient on the return on capital switches from negative to positive. However, it is still not statistically significant. Firm size becomes significant in models Q1 to Q3 but with a negative and counterintuitive sign. The interaction term between leverage and firm size remains relatively stable across model specifications, while the interaction term between cash-flow coverage and EBITDA interest coverage is only statistically signifi-

Table 9 - Descriptive statistics (qualitative criteria)

	Variable										
Statistics	RFP	OTCB	DM	OTCP	CM	CP	RFS	OTPD	EM	ARM	APC
N	266	266	266	266	266	266	266	266	266	266	266
Q10	2.0	2.0	2.0	1.0	1.0	2.0	3.0	2.0	2.0	2.0	2.0
Mean	2.9	3.2	2.9	2.3	2.6	3.6	3.3	3.1	3.3	3.2	3.2
Median	3.0	3.0	3.0	2.0	2.5	4.0	3.0	3.0	3.0	3.0	3.0
Q90	4.0	4.0	4.0	3.0	4.0	5.0	4.0	4.0	4.0	4.0	4.0

RFP and OTCB are related to the financial planning. RFP refers to the reliability and the feasibility of a firm's financial planning. OTCB is opportunities and threats determining the future availability of lines of credit, leasing and factoring, and future relationships to banks and investors. DM, OTCP, CM and CP provide information on markets and competitors. DM is the future development of key markets. OTCP refers to opportunities and threats determining judicial, political and economic conditions, and price trend of raw materials. CM is the cyclicality of the market and CP is the competitive position and pricing pressure through customers. The strategy is assessed by RFS and OTPD. RFS refers to the reliability and the feasibility of a firm's strategic objectives. OTPD is opportunities and threats determining the strategic planning, and dependencies from suppliers and customers. EM, ARM and APC are related to the management. EM is the executive ability of the management board. ARM is the adequacy of internal risk management systems and APC is the adequacy of internal planning and controlling systems. See Appendix B for a detailed description.

Table 10 - Ordinal rating notation			
Rating notation	Ordinal rating notation	# firm-years [abs]	# firm-year [rel]
AAA	16	1	0.004
AA+	15	0	0.000
AA	14	2	0.008
AA-	13	6	0.023
A+	12	9	0.034
A	11	18	0.068
A-	10	15	0.056
BBB+	9	31	0.117
BBB	8	40	0.150
BBB-	7	29	0.109
BB+	6	23	0.086
BB	5	36	0.135
BB-	4	20	0.075
B+	3	15	0.056
B	2	9	0.034
B-	1	8	0.030
CCC/C	0	4	0.015
		266	1.000

The absolute and the relative number of firm-years are presented by rating notation and the corresponding ordinal rating notation based on the reduced dataset with 266 firm-year observations. As there is no observation for rating category AA+, we use a combined rating category AAA/AA+ (ordinal rating notation: 15).

Table 11 - Test for mutlicollinearity (financial ratios and qualitative cirtieria)

Panel A - Correlation matrix

	Lev	EA_ic	CF_c	Roce	FrmSz	CF_c•EA_ic	Lev• FrmSz	RFP	OTCB	DM	OTCP	CM	CP	RFS	OTPD	EM	ARM	APC
Lev	1																	
EA_ic	0.496***	1																
CF_c	0.792***	0.667***	1															
Roce	0.255***	0.549***	0.615***	1														
FrmSz	0.245***	0.404***	0.291***	0.195***	1													
CF_c•EA_ic	0.664***	0.921***	0.803***	0.599***	0.340***	1												
Lev•FrmSz	0.498***	0.431***	0.465***	0.232***	0.848***	0.488***	1											
RFP	0.441***	0.332***	0.358***	0.119*	0.193***	0.327***	0.225***	1										
OTCB	0.470***	0.396***	0.422***	0.190***	0.406***	0.386***	0.469***	0.674***	1									
DM	0.327***	0.391***	0.377***	0.213***	0.256***	0.337***	0.208***	0.461***	0.509***	1								
OTCP	0.295***	0.294***	0.390***	0.374***	0.102*	0.357***	0.189***	0.311***	0.317***	0.563***	1							
CM	0.182***	0.355***	0.290***	0.288***	0.184***	0.314***	0.178***	0.346***	0.351***	0.618***	0.643***	1						
CP	0.423***	0.393***	0.415***	0.291***	0.441***	0.397***	0.407***	0.462***	0.593***	0.638***	0.447***	0.452***	1					
RFS	0.324***	0.326***	0.336***	0.166***	0.247***	0.281***	0.177***	0.608***	0.471***	0.412***	0.232***	0.294***	0.474***	1				
OTPD	0.437***	0.336***	0.419***	0.191***	0.447***	0.344***	0.464***	0.408***	0.543***	0.359***	0.347***	0.326***	0.571***	0.501***	1			
EM	0.470***	0.472***	0.458***	0.209***	0.390***	0.430***	0.430***	0.619***	0.671***	0.463***	0.192***	0.351***	0.557***	0.616***	0.531***	1		
ARM	0.505***	0.429***	0.495***	0.238***	0.477***	0.420***	0.487***	0.530***	0.575***	0.336***	0.144**	0.266***	0.477***	0.473***	0.556***	0.709***	1	
APC	0.407***	0.356***	0.348***	0.183***	0.422***	0.355***	0.422***	0.583***	0.542***	0.239***	0.085	0.230***	0.482***	0.511***	0.390***	0.711***	0.715***	1

Panel B - Variance inflation factor and condition index

	VIF		CI
Lev	5.04	1	1.00
EA_ic	12.46	2	3.83
CF_c	6.62	3	5.18
Roce	2.53	4	7.77
FrmSz	6.83	5	9.93
CF_c•EA_ic	17.96	6	11.04
Lev•FrmSz	7.55	7	15.41
RFP	2.82	8	18.53
OTCB	2.90	9	19.78
DM	2.99	10	22.23
OTCP	2.50	11	22.82
CM	2.25	12	25.16
CP	2.82	13	25.44
RFS	2.24	14	27.44
OTPD	2.27	15	29.74
EM	3.80	16	35.30
ARM	3.13	17	38.86
APC	3.21	18	40.49
		19	41.90

The correlation matrix for the five quantitative variables, the two interaction terms and the eleven qualitative criteria is presented in Panel A. Panel B presents the variance inflation factor for the five quantitative variables, the two interaction terms and the eleven qualitative criteria as well as the condition index for the nineteen Eigenvalues. Our threshold values for VIF and CI are, respectively, 10 and 30. ***, **, and * denote the significance at the 1, 5 and 10% levels.

Table 12 - OLR estimates (financial ratios and qualitative criteria)					
	Q1	*Q2*	*Q3*	*Q4*	*Q5*
	Rating	Rating	Rating	Rating	Rating
Lev	0.151***	0.145***	0.125***	0.172***	0.167***
EA_ic	0.425***	0.425***	0.520***	0.420***	0.382***
CF_c	-0.060	-0.055	0.000	-0.050	-0.042
Roce	0.031	0.031	0.013	0.041	0.043
FrmSz	-0.114**	-0.113*	-0.090*	-0.071	-0.089
CF_c•EA_ic	-0.012	-0.012	-0.018**	-0.012	-0.012*
Lev•FrmSz	0.015***	0.015***	0.012**	0.013**	0.019***
RFP	-0.290			-0.149	0.769***
OTCB	1.580***	1.492***	1.603***	1.560***	
DM	0.047	0.026		-0.077	0.184
OTCP	0.646***	0.623***	0.611***	0.486**	
CM	0.640***	0.634***		0.726***	0.848***
CP	-0.532***	-0.514***		-0.522***	-0.216
RFS	1.195***	1.120***		1.078***	0.944***
OTPD	0.054	0.065	0.507***	0.237	
EM	0.176	0.179		0.549**	0.719***
ARM	0.818***	0.814***			
APC	0.043	-0.006			
chi2	438.0	437.2	365.9	424.5	372.8
Prob > chi2	0.000	0.000	0.000	0.000	0.000
No. Obs.	266	266	266	266	266

The results are estimated using an ordered logit model and the reduced dataset with 266 firm-year observations. Models Q1 to Q5 are based on the second quantitative model [M1'] (with interaction terms) and include different sets of qualitative factors. The models are estimated using maximum likelihood, and variance estimates are calculated via the observed information matrix. The dependent variable is the corporate rating for the respective firm-year according to the ordinal rating notation. ***, **, and * denote the significance at the 1, 5 and 10% levels.

cant for models Q3 and Q5.

Among the eleven qualitative criteria, opportunities and threats with respect to the future availability of lines of credit, leasing and factoring, and future relationships to banks and investors (OTCB), opportunities and threats with respect to judicial, political and economic conditions, and price trends of raw materials (OTCP), the cyclicality of the market (CM), strategic objectives (RFS) as well as the adequacy of internal risk management systems (ARM) are statistically significant across all models into which they are incorporated. Hence, at least one qualitative criterion across the four superordinate categories financial planning, market and competitors, strategy and management is significantly positive. Surprisingly, strategic objectives are statistically superior to opportunities and threats, which are related to corporate strategy and risk management is superior to the executive ability of the management board. A possible explanation for the latter finding could be that the evaluation of the management board is solely a resulting characteristic of the remaining criteria and the overall performance of the company. With respect to the corporate strategy, rating agencies might focus more on primary characteristics of a firm's strategy rather than on single strategic tasks and intentions. Also, with respect to the SWOT analysis that is presented in every rating report, opportunities and threats with respect to a firm's strategic planning might be indicated in the opportunities and threats relating to the future availability of liquidity and changes in the judicial, political and economic conditions. The future development of key markets (DM) and the adequacy of internal planning and controlling systems (APC) are not statistically significant in any model. The latter finding might be interpreted with respect to the aforementioned evidence, i.e., internal planning and controlling systems could be considered more as an underlying determinant of corporate performance, which is then expressed in the remaining criteria. Also, some rating reports do not explicitly differentiate between risk management systems and planning and controlling systems and, thus, the explanatory power of the latter might be less pronounced. The future development of key markets might primarily be taken into account through the financial rating and may not be explicitly considered as a qualitative criterion.[26] This interpretation then supports our view that rating agencies apply a through-the-cycle methodology rather than a point-in-time

[26] We have no data on financial planning. However, we might assume that they are explicitly used in assessing a firm's creditworthiness and might capture additional information, which is less likely to rely solely on a qualitative assessment.

concept, and that this is already considered in the evaluation of their key financial ratios. Financial planning (RFP), the competitive position and pricing pressure through customers (CP), opportunities and threats relating to strategic planning, and dependencies from suppliers and customers (OTPD) as well as the executive ability of the management board (EM) are statistically significant across some models. RFP becomes statistically significant in model Q5 where OTCB is excluded. This might indicate that a firm's financial planning still captures some qualitative information but is outweighed by opportunities and threats related to the supply of liquidity. CP might be factually linked to OTCP and becomes statistically insignificant when the latter is excluded from model Q5. OTPD is statistically significant in model Q3 indicating that the three qualitative factors relating to opportunities and threats are generally assessed by rating agencies but might be – to some extent – outweighed by subordinate factors. Finally, EM becomes statistically significant with the remaining variables relating to risk management as well as planning and controlling systems be excluded in models Q4 and Q5, supporting our view that the latter two factors predominate EM.

In terms of the magnitude of the coefficients[27], the two most important criteria are the future risks for liquidity supply and strategic objectives. The coefficient on the competitive position and pricing pressure through customers (CP) is statistically significant but has a negative sign. This must, however, be interpreted with respect to the predictive accuracy and the marginal effects of the individual qualitative criteria.

C. Predictive accuracy

Again, we calculate the in-sample and average hold-out sample predictive accuracy in Tables 13 and 14. The in-sample predictive accuracy ("within two notches") is, on average, 9.4 pps above that estimated for M1', which solely incorporates financial ratios and their interaction terms. Moreover, the correct classification of ratings increases by about 10.1 pps.

The average hold-out sample predictive accuracy rises by about 7.3 pps, and the correct classification is about 9.7 pps greater than in the quantitative explanatory model.

These findings indicate that – to some extent – the qualitative criteria pointed out by rating agencies might impact the overall rating, and that a pure quantitative approach

[27] The magnitude of the coefficients is not directly comparable between financial ratios and qualitative factors because they are differently scaled.

Table 13 - In-sample predicitve accuracy (financial ratios and qualitative criteria)

Q1			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.259	0.500	0.169	0.929

Q2			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.289	0.462	0.162	0.914

Q3			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.267	0.421	0.226	0.914

Q4			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.271	0.459	0.195	0.925

Q5			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.286	0.414	0.195	0.895

The in-sample predictive accuracy is calculated using the reduced dataset with 266 firm-year observations and the coefficient estimates from Table 12. The ordered logit model yields a specific probability for each rating category with respect to the different cut-off points. For each firm-year, a probability is assigned to each rating category with respect to the coefficient estimates and the firm-year data for each variable. The predicted rating is calculated by weighting each category with its corresponding probability. The predictive accuracy is measured by comparing the predicted rating and the genuine credit rating for each firm-year and dividing the number of firm years with the specific deviation by the total number of firm-year observations. The +/- 0 notch classification refers to the hit rate, while the +/-1 notch and +/- 2 notches classifications exhibit a deviation by 1 and 2 notches, respectively, from the original rating. The “within 2 notches” classification is the sum of the three individual classifications.

Table 14 - Average hold-out sample predictive accuracy (financial ratios and qualitative criteria)

Q1			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.247	0.418	0.219	0.884

Q2			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.279	0.402	0.196	0.878

Q3			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.271	0.334	0.309	0.914

Q4			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.240	0.457	0.201	0.898

Q5			
+/- 0 notch	+/- 1 notch	+/- 2 notches	within 2 notches
0.238	0.423	0.191	0.851

The average hold-out sample predictive accuracy is calculated by holding out thirty per cent of the reduced dataset, re-estimating models Q1 to Q5 and estimating the ratings in the hold-out sample. The ordered logit model yields a specific probability for each rating category with respect to the different cut-off points. For each firm-year, a probability is assigned to each rating category with respect to the coefficient estimates and the firm-year data for each variable. The predicted rating is calculated by weighting each category with its corresponding probability. The predictive accuracy is measured by comparing the predicted rating and the genuine credit rating for each firm-year and dividing the number of firm years with the specific deviation by the total number of firm-year observations in the hold-out sample. The +/- 0 notch classification refers to the hit rate, while the +/-1 notch and +/- 2 notches classifications exhibit a deviation by 1 and 2 notches, respectively, from the original rating. The “within 2 notches” classification is the sum of the three individual classifications.

could not capture all information assigned to a corporate credit rating. With respect to the individual models, there exist some remarkable differences. The "within 2 notches" in-sample predictive accuracy is comparable across models Q1 to Q4 ranging from 91.4 to 92.9% but it slightly decreases in model Q5 to 89.5%. The correct classification is highest in Q2 and Q5 for the in-sample prediction ranging from 28.6 to 28.9% but the hold-out sample predictive accuracy is highest for Q2 and Q3 (27.9 and 27.1%, respectively). Also, Q3 has the greatest average hit rate (91.4%) for the "within 2 notches" hold-out sample category while it is comparable for models Q1, Q2 and Q4 (ranging from 87.8 to 89.8%) and drops to 85.1% for Q5. Q3 has, however, the lowest average hold-out sample predictive accuracy for the +/- 1notch category. Seemingly, rating agencies might strongly focus on opportunities and threats relating to several factors including liquidity, markets and strategy as the predictive accuracy for Q5 with those variables be excluded is lowest on average. Interestingly, a model consisting of only those variables (Q3) performs relatively well but with a loss in explanatory power across all categories. It is, however, still difficult to draw conclusions on which factors do affect most corporate credit ratings. Thus, we estimate the marginal effects separately for each qualitative factor.

D. Marginal effects

Table 15 provides marginal effects and the respective *p*-values across the financial ratios and the eleven qualitative criteria by rating category for model Q1. Negative marginal effects indicate a decreasing probability of belonging to a particular rating category with an increase in either a financial risk factor or a business risk factor. A positive outcome indicates an increasing probability to fall into the respective rating category. We estimate the average marginal effects of each variable, where the remaining variables are held constant at the value of the respective rating category.[28] The results for the five non-interacted quantitative variables are qualitatively the same as those reported in Table 8. The marginal effects for leverage and EBITDA interest coverage are, however, considerably lower in magnitude as compared to those in the quantitative model but they exhibit similar signs and significance levels. Cash-flow

[28] As the scope of the qualitative variables (ranging from 1 to 5) is not congruent to that of the ordinal rating categories (ranging from 0 to 15), we reassign them as follows: qualitative factor = 1 for rating category = 0 to 2, qf = 2 for rc = 3 to 5, qf = 3 for rc = 6 to 8, qf = 4 for rc = 9 to 11, and qf = 5 for rc = 12 to 15.

Table 15 - Marginal effects of qualitative criteria by rating category

	Rating = y															
	0		1		2		3		4		5		6		7	
d(y)/d(Lev)	-0.00222	0.02	-0.00252	0.02	-0.00244	0.01	-0.00381	0.00	-0.00393	0.00	-0.00538	0.00	-0.00197	0.00	-0.00079	0.33
d(y)/d(EA_ic)	-0.00475	0.01	-0.00477	0.01	-0.00515	0.01	-0.00796	0.00	-0.00588	0.00	-0.00590	0.00	-0.00141	0.17	0.00018	0.80
d(y)/d(CF_c)	0.00131	0.37	0.00178	0.32	0.00216	0.25	0.00330	0.13	0.00312	0.07	0.00450	0.05	0.00232	0.11	0.00135	0.29
d(y)/d(Roce)	-0.00052	0.31	-0.00055	0.31	-0.00055	0.32	-0.00082	0.31	-0.00080	0.30	-0.00118	0.32	-0.00054	0.36	-0.00020	0.46
d(y)/d(FrmSz)	0.00237	0.10	0.00198	0.11	0.00166	0.13	0.00201	0.15	0.00152	0.21	0.00164	0.32	0.00047	0.51	0.00007	0.78
d(y)/d(RFP)	0.04743	0.39	-0.01156	0.59	-0.01480	0.42	0.00648	0.33	-0.00488	0.57	-0.01658	0.43	0.01056	0.44	-0.00112	0.72
d(y)/d(OTCB)	-0.08578	0.00	-0.07435	0.00	-0.02290	0.24	-0.05409	0.00	-0.02106	0.04	-0.00354	0.61	-0.02166	0.01	-0.00368	0.43
d(y)/d(DM)	-0.00721	0.87	0.00062	0.85	0.00205	0.87	-0.00144	0.87	0.00038	0.86	0.00226	0.87	-0.00148	0.87	0.00016	0.88
d(y)/d(OTCP)	-0.08584	0.00	-0.00688	0.68	0.01599	0.14	-0.01566	0.10	0.00268	0.62	0.02383	0.02	-0.00785	0.07	0.00813	0.12
d(y)/d(CM)	-0.08081	0.00	-0.00890	0.57	0.01046	0.25	-0.01707	0.06	0.00098	0.81	0.01691	0.04	-0.00896	0.06	0.00452	0.22
d(y)/d(CP)	0.08799	0.00	-0.03886	0.11	-0.02673	0.01	0.00539	0.58	-0.01753	0.15	-0.03765	0.01	0.01888	0.04	-0.00553	0.35
d(y)/d(RFS)	-0.07750	0.01	-0.06843	0.01	-0.01838	0.31	-0.05323	0.00	-0.02406	0.02	-0.00035	0.98	-0.03173	0.00	-0.01034	0.15
d(y)/d(OTPD)	-0.00834	0.81	0.00066	0.79	0.00235	0.81	-0.00169	0.82	0.00042	0.79	0.00260	0.81	-0.00173	0.81	0.00017	0.83
d(y)/d(EM)	-0.02570	0.48	-0.00001	1.00	0.00638	0.41	-0.00597	0.57	0.00054	0.76	0.00724	0.42	-0.00536	0.50	0.00017	0.91
d(y)/d(ARM)	-0.07873	0.00	-0.03347	0.12	0.00272	0.84	-0.03096	0.01	-0.01044	0.21	0.01313	0.15	-0.02045	0.01	-0.00344	0.57
d(y)/d(APC)	-0.00670	0.85	0.00057	0.82	0.00190	0.84	-0.00135	0.85	0.00035	0.83	0.00210	0.84	-0.00140	0.85	0.00013	0.84
	8		9		10		11		12		13		14		15	
d(y)/d(Lev)	0.00046	0.40	0.00058	0.38	0.00116	0.07	0.00506	0.01	0.00774	0.00	0.00901	0.01	0.00493	0.14	0.00473	0.24
d(y)/d(EA_ic)	0.00083	0.47	0.00308	0.01	0.00314	0.00	0.00719	0.00	0.00673	0.00	0.00613	0.01	0.00305	0.12	0.00265	0.27
d(y)/d(CF_c)	-0.00228	0.18	-0.00539	0.09	-0.00414	0.09	-0.00864	0.06	-0.00854	0.07	-0.00930	0.11	-0.00682	0.25	-0.01254	0.31
d(y)/d(Roce)	0.00017	0.37	0.00039	0.28	0.00040	0.31	0.00109	0.31	0.00119	0.32	0.00116	0.33	0.00065	0.39	0.00074	0.43
d(y)/d(FrmSz)	0.00003	0.87	0.00030	0.53	0.00049	0.30	0.00171	0.14	0.00217	0.08	0.00238	0.06	0.00149	0.17	0.00172	0.28
d(y)/d(RFP)	-0.01586	0.42	0.01408	0.49	0.00170	0.72	-0.00636	0.38	0.01619	0.38	0.01392	0.56	0.00064	0.95	-0.04663	0.41
d(y)/d(OTCB)	0.02334	0.04	-0.00033	0.95	0.00715	0.26	0.03863	0.01	0.00502	0.66	0.03415	0.23	0.04275	0.18	0.10334	0.03
d(y)/d(DM)	0.00239	0.87	-0.00152	0.86	0.00003	0.95	0.00128	0.87	-0.00235	0.87	-0.00097	0.86	0.00060	0.88	0.00679	0.87
d(y)/d(OTCP)	0.03179	0.01	0.00087	0.88	0.00782	0.10	0.02436	0.02	-0.00293	0.77	0.01302	0.35	0.02054	0.29	0.06041	0.04
d(y)/d(CM)	0.02564	0.00	-0.00098	0.89	0.00474	0.18	0.01925	0.05	-0.00423	0.73	0.00792	0.47	0.01651	0.38	0.06603	0.01
d(y)/d(CP)	-0.03823	0.01	0.02823	0.06	0.00562	0.51	-0.01356	0.15	0.02757	0.02	0.03075	0.11	0.00837	0.70	-0.09163	0.00
d(y)/d(RFS)	0.02845	0.01	-0.00993	0.37	0.00620	0.29	0.03132	0.01	-0.00474	0.77	0.02031	0.34	0.03429	0.29	0.10920	0.02
d(y)/d(OTPD)	0.00275	0.81	-0.00177	0.81	0.00003	0.94	0.00147	0.81	-0.00272	0.81	-0.00111	0.80	0.00070	0.84	0.00786	0.81
d(y)/d(EM)	0.00816	0.47	-0.00489	0.43	0.00022	0.88	0.00459	0.52	-0.00768	0.44	-0.00232	0.63	0.00261	0.69	0.02456	0.50
d(y)/d(ARM)	0.02713	0.00	-0.00993	0.27	0.00472	0.32	0.02246	0.02	-0.01120	0.39	0.00966	0.54	0.02068	0.32	0.08355	0.01
d(y)/d(APC)	0.00221	0.85	-0.00144	0.84	0.00002	0.96	0.00118	0.85	-0.00220	0.84	-0.00093	0.84	0.00055	0.87	0.00632	0.85

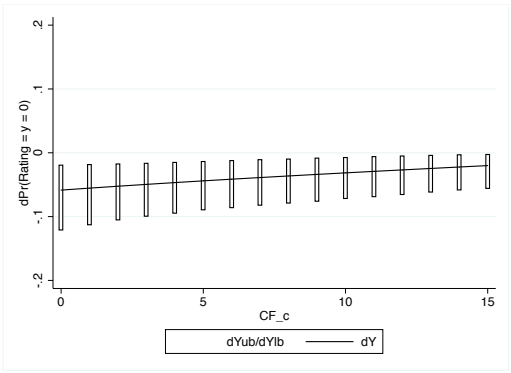
Average marginal effects are separately estimated for each quantitative and qualitative variable. The remaining variables are held constant at the value of the respective rating category. For each rating category, the left column presents the average marginal effect and the right column presents the respective *p*-value. A negative marginal effect indicates a decreasing probability of belonging to a particular rating category with an increase in either a financial ratio or a qualitative factor. A positive outcome indicates an increasing probability to fall into that category.

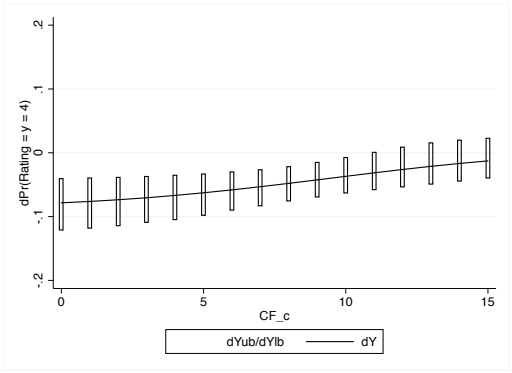
coverage is negatively related to the change in the probability of higher rating categories with a greater magnitude as compared to M1'. The marginal effects of firm size are only statistically significant across single rating categories, and the marginal effects for the return on capital remain non-significant.

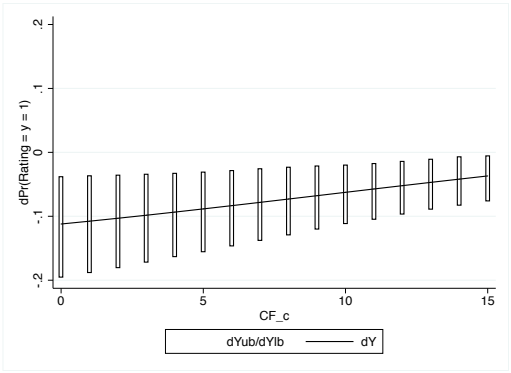
Again, we apply the simulation-based estimation of marginal effects provided by Zelner (2009) to assess the marginal effects of the interaction terms between cash-flow coverage and EBITDA interest coverage as well as between leverage and firm size. The marginal effects and the respective confidence intervals are reported graphically in figures 2a and 2b. When the confidence interval contains the zero line, the marginal effect is not statistically significant. The marginal effects of EA_ic are comparable to those reported in figure 1a. However, they are slightly differently distributed. Specifically, they are consistently significantly negative up to rating category 6 for low values of cash-flow coverage, while for higher rating categories, they are only statistically positive for greater values of CF_c. Similar to figure 1b, a decrease in leverage positively affects the probability to fall into higher rating categories.

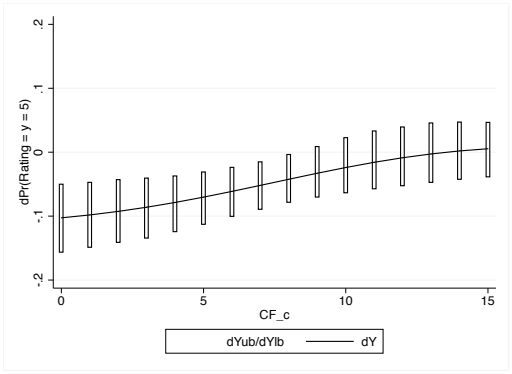
The marginal effects of the eleven qualitative criteria (Table 15) are in line with the OLR estimates in Table 11. The marginal effects for financial planning (RFP), the future development of key markets (DM), opportunities and threats relating to strategic planning, and dependencies from suppliers and customers (OTPD), the executive ability of the management board (EM) as well as the adequacy of internal planning and controlling systems (APC) are not statistically significant for any rating category. Opportunities and threats with respect to the future availability of lines of credit, leasing and factoring, and future relationships to banks and investors (OTCB) as well as strategic objectives (RFS) decrease most the probability of lower outcomes up to rating category 6 (non-investment grade ratings). The marginal effects for the adequacy of internal risk management systems (ARM) are comparable to those for OTCB and RFS in magnitude but they are only significantly related to a change in the profitability across three outcomes. An increase in opportunities and threats relating to judicial, political and economic conditions, and price trends of raw material (OTCP), the cyclicality of the market (CM) as well as the competitive position and pricing pressure through customers (CP) do not consistently positively or negatively affect the probability of belonging to rating categories 0 to 6, and they are only significant across four outcomes. For higher rating categories (investment grade ratings), all variables simi-

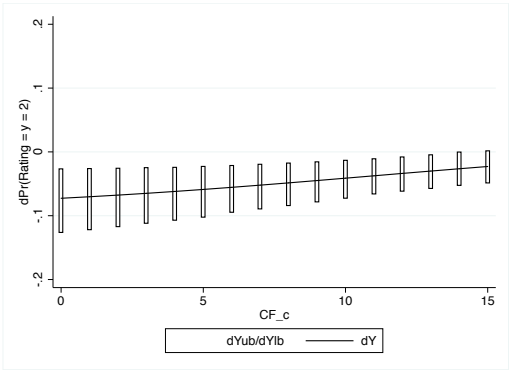
Figure 2a - Marginal effects of interaction terms by rating category (EBITDA interest coverage and cash-flow coverage)

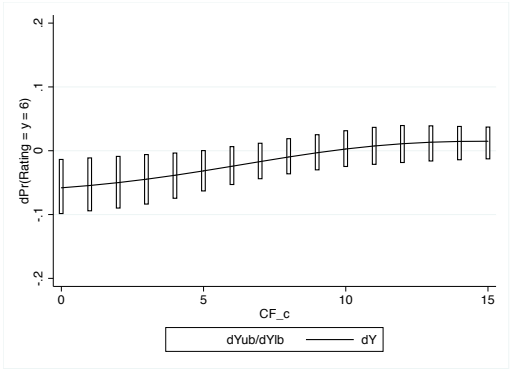


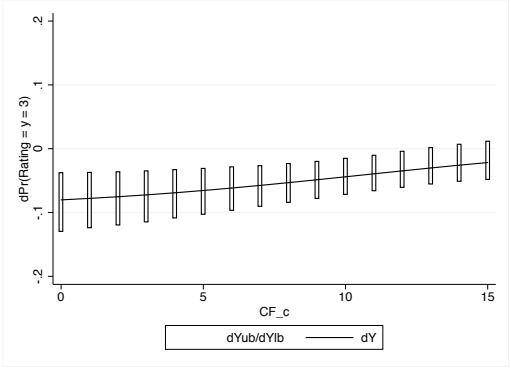


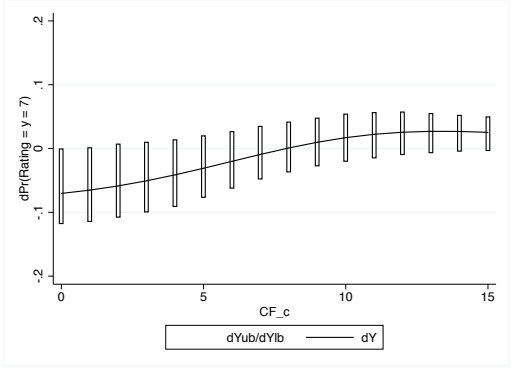


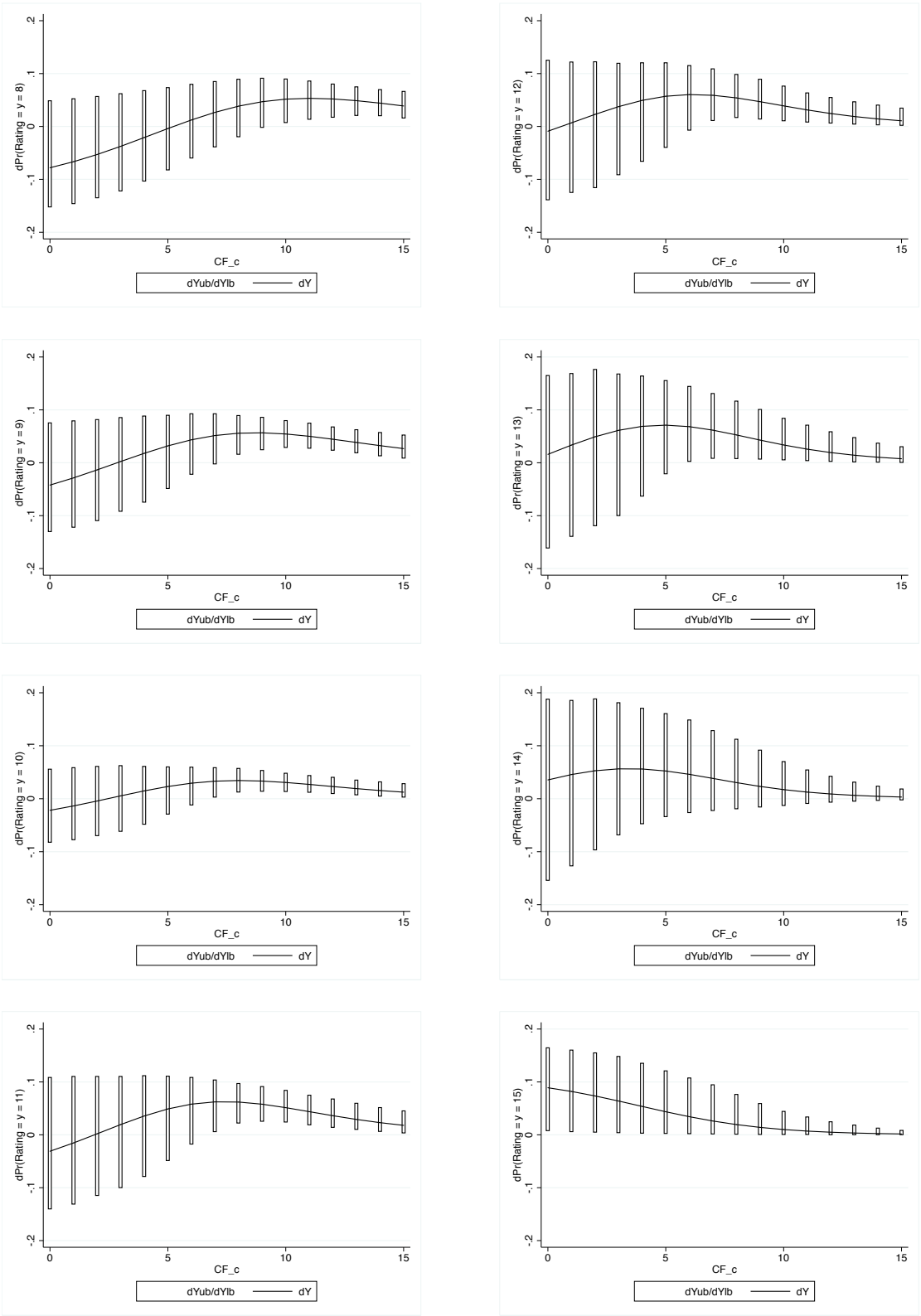






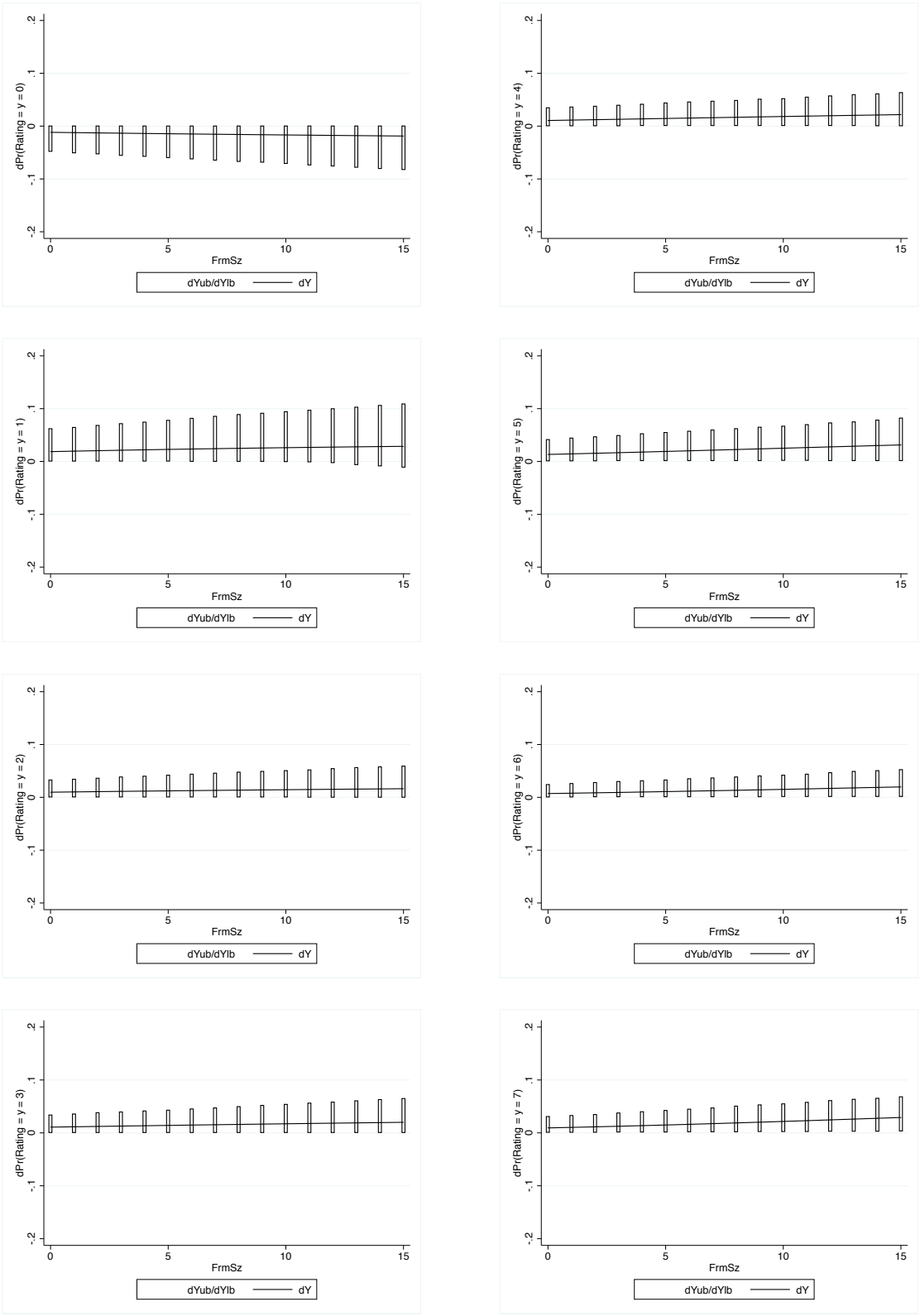


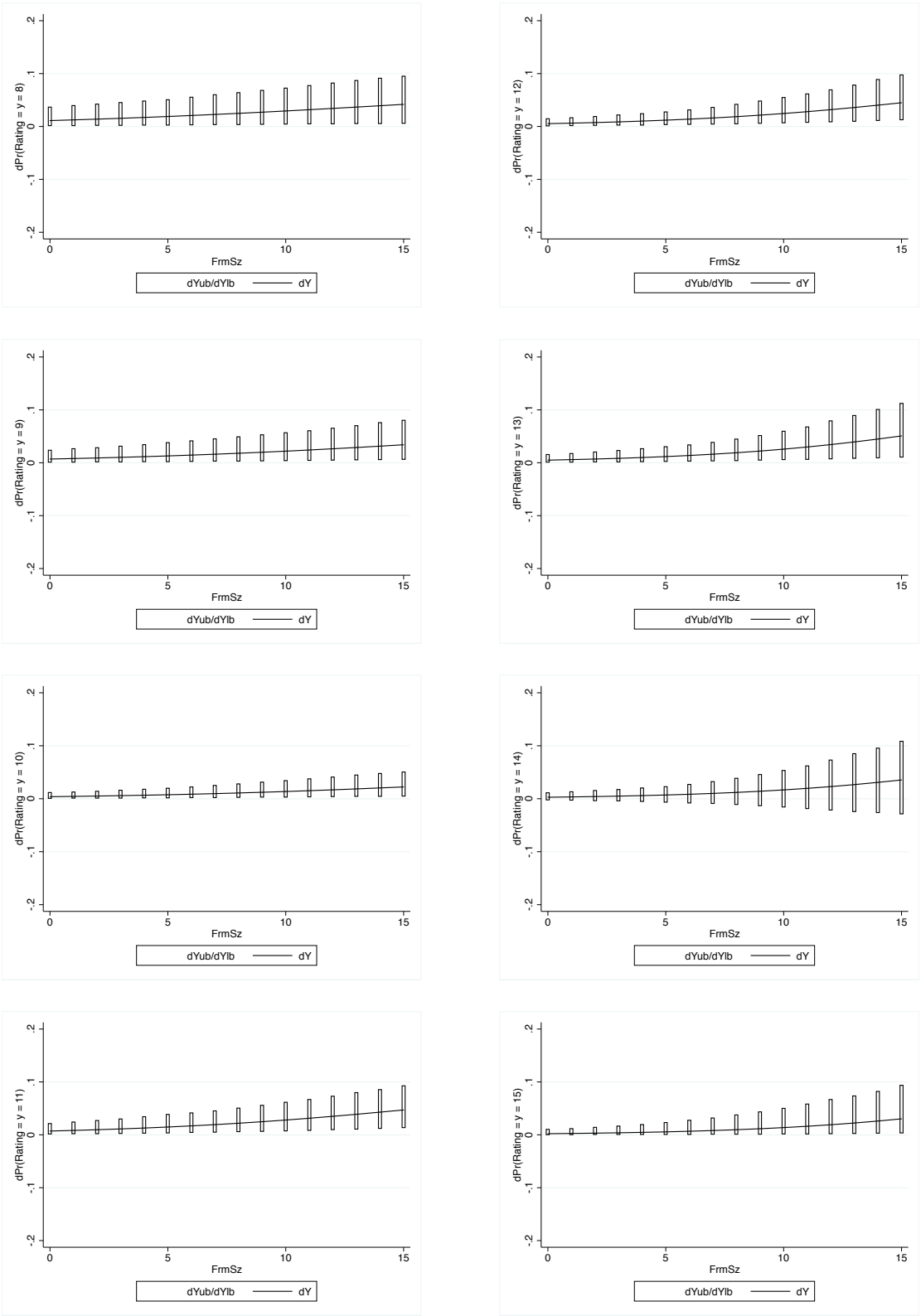




The marginal effects of the interaction term between EBITDA interest coverage and cash-flow coverage are estimated using a simulation-based approach according to Zelner (2009). The marginal effect for each rating category is estimated by an increase in EA_ic from "rating category - 1" to "rating category + 1" across all possible outcomes of CF_c. The graphs present the marginal effects and the respective confidence intervals. The x axis denotes the score of the respective variable (cash-flow coverage and firm size) ranging from 0 to 15. The y axis denotes the change in the probability of belonging to the respective rating category. When the confidence interval contains the zero line, the marginal effect is not statistically significant.

Figure 2b - Marginal effects of interaction terms by rating category (leverage and firm size)





The marginal effects of the interaction term between leverage and firm size are estimated using a simulation-based approach according to Zelner (2009). The marginal effect for each rating category is estimated by an increase in Lev from "rating category - 1" to "rating category + 1" across all possible outcomes of FrmSz. The graphs present the marginal effects and the respective confidence intervals. The x axis denotes the score of the respective variable (cash-flow coverage and firm size) ranging from 0 to 15. The y axis denotes the change in the probability of belonging to the respective rating category. When the confidence interval contains the zero line, the marginal effect is not statistically significant.

larly affect the profitability of belonging to a respective rating category, and the marginal effects are significantly positive across three and four outcomes. The marginal effects for CP are, however, significantly negative for both, rating category 8 and 15. It is noteworthy that the significant marginal effects for the qualitative factors are clustered at rating categories 7 (BBB), 11 (A) and 15 (AAA/AA-). This might indicate that, for higher rating categories, the rating is essentially based on qualitative information, and that financial ratios help to differentiate between single notch categories.

Our findings provide evidence that the impact of quantitative information on the prediction of corporate credit ratings weakens once a set of qualitative criteria is incorporated into the model.[29] Also, the marginal effects of the financial ratios decrease across all rating categories. This together suggests that – to some extent – the business risk profile might outweigh the financial risk profile. But financial ratios are seemingly more important for non-investment grade ratings because the marginal effects for the qualitative factors do less consistently affect the change in probability as compared to higher rating categories. Additionally, taking into account the coefficient estimates and the marginal effects, only a few aspects of the business risk profile seem to be considered by rating agencies. Specifically, while the financial planning might already be incorporated through key financial ratios based on forecasting and planning figures, opportunities and threats relating to future liquidity could be viewed as one of the most relevant sources of information. Similarly, the projected development of key markets might be included into the financial (planning) analysis. The market-related evaluation of the firm's creditworthiness might then be built upon opportunities and threats within its key markets, the cyclicality of the market and its competitive position. However, our findings suggest that, at least for lower rating categories, the analysis of the financial planning might still contain relevant information because the qualitative factors do not consistently affect the change in probability for non-investment grade categories. Strategic objectives exhibit the second most important criteria after future liquidity predominating opportunities and threats related to them. Interestingly, the adequacy of internal risk management systems has a greater

[29] Note that the magnitude of the marginal effects is not directly comparable between financial ratios and qualitative factors. They are differently scaled and, hence, a one-unit increase in a qualitative factor approximately equals a three-unit increase in a financial variable. Therefore, the effect of an increase in a qualitative factor on the change in the probability to fall into a respective rating category is substantially greater.

bearing on the credit rating than the superordinate management board assessment, indicating that risk-related firm characteristics are more likely to be considered by rating agencies.

V Conclusions

We investigate the determinants of corporate credit ratings from two rating agencies. Our findings could make a contribution to better understand the "black box" effect of what factors drive corporate ratings when there is no mathematical or statistical model available due to the analyst-driven approach of most rating agencies. This might particularly be relevant for national and international supervising authorities, which require an extensive reporting of the methodologies used by rating agencies for decision-making.

We test the effect of financial information and business risk factors on the final rating. First, we incorporate into our model solely a set of financial ratios for which the description of methodology in S&P's (2008) and EH (2014) point out to be substantially relevant. Additionally, we include two interaction terms, which are supposed to take into account possible interdependencies subject to financial obligations and the access to external financing. Second, the quantitative model is extended by different sets of qualitative factors because there exist neither any theoretically derived significance levels of individual soft facts, nor a predefined combination thereof. Rating agencies generally note that the business risk is considered when a firm's creditworthiness is assessed but the extent remains unclear. Our dataset includes 347 ratings of 162 publicly listed and non-listed large corporates and small and medium sized companies in Germany over the period 2000 to 2010. We use accounting data and qualitative information from the corresponding rating reports.

Our results indicate that corporate ratings are based on the financial risk and business risk profile of firms. We find that qualitative information is significant in explaining credit ratings, and that the pure financial information is – at least to some extent – predominated by soft facts. Specifically, with respect to the financial risk profile, our findings suggest that the ability to meet financial obligations, the level of debt and

access to external financing are the most important factors in deriving corporate ratings. Moreover, rating agencies seemingly take into account interdependencies between financial ratios. Profitability does not significantly affect the rating assessment. Financial liquidity and strategic objectives turn out to be the most significant business risk factors. The assessment of a firm's financial planning may capture some qualitative information and, therefore, weakens the impact of the market-related qualitative criteria. Additionally, there might exist some differences between investment grade ratings and non-investment grade ratings, where financial ratios are seemingly more important for non-investment grade ratings.

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Appendix A - Definition of financial ratios

1) Lev = (Debt - cash) / [(Debt - cash) + equity]	Debt = Loans and debenture + Liabilities to banks + Liabilities on bills accepted and drawn + Payable to partners/shareholders + Other financial liabilities - Liabilities with subordination statement	
	Cash = Other short term investments + Cash and cash equivalents	
	Equity = Equity - Special items (assets) - Loans to partners/shareholders - Receivables from partners/shareholders - Treasury stock - Accrual + Special items (liabilities)	
2) EA_ic = EBITDA / Interest expenses	EBITDA = Net sales (Total cost accounting) + Changes in inventories + Own work capitalised + Other operating income - Cost of raw materials, consumables, supplies and purchased merchandise - Cost of purchased services - Wages and salaries - Social security and pension expenses - Other operation expenses - Other taxes	
	EBITDA = Net sales (Cost of sales accounting) + Other operating income - Cost of goods sold - Sales expenses - General administration expense - R&D expenses - Other operation expenses + Depreciation and amortisation - Other taxes	
	Interest expenses = Financial expenses	
3) CF_c = (Debt - cash) / EBITDA	Debt = Loans and debenture + Liabilities to banks + Liabilities on bills accepted and drawn + Payable to partners/shareholders + Other financial liabilities - Liabilities with subordination statement	
	Cash = Other short term investments + Cash and cash equivalents	
	EBITDA = Net sales (Total cost accounting) + Changes in inventories + Own work capitalised + Other operating income - Cost of raw materials, consumables, supplies and purchased merchandise - Cost of purchased services - Wages and salaries - Social security and pension expenses - Other operation expenses - Other taxes	
	EBITDA = Net sales (Cost of sales accounting) + Other operating income - Cost of goods sold - Sales expenses - General administration expense - R&D expenses - Other operation expenses + Depreciation and amortisation - Other taxes	
4) Roce = EBIT / [(Debt - cash) + equity]	EBIT = Net sales (Total cost accounting) + Changes in inventories + Own work capitalised + Other operating income - Cost of raw materials, consumables, supplies and purchased merchandise - Cost of purchased services - Wages and salaries - Social security and pension expenses - Other operation expenses - Other taxes - Depreciation and amortisation	
	EBIT = Net sales (Cost of sales accounting) + Other operating income - Cost of goods sold - Sales expenses - General administration expense - R&D expenses - Other operation expenses - Other taxes	
	Debt = Loans and debenture + Liabilities to banks + Liabilities on bills accepted and drawn + Payable to partners/shareholders + Other financial liabilities - Liabilities with subordination statement	
	Cash = Other short term investments + Cash and cash equivalents	
	Equity = Equity - Special items (assets) - Loans to partners/shareholders - Receivables from partners/shareholders - Treasury stock - Accrual + Special items (liabilities)	
5) FrmSZ = Liabilities + equity	Liabilities + equity = Equity - Special items (assets) - Loans to partners/shareholders - Receivables from partners/shareholders - Treasury stock - Accrual + Special items (liabilities) + Accruals for pensions and similar obligations + Tax accruals + Other accruals + Loans and debentures + Liabilities to banks + Prepayments received on account of orders + Trade payables + Liabilities on bills accepted and drawn + Payable to partners/shareholders + Payable to affiliated companies + Payables to companies in which participations are held + Other liabilities + Deferred income	

The definition of financial ratios exhibits the calculation schemas for leverage (Lev), EBITDA interest coverage (EA_ic), cash-flow coverage (CF_c), return on capital employed (Roce) and firm size (FrmSz). Some individual items are rearranged on the balance sheet and the income statement, based on the adjustments described in S&P's (2008) and EH (2012). EBITDA and EBIT are calculated via the total cost accounting or the cost of sales accounting method, depending on the firm's reporting standards. Off-balance items are included when they are available.

Appendix B - Questionnaire of qualitative factors

	Financial planning				
	1) Financial planning (*RFP*)				
characteristic	comprehensible financial planning; scenarios	comprehensible financial planning; detailed assumptions	comprehensible financial planning	finanical planning with incomprehensible assumptions	insufficient financial planning; missing liquidity forecast
attributes, e.g.	scenario, realistic assumptions	realistic assumptions		optimistic assumptions	restrictive assumptions, unrealistic assumptions
	2) Opportunities and threats determining future availability of lines of credit, leasing and factoring, and future relationships to banks and investors (*OTCB*)				
characteristic	no utilisation of existing lines of credit; very good relationship to banks/investors	low utilisation of existing lines of credit; good relationship to banks/investors	no	high utilisation of existing lines of credit; critical relationship to banks/investors	no free lines of credit; very critical relationship to banks/investors
attributes, e.g.	high finacial flexibility	good financial flexibility		low financial flexibility	financially constrained
	Market and competitors				
	3) Future development of key markets (*DM*)				
characteristic	strong positive	positive	stable	negative	strong negative
attributes, e.g.	strong increase	increase		decrease	strong decrease
	4) Opportunities and threats determining judicial, political and economic conditions, and price trends of raw materials (*OTCP*)				
characteristic	opportunities with particular positive implications	opportunities without particular positive implications	no	threats with negative implications	threats endangering individual business divisions/the company
attributes, e.g.	government aid	punitive tariffs for foreign competitors		lawsuit, increase in raw material prices	non-sustainable business concept
	5) Cyclicality of the market (*CM*)				
characteristic	very stable	stable	alternate	cyclical	strong cyclical
attributes, e.g.	highly stable market, publicly regulated	stable market		cyclical market	highly cyclical market
	6) Competitive position and pricing pressure through customers (*CP*)				
characteristic	very strong market position; no pricing pressure	strong market position; low pricing pressure	average market position; average pricing pressure	weak market position; strong pricing pressure	very weak market position; very strong pricing pressure
attributes, e.g.	no competitors, very high margins	few or weak competitors, high margins		many competitors, low margins	heterogeneous market, very low margins
	Strategy				
	7) Strategic objectives (*RFS*)				
characteristic	comprehensible strategy	comprehensilble strategy; few uncertainties	strategy with uncertainties	strategy with incomprehensible assumptions	unclear strategy
attributes, e.g.	conservative, realistic assumptions	realistic assumptions		optimistic assumptions	inconsistent business concept
	8) Opportunities and threats determining strategic planning, and dependencies from suppliers and customers (*OTPD*)				
characteristic	opportunities with particular positive implications	opportunities without particular positive implications	no	threats with negative implications	threats endangering individual business divisions/the company
attributes, e.g.	complementary product porfolio	expansion of the clientele		decreasing number of suppliers	non-sustainable business concept
	Management				
	9) Executive ability of the management board (*EM*)				
characteristic	highly qualified leading team	qualified leading team; highly qualified manager	leading team without highlighted characteristics; qualified manager	leading team or manager with noticable weaknesses	leading team or manager with noticable insufficiencies
attributes, e.g.	extensive experience in related business fields	good personnel development		inconsistent decisions, lacking experience	wrong decisions
	10) Adequacy of internal risk management systems (*ARM*)				
characteristic	comprehensive and continuous examination of all threats	examination of all threats with time lags	examination of essential threats	expandable	not available
attributes, e.g.	scenario, realistic assumptions	quarterly/bi-annual, realistic assumptions		insufficient evaluation of risks, no risk inventory	not implemented
	11) Adequacy of internal planning and controlling systems (*APC*)				
characteristic	quantitatve and qualitative information; comprehensive and continuous examination	quantitative and qualitative information; examination with time lags	quantitative information	expandable	not available
attributes, e.g.	realistic assumptions, extensive data collection	quarterly/bi-annual, realistic assumptions		insufficient marketing controlling	not implemented

The questionnaire exhibits the evaluation scheme for the eleven qualitative criteria in the four categories financial planning, market and competitors, strategy and management based on the original rating reports. Characteristic refers to the overall evaluation of the individual criteria, while attributes are specific and exemplary comments, which may be mentioned in the corresponding rating reports. The left column presents the best characteristic and is assigned the score 5. The right column presents the worst characteristic and is assigned the score 1. Column 3 is the residual and is used when the remaining characteristics do not apply.

Chapter 4

The Impact of Credit Rating Changes on Capital Structure Decisions
Evidence from Non-listed Firms in Germany

with Wolfgang Drobetz

Abstract

Changes in corporate credit ratings affect subsequent capital structure decisions. The results for listed companies in our U.S. sample support Kisgen's (2006, 2009) credit rating-capital structure hypothesis. However, applying a system GMM approach, the implications of this hypothesis are weakened by our estimates for the speed of capital structure adjustment after credit rating changes. In contrast, publicly listed companies in our German sample are widely independent from changes in their creditworthiness. Similarly, changes in the capital structure and financing choices of high creditworthy privately-held firms in Germany are more or less independent from credit rating changes. At speculative grade rating levels, however, these firms implement financing activities that strengthen their capital structure subsequent to a rating downgrade. Our findings for the speed of adjustment support these results. We find some contradictory patterns for credit rating upgrades at lower rating levels. We conclude that the close relationship of German firms, whether publicly listed or not, to their banks helps them to mitigate else substantial effects of adverse changes in their creditworthiness.

Keywords: Capital structure, financing decisions, speed of adjustment, credit ratings, non-listed companies

JEL classification codes: G32, G24

I Introduction

The trade-off theory and the pecking order theory are the two most common theories to explain firms' capital structure decisions and financing choices. In its most basic form, the trade-off theory predicts that a firm balances the costs (financial distress or bankruptcy costs) and benefits (tax shield) of debt, thus firms target an optimal leverage ratio (Kraus and Litzenberger, 1973). In contrast, the pecking order theory suggests that funding requirements that cannot be met by internal funds must be raised from external capital markets (Myers, 1984; Myers and Majluf, 1984). Most important, firms prefer not to issue equity due to the higher costs associated with information asymmetries. Several earlier studies analyse the factors, which drive the underlying capital structure and financing decisions (Fama and French, 2002; Frank and Goyal, 2008; Graham and Leary, 2011; among others). Arguably, the traditional capital structure factors do not fully reflect the information contained in credit ratings and, thus, also omit some of the issues related to financial distress as well as the access to external financing.

Kisgen (2006) tests the impact of credit ratings on subsequent capital structure decisions and incorporates related measures into the existing frameworks of trade-off theory and pecking order theory tests. He conjectures that corporate credit ratings "are a material consideration in managers' capital structure decisions due to the discrete costs (benefits) associated with different rating levels" (p. 1037). This notion is referred to as the credit rating-capital structure hypothesis (CR-CS), and it implies that firms near either a credit rating upgrade or downgrade will issue less net debt relative to net equity. On the one hand, firms close to a rating upgrade will try to benefit from that upgrade by incurring lower costs of external capital and having better access to external financing. On the other hand, as a rating downgrade may result in higher costs of external capital, limited access to external financing and a negative sign to outside investors, firms will attempt to prevent their credit rating to be effectively downgraded.

In a related study, Kisgen (2009) modifies his framework and tests the impact of a realised change in a firm's credit rating (i.e., a realised upgrade or downgrade) on its capital structure rather than the effect of a firm being near either a rating upgrade or a downgrade. The related CR-CS hypothesis suggests that an already realised credit

rating upgrade will not affect subsequent capital structure decisions as firms do not try to reverse the upgrade. In contrast, however, a rating downgrade will induce firms to make all efforts to avoid a further downgrade or even try to reverse it.

Our own study expands the framework presented in Kisgen (2009) in three directions. First, in addition to a sample of listed U.S. firms, we examine the association between capital structure behaviour and credit ratings for listed and privately-held firms in Germany. Compared to the U.S., there exist only a small number of listed firms in Germany, which is often regarded as an example of a bank-based financial system. In fact, the large majority of firms are non-listed and have long-lasting relationships with banks (relationship lending). Therefore, our novel dataset of German privately-held firms allows us to investigate the validity of the CR-CS hypothesis in a different institutional environment. Second, we incorporate the level of a firm's creditworthiness (investment grade and speculative grade) into our research design. Third, we apply a system GMM approach in our estimation of the speed of capital structure adjustment.

To determine credit rating changes, we use Standard & Poor's long-term corporate credit ratings for U.S. firms. However, given that the number of outstanding credit ratings for publicly listed firms in Germany is comparably low and there exist only very few credit ratings for privately-held firms, we apply estimated credit ratings. Assuming that the estimated coefficients in our rating model are valid, we expect that the genuine Standard & Poor's credit ratings and the estimated ratings do not differ substantially. The rationale to apply estimated ratings for privately-held firms is different. Only few privately-held firms have outstanding credit ratings and issue public debt but they rather borrow from banks and are, thus, monitored by financial intermediaries. Arguably, our estimated credit ratings replicate bank-internal assessments of a firm's creditworthiness. Any bias, which may result from estimating ratings with error is mitigated by applying credit rating changes rather than levels. Gul et al. (2009) and Dichev and Piotroski (2011) even argue that an explicit credit rating might be less reliable because the assessment through the respective external credit rating agency is – at least partly – subjective. In contrast, rating changes presumably capture long-term changes in a firm's overall economic condition and creditworthiness.

In our U.S. sample, we find that the impact of credit rating changes on capital structure decisions and individual financing choices is more pronounced for downgrades – particularly to non-investment grade levels – compared to upgrades. Our results sug-

gest that there exists a minimum target rating, i.e., firms set a minimum target rating that is related to a specific level of external capital costs and helps them to pursue a particular financing strategy. Firms undertake financing activities to ensure that their credit rating remains equal or above this threshold rating once it is jeopardised. Another implication is that financial distress concerns are of secondary importance. Firms do not issue more debt subsequent to a credit rating upgrade although they exhibit a lower probability of default and possess a greater debt capacity. These findings are consistent with the CR-CS hypothesis. However, applying the system GMM approach, the CR-CS hypothesis is weakened by our estimates for the speed of capital structure adjustment after credit rating changes. In fact, upgrades are accompanied by a higher speed of adjustment than downgrades. This observation indicates that firms' financing activities subsequent to rating changes are affected by their access to external financing and their remaining debt capacity.

In contrast to the U.S., publicly listed firms in Germany are widely independent from changes in their creditworthiness, arguably due to extensive monitoring in a bank-based financial system and their largely unconstrained access to capital markets. Similarly, changes in the capital structure and financing choices of high creditworthiness privately-held German firms are also more or less independent from credit rating changes. In contrast, at speculative grade rating levels, these firms implement financing activities that strengthen their capital structure subsequent to a downgrade. Our findings for the speed of adjustment support these results for rating downgrades and for rating upgrades to investment grade levels. We conjecture that the close relationship to banks helps firms mitigating else substantial effects of adverse changes in their creditworthiness. However, we find contradictory patterns for credit rating upgrades at lower rating levels, which seem to be related to different levels of deviation from the target leverage.

The remainder of this paper is organised as follows. Section II presents our hypotheses and reviews the related literature. Section III describes the data and our empirical methodology. The empirical results are reported and discussed in section IV. Section V concludes.

II Hypotheses and related literature

A. Testable hypotheses

A.1. Capital structure decisions

This study analyses the impact of credit rating changes on capital structure decisions by testing Kisgen's (2006, 2009) credit rating-capital structure (or CR-CS) hypothesis. The CR-CS hypothesis implies that firms either near a credit rating change, as indicated by a positive or negative notch value, or after a credit rating downgrade will adjust their capital structure, as measured by their net debt relative to net equity issuance. In contrast, an upgrade may not necessarily affect subsequent capital structure decisions.

Differences exist between the 'near rating change' and the 'after rating change' hypotheses. The original CR-CS hypothesis (Kisgen, 2006) posits that firms near a rating change (near an upgrade or downgrade) issue less net debt relative to net equity as compared to firms not close to a rating change. While an upgrade results in better access to external financing and lower costs of capital, a downgrade has opposite implications and should be avoided. In contrast, according to the 'after rating change' hypothesis (Kisgen 2009), capital structure decisions are asymmetrically affected by previous year's rating changes. On the one hand, an already realised downgrade sends a negative signal to outside investors and has negative implications in terms of higher costs of capital and restricted access to external financing. Therefore, a firm will attempt to reverse that downgrade to be reclassified into a higher-ranked group of firms and to benefit from better access to external financing as well as lower interest rates. On the other hand, a firm that has already been upgraded will not necessarily adjust its capital structure in the subsequent year as it will not benefit from a possibly ensuing downgrade.

In our study, we test the impact of credit rating changes on a firm's capital structure. According to the CR-CS hypothesis, if a downgrade induces a lower ratio of net debt relative to net equity issuances but an upgrade does not lead to changes in capital structure decisions, firms target a minimum rating and financial distress concerns are only of secondary importance. Alternatively, if rating upgrades exert a significant impact on capital structure decisions (either leverage reducing or increasing), this finding could be interpreted in terms of a more proactive adjustment of upgraded

firms' capital structure as well as the importance of financial distress concerns. We go beyond simple credit rating changes and further divide the observed changes with respect to the resulting rating level. In particular, we test whether there exist any differences between a rating change resulting in an investment grade rating level (ranging from AAA to BBB-) or a speculative grade rating level (ranging from BB+ to CCC/C). Investment grade firms have better access to external financing, pay lower interest rates and exhibit a more stable business development (Strahan, 1999; Lemmon and Roberts, 2010). From a regulatory perspective, some investors (such as pension funds and insurance companies) are only allowed to invest in loans, bonds or hybrid financing instruments of investment grade rated firms (Kisgen and Strahan, 2010). Moreover, capital requirements of banks are – at least partly – dependent on the credit ratings of their obligors (Altman et al., 2002; Boot et al., 2006). We conjecture that downgraded firms and where the resulting rating is speculative grade exhibit the most distinct adjustment patterns. Upgraded firms to investment grade levels are expected to show no subsequent capital structure changes, unless firms not only target a minimum rating but ratings are directly associated with financial distress concerns.

A.2. Financing choices

While capital structure decisions (defined as net debt relative to net equity issuances) reflect an aggregate measure, we further test the likelihood for debt issuances, debt reductions, equity issuances and equity reductions separately for downgraded and upgraded firms. Our research design is based on Kisgen (2009) and has been further recommended in Chang and Dasgupta (2009). According to the CR-CS hypothesis, we expect different implications for credit rating upgrades and downgrades. If firms target a minimum rating, they will react to a downgrade by undertaking financing decisions, which support an upgrade in the subsequent periods. Specifically, we may expect that downgraded firms will be (i) more likely to reduce debt, (ii) less likely to issue debt, (iii) less likely to reduce equity and (iv) more likely to issue equity. Assuming that rating changes are unrelated to changes in financial distress concerns, an upgrade should not significantly affect financing decisions, i.e., the likelihood for adjusting their capital structure through external financing should not be different from zero because upgraded firms will not attempt to reverse the upgrade. Alternatively, if upgrades affect subsequent adjustments of a firm's capital structure, one expects that upgraded firms become more proactive and will be (i) more likely to issue

debt, (ii) less likely to reduce debt, (iii) more likely to reduce equity and (iv) less likely to issue equity.

We estimate the likelihood for debt (equity) increases and reductions with respect to investment grade and speculative grade rating levels separately for rating upgrades and downgrades. Upgrades to investment grade levels should not significantly affect firms' financing decision. In contrast, firms that suffer from downgrades to non-investment grade levels arguably exhibit the highest sensitivity with respect to any type of financing choices.

A.3. Speed of adjustment

The speed of adjustment measures the speed with which a firm adjusts the current debt ratio towards a target debt ratio subsequent to deviations from the target. A positive speed of adjustment implies that firms have a target debt ratio and that a deviation from the target results in a loss of firm value, as predicted by the static version of the trade-off theory (Hovakimian et al., 2001). Assuming that there exists a minimum target rating, downgraded firm may adjust its current debt ratio faster than other firms to maximise firm value and to be in a position for a rating upgrade in future periods. In contrast, one would not expect a higher speed of adjustment for upgraded firms compared to firms with no change in their rating; these firms will not attempt to reverse the upgrade. If financial distress arguments do matter, however, upgraded firms could exhibit a higher adjustment speed than firms whose rating has not been changed because they will issue more debt due to their lower probability of default and their higher debt capacity.

B. Related literature

Graham and Harvey (2001) investigate different aspects of the practice of corporate finance among 392 CFOs of listed and privately-held U.S. firms. They find that financial flexibility and credit ratings are the most important criteria for debt financing choices. Financing decisions through equity are mainly determined by earnings per share dilution and market timing. Graham and Harvey (2001) conclude that the trade-off theory is supported by firms' target debt-to-equity ratios. Furthermore, financial flexibility and market timing considerations are generally consistent with the pecking order theory.

Bancel and Mittoo (2004) survey the financial policy of 87 CFOs of listed firms across sixteen European countries. Similar to the U.S. results, financing decisions through debt are mainly affected by financial flexibility and credit ratings, whereas equity-related financing choices are primarily determined by earnings per share dilution and a target debt-to-equity ratio. Bancel and Mittoo (2004) also document that the institutional environment and a firm's international operations play an important role in debt financing decisions across different countries. They conclude that a firm's capital structure decisions are mainly driven by considerations related to the trade-off theory. Brounen et al. (2006) increase the number of surveyed CFOs to 313, limiting the number of countries to France, Germany, the Netherlands and the United Kingdom as well as including publicly listed and privately-held firms. They reconfirm that Graham and Harvey's (2001) results also hold for European firms, although in some instances to a lower extent, e.g., credit ratings do less affect financing choices particularly of privately-held firms. Moreover, some determinants, such as market timing and signalling considerations as well as takeover behaviour, are not relevant for privately-held firms.

B.1. Capital structure decisions

There is little evidence for the relationship between credit rating changes and capital structure decisions. Kisgen (2006) studies whether there are any differences between plus and minus notch categories (e.g., BB+ and BB-) and flat rating categories (e.g., BB) with respect to capital structure decisions. He finds that firms, which have a plus or minus notch rating and, thus, are close to a credit rating upgrade or downgrade to a different broad rating level issue less net debt relative to net equity during the subsequent period. He further tests the impact of a firm's relative position within a specific rating category (e.g., the lower and upper third within BB) and finds that the broad rating results also hold for these micro rating tests. Firms close to a change to a different rating category (e.g., from BB to BB+), as indicated by a firm's position in the lower or upper third within a specific rating category, issue less net debt relative to net equity to benefit from belonging to a higher-ranked firm group with lower cost of capital. Kisgen (2006) concludes that the broad rating results indicate that firms take into account the costs and benefits related to specific rating levels and the regulatory effects on bond investments. The micro rating results support the interpretation that

managers view credit ratings as providing information and, thus, as a signal of firm's quality.

This initial framework is expanded in Kisgen (2009), where he analyses the relationship between (realised) credit rating changes and the net debt relative to net equity issuances in the subsequent year. Consistent with the CR-CS hypothesis, he shows that credit rating downgrades affect capital structure decisions and result in lower relative net debt issuances. In contrast, credit rating upgrades do not substantially affect issuance decisions because a firm will not attempt to reverse an upgrade (and its related benefits).

For their U.S. and EMEA samples, Michelsen and Klein (2011) use the credit rating outlook rather than notch values or changes in the credit rating to assess the impact of potential subsequent rating changes on capital structure decisions. They report that both a positive and a negative rating outlook result in significantly lower net debt to net equity issuances compared to a stable outlook. U.S. firms exhibit a stronger sensitivity with respect to positive and negative outlooks than EMEA firms. Furthermore, they find that these patterns are more pronounced at investment grade levels and that the economic effect of the lower relative net debt issuance is greater for downgraded than for upgraded firms.

Agha (2011) separates the credit rating change sample into financially flexible and financially inflexible (constrained) firms. He finds that the relative net debt issuances are asymmetric. A credit rating upgrade positively impacts the net debt issuances of financially flexible firms but has no significant impact on financially inflexible firms. A rating downgrade has the opposite effect; while financially inflexible firms exhibit lower net debt to equity issuances, there is no impact on financially flexible firms. Kemper and Rao (2013a, 2013b) find some contrasting results, indicating that credit ratings are not always related to capital structure decisions. Replicating the methodology in Kisgen (2006, 2009), they document that the impact of credit ratings close to either a downgrade or upgrade and the credit watch status depends on the subsample under investigation. They conclude that the association between credit ratings and the relative net debt issuances may be non-significant or even contradictory to what the CR-CS hypothesis suggests.

B.2. Financing choices

Kisgen (2009) analyses financing activities after (realised) credit rating downgrades. He finds that downgraded firms are more likely to reduce debt and less likely to issue debt or reduce equity. Equity issuances are unaffected by downgrades. He concludes that these findings indicate that there exists a minimum target rating; any alternative interpretation cannot fully explain all three financing channels. However, he does not incorporate credit rating upgrades into his logit regressions.

Hovakimian et al. (2009) test whether a deviation from a target rating affects financing choices. They find that firms with a below-(above-)target credit rating are likely to make issuance and repurchase decisions, which will decrease (increase) leverage. These results are more pronounced for ratings below the target. Hovakimian et al. (2009) argue that their results indicate that corporate governance issues outweigh effects arising from debt overhang, i.e., managers prefer better ratings due to the prestige related and the higher job security due to lower probability of default. Managers, thus, tend to increase a firm's rating when it is below target.

Agha (2011) shows that financially flexible firms issue debt rather than equity after a credit rating upgrade. A downgrade, however, does not significantly affect debt or equity issuances. While a downgrade of financially inflexible (constrained) firms has a negative impact on debt issuances but no significant effect on equity issuances, an upgrade has no impact on either debt or equity issuances. Ahga (2011) thus conjectures that Kisgen's (2009) findings may be driven by financially inflexible firms, as these firms are more sensitive with respect to upgrades than to downgrades. In a related study, Hess and Immenkötter (2014) analyse the relationship between financing decisions and debt capacity. They show that issuing debt and repurchasing equity are more likely for firms with a sufficiently large debt buffer. In contrast, firms redeem debt or issue equity when their financial flexibility is limited, i.e., when their rating is likely to be downgraded.

B.3. Speed of adjustment

Flannery and Rangan (2006) analyse the adjustment behaviour towards a target capital structure. Results from a partial adjustment model indicate that there exists a target capital structure, and that firms adjust about one-third per year of the gap towards target leverage. Kisgen (2009) estimates a similar adjustment speed. When the sample

is split into firms with downgrades and upgrades and those with unchanged ratings, his findings suggest that there exists a minimum target rating. Most important, he shows that the speed of adjustment is significantly greater for downgraded firms than upgraded or no change firms.

Byoun (2008) estimates the speed of adjustment conditional on either a financial deficit or a surplus. He reports an adjustment speed of one-third for firms with an above-target debt ratio and a financial surplus as well as about one-fifth for firms with a below-target debt ratio and a financial deficit. The remaining firm groups exhibit much lower adjustment speeds. Moreover, Byoun (2008) splits the sample into firms with an outstanding credit rating and those with no credit rating. He finds that a credit rating positively affects the adjustment speed for above-target debt firms, indicating that it is more costly to maintain the current debt level and/or less costly to reduce debt compared to non-rated firms.

III Data and empirical methodology

A. Data description

Our data is taken from several databases. Financial data for listed companies are from Standard & Poor's Compustat Global and the ratings are from Standard & Poor's RatingsXpress. Financial data for non-listed companies are taken from the Euler Hermes database. Our sample includes rated and non-rated publicly listed U.S. firms and non-rated listed and privately-held German firms over the period from 2002 to 2010. Data for privately-held firms are only available for this period. We exclude firms in the financial (SIC 6000-6799, NACE K) and utility (SIC 4910-4939, NACE D) sectors.[30] To ensure that all variables are calculated identically and based on the same disaggregated data items, we build a balance sheet and income statement model closely following that used in Standard & Poor's Compustat Global and the German HGB (Handelsgesetzbuch) framework to incorporate items that are specific for German

[30] The NACE code refers to the "Statistical Classification of Economic Activities" in the European Community (Nomenclature Statistique des Activités Economiques dans la Communauté Européenne) and is used as the industry classification scheme in the Euler Hermes database.

non-listed firms. Our final dataset contains 3,276 listed companies in the U.S. of which 906 have a public rating. The German sample consists of 655 listed companies and 24,693 privately-held firms. All variables are winsorised at the 1% and 99% levels.

Summary statistics are shown in Table 1. As we focus on the differences between credit rating downgrades and upgrades, the *p*-value for differences are reported for each variable. Firm size does not significantly differ between both groups in all three listed firm samples. Albeit small in magnitude, the difference is statistically significant in the sample of privately-held German firms. Across all samples, downgraded firms are less profitable than upgraded firms. While leverage is lower for the latter group of firms, the equity-to-assets ratio does not substantially differ. Against expectations, the average and median debt (equity) ratios are lower (higher) for firms in Germany than in the U.S. Except for the sample of listed German firms, the ratio of net debt relative to net equity issuances is greater for firms after a credit rating upgrade. The average rating level is only marginally different, with upgraded firms having a higher credit rating by one or two notches.

B. Empirical methodology

B.1. Capital structure decisions

We adopt the basic framework in Kisgen (2009) to test our hypotheses. He estimates the association between credit rating changes and capital structure decisions, measured as the ratio of net debt relative to net equity issuances. We restrict our analyses to specifications where equity is measured as book value of equity because data on the market value of equity is not available for privately-held firms. Moreover, we estimate a fixed effects model both at the firm level and the industry level by year. The latter fixed effect captures time-variant effects across industries. Following Kisgen (2009), we estimate the following model with the ratio of net debt relative to net equity issuances as the dependent variable:

$$[M1a] \quad Firm\ fixed\ effects\ specification: \quad \frac{\Delta D_{i,t} - \Delta E_{i,t}}{AT_{i,t-1}} = \beta_i + \beta_1 DG_{i,t-1} + \beta_2 UG_{i,t-1} + \beta_4 \Delta\left[\frac{D_{i,t-1}}{D_{i,t-1}+E_{i,t-1}}\right] + \beta_6 \Delta\left[\frac{EDA_{i,t-1}}{AT_{i,t-1}}\right] + \beta_8 \Delta\left[log\left(S_{i,t-1}\right)\right] + \varepsilon_{i,t};$$

Table 1 - Descriptive statistics

Panel A - U.S. firms

		U.S. genuine ratings					*U.S. estimated ratings*				
		All firms	Downgrade firms	Delta	Upgrade firms	No change firms	All firms	Downgrade firms	Delta	Upgrade firms	No change firms
No obs		2,635	774		483	1,378	17,143	3,365		4,080	9,698
Size	Mean	7,172	7,050	0.56	6,684	7,411	2,669	2,994	0.36	3,146	2,356
	Median	2,869	2,764	0.84	2,569	3,026	585	640	0.00	727	523
Profitability	Mean	0.223***	0.204***	0.00	0.250***	0.223***	-0.020	0.081***	0.00	0.180***	-0.139***
	Median	0.176***	0.156***	0.00	0.210***	0.180***	0.149***	0.125***	0.00	0.167***	0.149***
Leverage	Mean	0.385***	0.405***	0.00	0.333***	0.391***	0.226***	0.247***	0.01	0.231***	0.217***
	Median	0.331***	0.352***	0.00	0.293***	0.330***	0.162***	0.202***	0.00	0.174***	0.141***
Equity ratio	Mean	0.028***	0.032***	0.09	0.024***	0.027***	0.049***	0.046***	0.65	0.048***	0.051***
	Median	0.001***	0.001***	0.05	0.001***	0.001***	0.001***	0.001***	0.43	0.001***	0.001***
Net debt relative to net equity issuance	Mean	0.016***	-0.006	0.00	0.031***	0.023***	0.018***	0.005**	0.00	0.029***	0.018***
	Median	-0.002*	-0.008***	0.00	-0.001	-0.001	0.000***	0.000***	0.00	0.000**	0.000***
Rating		BB	BB-	0.00	BB+/BB	BB	BB/BB-	BB-	0.00	BB	BB-

Panel B - German firms

		German estimated ratings: listed firms					*German estimated ratings: non-listed firms*				
		All firms	Downgrade firms	Delta	Upgrade firms	No change firms	All firms	Downgrade firms	Delta	Upgrade firms	No change firms
No obs		3,579	794		1,015	1,770	82,024	22,240		25,316	34,468
Size	Mean	2,619	3,315	0.42	2,799	2,203	41	41	0.00	37	44
	Median	106	116	0.95	111	98	7	6	0.02	6	7
Profitability	Mean	0.023	0.014	0.00	0.117***	-0.027	0.090***	0.075***	0.00	0.084***	0.105***
	Median	0.122***	0.096***	0.00	0.129***	0.129***	0.056***	0.048***	0.00	0.056***	0.063***
Leverage	Mean	0.178***	0.230***	0.00	0.188***	0.150***	0.193***	0.221***	0.00	0.189***	0.178***
	Median	0.120***	0.188***	0.00	0.142***	0.064***	0.068***	0.116***	0.00	0.081***	0.031***
Equity ratio	Mean	0.249***	0.220***	0.02	0.263***	0.253***	0.104***	0.098***	0.05	0.103***	0.108***
	Median	0.129***	0.123***	0.14	0.131***	0.131***	0.047***	0.045***	0.00	0.049***	0.047***
Net debt relative to net equity issuance	Mean	0.008***	0.004	0.62	0.008	0.009**	0.028***	0.022***	0.09	0.029***	0.030***
	Median	0.000	-0.001	0.62	-0.001	0.000	0.000***	0.000***	0.00	0.000***	0.000***
Rating		BBB	BB+	0.00	BBB	BBB	BBB-	BB+/BB	0.00	BBB/BBB-	BBB-

The genuine ratings U.S. sample contains listed firms in the U.S. for which a long-term issuer credit rating is available from Standard & Poor's. The estimated ratings U.S. sample includes companies for which a corporate credit rating is estimated through a quantitative model. The parameter estimates are conducted based on the model initially provided in Drobetz and Heller (2014) but recalibrated for listed U.S. firms. The listed (non-listed) German firms sample includes listed (privately-held) companies in Germany where the corporate credit rating is estimated through the original quantitative model provided in Drobetz and Heller (2014). Downgrade firms are firms, which have been downgraded in the previous year; upgrade firms are firms with a credit rating upgrade in year t-1. No change firms are firm,s which have neither been downgraded nor upgraded in the previous year. Size is book total assets in millions of Euros; profitability is defined as earnings before interest, taxes, depreciation and amortisation over revenues; leverage is total debt over beginning-of-year book total assets; equity ratio is defined as nominal capital over beginning-of-year book total assets; net debt relative to net equity issuance is the change in debt throughout the current year minus the change in nominal capital troughout the current year over beginning-of-year book total assets; and rating is the average corporate credit rating. The *p*-value of the difference of a variable between downgraded and upgraded firms is provided in the delta column. All variables are winsorised at the 1% and 99% levels. ***, **, and * denote the significance at the 1, 5 and 10% levels.

$[M1b]$ *Industry effects by year specification* $\frac{\Delta D_{i,t}-\Delta E_{i,t}}{AT_{i,t-1}} =$

$$\beta_0 + \beta_1 DG_{i,t-1} + \beta_2 UG_{i,t-1} + \beta_3 \frac{D_{i,t-1}}{D_{i,t-1}+E_{i,t-1}} + \beta_4 \Delta\left[\frac{D_{i,t-1}}{D_{i,t-1}+E_{i,t-1}}\right] + \beta_5 \frac{EDA_{i,t-1}}{AT_{i,t-1}} +$$

$$\beta_6 \Delta\left[\frac{EDA_{i,t-1}}{AT_{i,t-1}}\right] + \beta_7 log\left(S_{i,t-1}\right) + \beta_8 \Delta\left[log\left(S_{i,t-1}\right)\right] + \beta_9 R_{i,t-1} + \rho_{i,t} + \varepsilon_{i,t},$$

where *D* denotes long-term debt plus short-term debt; *E* is nominal capital; *AT* is book total assets; *DG* (*UG*) is a dummy variable indicating a rating downgrade (upgrade) and equals 1 if a firm's rating has been downgraded (upgraded); *EDA* is earnings before interest, taxes, depreciation and amortisation; *S* is total revenues; *R* is the beginning-of-year credit rating; and ρ is an industry (SIC or NACE) by year dummy variable. Our model omits the market-to-book ratio because the market value of equity is not observable for non-listed companies. We further exclude the z-score, as it is only available for U.S. firms and its original version requires the market value of equity. As the credit rating already indicates a firm's level of risk, we do not expect any bias. The estimated coefficients on the downgrade and upgrade dummy variables exhibit the marginal effects of credit rating changes on capital structure decisions. A negative (positive) sign on a dummy variable indicates that firms issue less (more) net debt relative to net equity after the respective rating change.

B.2. Financing choices

While the ratio of net debt relative to net equity issuances is an aggregate measure of capital structure decisions, we are further interested in whether changes in the capital structure might stem from either debt issuances or reductions or from either issuing or reducing equity. We follow the methodology used in Kisgen (2009) and estimate four logit models, each of them measuring a different financing behaviour. A reduction (issuance) is defined as the net reduction (issuance) throughout the current year exceeding 5% of the actual amount of either debt or equity. In contrast to Kisgen (2009), we incorporate an upgrade dummy variable. We estimate fixed-effect logit models, which allow us to more explicitly measure the impact of credit rating changes on different financing choices. Specifically, we estimate the following models:

$$[M2a]\quad Debt\ reduction: \qquad logit\left(\frac{\Delta D_{it}}{D_{it-1}} < -5\% \middle| \sum_{t=1}^{T} \frac{\Delta D_{it}}{D_{it-1}} = n_{1i}\right) =$$

$$\beta_1 DG_{it-1} + \beta_2 UG_{it-1} + \beta_3 \frac{D_{it-1}}{D_{it-1}+E_{it-1}} + \beta_4 \Delta\left[\frac{D_{it-1}}{D_{it-1}+E_{it-1}}\right] + \beta_5 \frac{EDA_{it-1}}{AT_{it-1}} +$$

$$\beta_6 \Delta\left[\frac{EDA_{it-1}}{AT_{it-1}}\right] + \beta_7 log(S_{it-1}) + \beta_8 \Delta[log(S_{it-1})] + \beta_9 R_{it-1};$$

$$[M2b]\quad Debt\ issuance: \qquad logit\left(\frac{\Delta D_{it}}{D_{it-1}} > 5\% \middle| \sum_{t=1}^{T} \frac{\Delta D_{it}}{D_{it-1}} = n_{1i}\right) =$$

$$\beta_1 DG_{it-1} + \beta_2 UG_{it-1} + \beta_3 \frac{D_{it-1}}{D_{it-1}+E_{it-1}} + \beta_4 \Delta\left[\frac{D_{it-1}}{D_{it-1}+E_{it-1}}\right] + \beta_5 \frac{EDA_{it-1}}{AT_{it-1}} +$$

$$\beta_6 \Delta\left[\frac{EDA_{it-1}}{AT_{it-1}}\right] + \beta_7 log(S_{it-1}) + \beta_8 \Delta[log(S_{it-1})] + \beta_9 R_{it-1};$$

$$[M2c]\quad Equity\ reduction: \qquad logit\left(\frac{\Delta E_{it}}{E_{it-1}} < -5\% \middle| \sum_{t=1}^{T} \frac{\Delta E_{it}}{E_{it-1}} = n_{1i}\right) =$$

$$\beta_1 DG_{it-1} + \beta_2 UG_{it-1} + \beta_3 \frac{D_{it-1}}{D_{it-1}+E_{it-1}} + \beta_4 \Delta\left[\frac{D_{it-1}}{D_{it-1}+E_{it-1}}\right] + \beta_5 \frac{EDA_{it-1}}{AT_{it-1}} +$$

$$\beta_6 \Delta\left[\frac{EDA_{it-1}}{AT_{it-1}}\right] + \beta_7 log(S_{it-1}) + \beta_8 \Delta[log(S_{it-1})] + \beta_9 R_{it-1};$$

$$[M2d]\quad Equity\ issuance: \qquad logit\left(\frac{\Delta E_{it}}{E_{it-1}} > 5\% \middle| \sum_{t=1}^{T} \frac{\Delta E_{it}}{E_{it-1}} = n_{1i}\right) =$$

$$\beta_1 DG_{it-1} + \beta_2 UG_{it-1} + \beta_3 \frac{D_{it-1}}{D_{it-1}+E_{it-1}} + \beta_4 \Delta\left[\frac{D_{it-1}}{D_{it-1}+E_{it-1}}\right] + \beta_5 \frac{EDA_{it-1}}{AT_{it-1}} +$$

$$\beta_6 \Delta\left[\frac{EDA_{it-1}}{AT_{it-1}}\right] + \beta_7 log(S_{it-1}) + \beta_8 \Delta[log(S_{it-1})] + \beta_9 R_{it-1},$$

where *D* denotes long-term debt plus short-term debt; *E* is nominal capital; *DG* (*UG*) is a dummy variable indicating a rating downgrade (upgrade) and equals 1 if a firm's rating has been downgraded (upgraded); *EDA* is earnings before interest, taxes, depreciation and amortisation; *AT* is book total assets; *S* is total revenues; and *R* is the beginning-of-year credit rating. Again, we omit the market-to-book ratio and the z-score. A positive (negative) estimated coefficient on the downgrade and upgrade dummy variables indicates a higher (lower) likelihood either for reducing or issuing debt or for reducing or issuing equity.

B.3. Speed of adjustment

We estimate the partial adjustment model from Flannery and Rangan (2006) but apply a system GMM approach. This approach allows us to take into account that the left-hand side variable may depend on its past realisations, and that the independent variables may not be strictly exogenous (but rather correlated with standard errors over several time periods).[31] Moreover, this approach is particularly designed for panel data with a small number of time periods but a large number of companies. Again, we use book debt ratios instead of market-valued debt ratios because data on the market value of equity is not observable for privately-held companies. Following Kisgen (2009), we estimate the following model separately for all downgraded and upgraded firms as well as for firms with no change in the credit rating:

$$[M3] \quad \frac{D_{i,t}}{AT_{i,t}} =$$

$$\beta_1 \frac{D_{i,t-1}}{AT_{i,t-1}} + \beta_2 \frac{EBIT_{i,t-1}}{AT_{i,t-1}} + \beta_3 \frac{DA_{i,t-1}}{AT_{i,t-1}} + \beta_4 log\left(AT_{i,t-1}\right) + \beta_5 \frac{PPE_{i,t-1}}{AT_{i,t-1}} + \mu_i + \varepsilon_{i,t},$$

where *D* is long-term debt plus short-term debt; *AT* is book total assets; *EBIT* is earnings before interest and taxes; *DA* is depreciation and amortisation; *PPE* is property, plant and equipment; and μ is a firm-fixed effects dummy variable. We again omit the market-to-book ratio due to the unobservable market value for equity for non-listed firms. R&D expenditures are not available in our sample of non-listed German firms. Most important, the speed of adjustment is one minus the coefficient on the book debt ratio in year $t-1$ $(1-\beta_1)$.

Except for the U.S. sample, where Standard & Poor's long-term local currency corporate credit ratings are available, we use estimated credit ratings to determine whether a firm has been downgraded or upgraded in the previous year. We, thus, apply the credit rating model provided in Drobetz and Heller (2014) for listed and non-listed German firms. This model is based on a set of German firms with either a Standard & Poor's or Euler Hermes corporate credit rating and financial ratios, which are contained in the descriptions of methodology provided by both rating agencies. The financial ratios are scored according to the three-year average medians, as described by

[31] See Hovakimian and Li (2012) and Chang and Dasgupta (2009) for a critique of partial adjustment models. The system GMM model is estimated using Roodman's (2009) Stata command *xtabond2*. For each lagged dependent variable, lags up to three years are used as instruments. The standard errors are robust against heteroscedasticity and autocorrelation.

Standard & Poor's. The model is estimated using an ordered logit regression approach. As firm characteristics may differ between the U.S. and Germany, we recalibrate the German-based model parameters using rated U.S. firms. We use the same set of financial ratios but apply different scoring schemes with respect to the published three-year average medians for U.S. firms. The model is then applied to the full U.S. sample (even to those firms without a public rating).[32]

IV Empirical results

A. Capital structure decisions

A.1. U.S. genuine ratings

Our findings for U.S. firms based on genuine rating changes in Panel A of Table 2 are comparable to those in Kisgen (2009). Compared to all other firms, firms, which were downgraded in the previous year issue less net debt relative to net equity. In contrast, the coefficient on the upgrade dummy variable is not statistically significant in any of the two specifications; this observation is consistent with the CR-CS hypothesis that upgrades do not have an impact on capital structure decisions. The results remain similar when we split the dummy variables into investment grade and non-investment grade (speculative) grade rating levels. For example, the variable labelled *downgrade_nig* equals 1 if a firm was downgraded in the prior year and the resulting new rating is non-investment grade (Panel B of Table 2). In the firm fixed effects specification, a rating downgrade to investment grade levels does not significantly impact capital structure decisions but downgrades to speculative grade levels induce firms to issue less net debt relative to net equity. The coefficient on investment grade downgrades also becomes statistically significant in the industry effects by year specification. However, the impact of rating downgrades on net debt issuances relative to net

[32] Kisgen (2009) states in a footnote that he has also applied estimated ratings but that downgrades and upgrades based on these ratings do not predict subsequent capital structure decisions. However, given the significant predictive performance of the credit rating model in Drobetz and Heller (2014) and comparable results between genuine ratings and estimated ratings for firms in the U.S., we do not expect any serious biases from the use of credit rating estimations.

Table 2 - Capital structure decisions and credit rating changes

Panel A - Credit rating changes

	U.S. genuine ratings		*U.S. estimated ratings*		*German estimated ratings: listed firms*		*German estimated ratings: non-listed firms*	
Net debt issuance-net equity issuance	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year
downgrade	-0.031**	-0.025**	-0.019***	-0.010***	-0.034***	0.000	-0.017***	0.000
upgrade	0.016	0.009	0.005	0.012***	-0.007	0.004	-0.003	0.006
lev		-0.082***		-0.020***		-0.052***		-0.047***
d_lev	-0.128***	-0.005	-0.051***	-0.013***	-0.104***	-0.018	-0.094***	-0.022***
ebitda_ta		0.082		-0.003		0.068		0.069***
d_ebitda_ta	0.380***	0.124	0.000	-0.004	-0.096**	-0.074*	-0.039	-0.025
log_sales		-0.004		-0.003***		0.010***		-0.012***
d_log_sales	-0.084**	0.000	0.006	0.030***	0.001	-0.011	-0.003	0.006***
rating		-0.004***		-0.005***		-0.001		-0.002***
intercept	0.029***	0.170***	0.020***	0.107***	0.019***	-0.024	0.033***	0.095***
R-sq	0.32	0.16	0.22	0.06	0.21	0.12	0.30	0.04
No obs	2,635	2,629	17,143	17,068	3,579	3,532	82,024	82,024

Panel B - Credit rating changes to investment grade/speculative grade levels

	U.S. genuine ratings		*U.S. estimated ratings*		*German estimated ratings: listed firms*		*German estimated ratings: non-listed firms*	
Net debt issuance-net equity issuance	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year
downgrade_ig	-0.015	-0.022**	0.004	-0.013*	-0.022**	-0.006	0.010	0.009
downgrade_nig	-0.037**	-0.026**	-0.021***	-0.010***	-0.045***	0.004	-0.032***	-0.004
upgrade_ig	0.026	0.002	0.006	0.006	-0.006	0.003	0.007	0.006
upgrade_nig	0.011	0.013	0.005	0.014***	-0.014	0.010	-0.023***	0.004
lev		-0.082***		-0.020***		-0.051***		-0.047***
d_lev	-0.128***	-0.004	-0.051***	-0.013***	-0.105***	-0.018	-0.094***	-0.021***
ebitda_ta		0.081		-0.005		0.068		0.068***
d_ebitda_ta	0.384***	0.126	-0.002	-0.004	-0.101**	-0.070	-0.048**	-0.028
log_sales		-0.004		-0.003***		0.010***		-0.012***
d_log_sales	-0.085**	0.000	0.006	0.030***	0.000	-0.011	-0.003	0.006***
rating		-0.004***		-0.006***		-0.001		-0.002*
intercept	0.029***	0.171***	0.020***	0.111***	0.019***	-0.020	0.034***	0.091***
R-sq	0.32	0.16	0.22	0.06	0.21	0.12	0.30	0.04
No obs	2,635	2,629	17,143	17,068	3,579	3,532	82,024	82,024

The sample selections are the same as described in Table 1. Models M1a and M1b are separately estimated for each sample. lev is leverage in year t-1, as defined through the total debt over total debt plus nominal capital ratio; ebitda_ta denotes profitability in year t-1, as defined through earnings before interest, taxes, depreciation and amortisation over book total assets; log_sales is logarithmic revenues in year t-1; and rating is the previous year's beginning-of-year credit rating. d_[variable] is the change in the respective variable from year t-2 to t-1. downgrade (upgrade) is a dummy variables equalling 1 if the firm has been downgraded (upgraded) over the previous year. [credit rating change]_ig and [credit rating change]_nig denote credit rating changes where the resulting credit rating is at investment grade (ranging from AAA to BBB-) and non-investment grade (ranging from BB+ to CCC/C) levels, respectively. The dependent variable is the net debt relative to net equity issuance and is defined through the change in debt throughout the current year minus the change in nominal capital troughout the current year over beginning-of-year book total assets. The models are estimated using time-series cross-sectional fixed effects regressions. All variables are winsorised at the 1% and 99% levels. ***, **, and * denote the significance at the 1, 5 and 10% levels.

equity issuances is slightly higher for speculative grade levels than for investment grade levels. Rating upgrades generally do not have a significant effect on capital structure decisions.

The interpretation of our results is similar to Kisgen (2009). Firms pursue a minimum target rating and will reduce leverage if this target rating is jeopardised. This notion particularly holds for non-investment grade ratings, where the cost of capital disproportionately increases with lower credit ratings (van Binsbergen et al., 2010). The industry effects by year specification supports the evidence; our results remain qualitatively the same when we control for exogenous industry shocks, e.g., a limited supply of external financing to an industry due to weak economic industry-specific conditions or a weak economic outlook not conditional on firm-specific characteristics. In contrast, a credit rating upgrade does not affect capital structure decisions arguably because firms do not take into account the lower financial distress concerns associated with an upgrade. Moreover, one does not expect that firms will try to reverse the achieved rating upgrade.

A.2. U.S. estimated ratings

Our results are similar for U.S. firms when credit rating changes are determined through estimated ratings (rather than using the genuine ratings). However, the impact of credit rating downgrades is slightly lower and the upgrade dummy variable becomes statistically significant in the industry effects by year specification. Splitting the dummy variables into investment grade and speculative grade levels reveals that the positive estimated coefficient on the upgrade dummy variable stems from the non-investment grade firms. Downgrades to investment grade levels affect capital structure decisions less than downgrades to speculative grade levels, indicating that there may exist a minimum target rating. The results further suggest that non-investment grade downgrades induce firms to undertake financing activities due to an excessive increase in the cost of capital. Overall, our interpretation for the U.S. genuine rating results also holds for the estimated ratings sample.

A.3. German estimated ratings: listed firms

For listed German firms, we find a much weaker relationship between rating changes and capital structure decisions. The coefficients on the downgrade dummy variables, both at investment grade and speculative grade levels, are only significantly negative

in the firm fixed effects specification. Capital structure decisions are not significantly affected by rating upgrades. We conclude that capital structure choices for listed German firms are more or less independent from credit rating changes. In fact, the significant coefficient on the downgrade dummy variable in the firm fixed effects specification becomes insignificant once time-variant industry effects are incorporated, indicating that only exogenous industry shocks may substantially affect capital structure decisions of downgraded firms. Arguably, this effect will be more pronounced at speculative grade levels in crises times when external financing is mainly allocated to high creditworthiness firms.

A.4. German estimated ratings: non-listed firms

We find some different patterns for non-listed German firms. In particular, the coefficient on the downgrade dummy variable is significantly negative in the firm fixed effects specification, while upgrades do not affect capital structure decisions. Downgraded firms issue less net debt relative to net equity compared to all other firms. However, the additional dummy variable split uncovers some differences to our previous findings. Firms downgraded and upgraded to investment grade levels do not exhibit subsequent capital structure decisions. At speculative grade levels, however, the relationship between rating changes – both downgrades and upgrades – and the net debt relative to net equity is significantly negative in the firm fixed effects specification. This relationship vanishes when time-variant industry effects are included.

In general, access to external financing of privately-held high creditworthiness firms in Germany is more or less insensitive to rating changes. However, following either downgrades or upgrades, speculative grade rated firms attempt to improve that rating in order to lower their cost of capital. Time-variant industry level shocks seem to magnify these patterns.

A.5. Summary

In our U.S. sample, credit rating upgrades do not affect subsequent capital structure decisions of publicly listed firms. Firms react strongest to downgrades to non-investment grade levels but this relationship weakens for downgrades to investment grade levels. Our findings support Kisgen (2009), suggesting that firms try to reverse a downgrade to speculative grade levels as the cost of capital disproportionately increases with lower creditworthiness. The results for downgrades do not per se imply

the existence of a minimum target rating, albeit this interpretation seems most valid for the lowest level of creditworthiness firms. These patterns are less distinct for listed firms in Germany; the negative relationship between the net debt relative to net equity issuance and credit rating downgrades no longer shows up once time-variant industry effects are included. Our results for privately-held German firms are notably different. Capital structure decisions of firms with high creditworthiness, i.e., with a rating at investment grade levels, are insensitive to changes in their level of creditworthiness. However, at speculative grade levels, firms react to both, downgrades and upgrades. These firms may try to avoid negative effects from a downgrade or further strengthen their capital structure following an upgrade to achieve an investment grade rating. However, these findings disappear when we control for time-variant economic shocks at the industry level.

We interpret our results for German firms with respect to their close relationship with financial intermediaries in a bank-based economy. First, both, listed and non-listed German firms may be less sensitive to rating downgrades because they are better monitored by banks and other financial intermediaries, thus access to external finance is less dependent on adverse selection problems (Leland and Pyle, 1977; Gorton and Schmid, 2000; Aggarwal and Zong, 2006). Second, given their strong relationship with financial intermediaries but limited access to public capital markets, high creditworthy privately-held firms may be least sensitive to changes in their creditworthiness. These firms generally raise debt through loans from their house-bank, which may have a high level of collateral and are senior to other financing instruments (Khieu et al., 2012; Mora, 2012). An improving creditworthiness does not affect capital structure decisions; these firms will not implement financial decisions immediately following an upgrade because they want to preserve their higher debt capacity. Moreover, term loans are generally amortised over a longer period of time and may not be repaid before maturity. At speculative grade levels, however, a rating upgrade may trigger an opposite reaction because these firms try to further lower their cost of capital and issue less net debt relative to net equity. A worsening creditworthiness to investment grade levels has an immediate effect on the capital structure in case the corresponding financial covenants are broken. In general, low creditworthiness firms arguably react strongest to a downgrade because they only have limited possibility to issue debt and may even be forced to redeem debt, e.g., because the obligee has a contractual right to

require redemption due to an imminent breach of financial covenants (Bradley and Roberts, 2004; Demiroglu and James, 2010).

B. Financing choices

B.1. U.S. genuine ratings

In the U.S. sample based on genuine ratings, our results are comparable to those in Kisgen (2009) for both, debt issuances and reductions, i.e., it is more likely that a downgraded firm will reduce its debt in the subsequent year, and the firm is less likely to issue debt (Panel A in Table 3). Debt financing is not significantly affected by upgrades. Furthermore, a downgrade does not significantly affect equity issuances or reductions. Firms with an improving creditworthiness, however, are less likely to reduce equity. Splitting the sample, we observe that the positive coefficient on debt reductions for downgrades only stems from non-investment grade level firms and the coefficient becomes insignificant for downgrades to investment grade levels (Panel B in Table 3). Upgrades, both to investment grade and speculative grade levels, do not affect the likelihood for debt reductions. Similarly, debt issuances are only negatively affected by downgrades to non-investment grade levels. The estimated coefficients on equity reductions subsequent to downgrades and upgrades depend on the model specification.

Taken together, our findings indicate that firms attempt to strengthen their capital structure after a downgrade. This is most pronounced for downgrades to non-investment grade levels. These firms undertake debt financing activities, which seem to have a stronger impact on reversing that downgrade than equity-related capital structure changes. Moreover, a downgrade also prevents firms from issuing additional debt, and this particularly holds for speculative grade ratings. In contrast, firms at investment grade levels possibly react less sensitive to a downgrade as the cost of capital increases only slightly at higher rating levels. These results are consistent with our findings in Table 2.

B.2. U.S. estimated ratings

Our results for the model using the estimated U.S. ratings (rather than the genuine ratings) are qualitatively similar for firms, which were downgraded in the previous year. Downgrades to speculative grade levels again have the largest impact on debt

Table 3 - Financing choices and credit rating changes

Panel A - Credit rating changes

	U.S. genuine ratings				*U.S. estimated ratings*				*German estimated ratings: listed firms*				*German estimated ratings: non-listed firms*			
Dependent variable =0/1	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity
downgrade	0.240*	-0.368**	0.161	0.027	0.242***	-0.207***	-0.159	0.058	0.130	-0.109	0.058	0.402**	0.133***	-0.226***	-0.148	-0.111
upgrade	-0.033	0.185	-0.639*	-0.104	-0.019	0.085	-0.020	-0.147*	-0.058	0.252*	0.262	-0.186	-0.157***	0.173***	0.255*	0.078
lev	7.331***	-3.156	-12.375***	3.654*	0.570**	-1.651***	-1.634***	0.377	2.605***	-3.478***	-0.517	1.965**	4.911***	-6.166***	-3.402***	4.223***
d_lev	-2.337	1.801	2.457	0.181	-0.360**	0.362*	-0.134	0.267	-0.985**	1.255***	0.198	0.159	-0.741***	0.660***	-1.447***	-0.189
ebitda_ta	-2.666**	2.686	0.702	-0.048	-0.709	0.812	-1.404	1.096*	0.351	-0.124	-4.107	0.480	-0.680**	1.012***	-5.949***	0.943
d_ebitda_ta	-1.569	1.840	0.342	-0.986	-0.043	-0.240	1.488**	-0.915*	1.457	-1.865**	3.949	1.352	0.045	-0.130	1.137	-0.215
log_sales	0.256	-0.644**	1.447**	-0.043	0.385***	-0.555***	0.039	-0.813***	-0.253	0.455*	-0.413	-0.960***	0.098**	-0.060	1.042***	-0.241**
d_log_sales	-0.185	-0.145	-1.149*	-0.063	-0.235**	0.258**	-0.141	0.483***	-0.075	0.283	-0.547	0.226	-0.060**	0.068**	-0.584***	0.182**
rating	0.128**	-0.157**	0.104	0.325***	0.179***	-0.261***	-0.208***	0.185***	0.146***	-0.108*	-0.171	0.009	0.113***	-0.154***	-0.080	-0.033
Pseudo R-sq	0.04	0.03	0.08	0.03	0.01	0.02	0.02	0.04	0.04	0.05	0.05	0.05	0.04	0.06	0.08	0.04
No obs	1,377	1,193	375	748	8,854	7,716	2,339	5,090	1,930	1,780	164	1,022	25,704	23,865	2,296	3,331

Panel B - Credit rating changes to investment grade/speculative grades levels

	U.S. genuine ratings				*U.S. estimated ratings*				*German estimated ratings: listed firms*				*German estimated ratings: non-listed firms*			
Dependent variable =0/1	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity
downgrade_ig	0.096	-0.144	-1.440*	-0.693	-0.073	0.127	-0.031	0.195	0.054	-0.023	0.027	0.332	0.034	-0.133**	-0.125	-0.024
downgrade_nig	0.275*	-0.442**	0.336	0.132	0.271***	-0.243***	-0.174	0.056	0.219	-0.194	0.046	0.447**	0.162***	-0.254***	-0.165	-0.126
upgrade_ig	-0.454	0.312	-0.810	-0.334	0.166	-0.044	0.024	-0.038	0.014	0.251	0.149	-0.222	-0.183***	0.173***	0.176	0.222*
upgrade_nig	0.220	0.095	-0.618	-0.009	-0.077	0.128	-0.038	-0.166*	-0.381	0.242	0.776	-0.059	-0.124***	0.170***	0.355**	-0.080
lev	7.264***	-3.199	-14.168***	3.506*	0.571**	-1.651***	-1.635***	0.378	2.662***	-3.502***	-0.554	1.976**	4.902***	-6.165***	-3.416***	4.309***
d_lev	-2.250	1.810*	2.190	0.176	-0.362**	0.356*	-0.133	0.267	-0.990**	1.253***	0.240	0.152	-0.739***	0.658***	-1.440***	-0.193
ebitda_ta	-2.828**	2.637	-0.164	0.116	-0.703	0.819	-1.401	1.113*	0.402	-0.160	-4.190	0.507	-0.634*	0.977***	-5.952***	0.781
d_ebitda_ta	-1.486	1.909	0.136	-1.186	0.036	-0.322	1.478*	-0.917*	1.458	-1.915**	4.026*	1.373	0.048	-0.133	1.120	-0.165
log_sales	0.288	-0.645**	1.542**	-0.061	0.383***	-0.553***	0.037	-0.815***	-0.243	0.454*	-0.418	-0.964***	0.097**	-0.058	1.045***	-0.250**
d_log_sales	-0.196	-0.173	-1.069	0.002	-0.237**	0.259**	-0.141	0.483***	-0.081	0.274	-0.549	0.232	-0.060**	0.068**	-0.588***	0.184**
rating	0.108*	-0.145*	0.092	0.300***	0.180***	-0.258***	-0.205***	0.190***	0.159***	-0.105*	-0.189	0.003	0.109***	-0.152***	-0.087	-0.021
Pseudo R-sq	0.05	0.04	0.09	0.04	0.01	0.02	0.02	0.04	0.04	0.05	0.05	0.05	0.04	0.06	0.08	0.04
No obs	1,377	1,193	375	748	8,854	7,716	2,339	5,090	1,930	1,780	164	1,022	25,704	23,865	2,296	3,331

The sample selections and the explanatory variables are the same as described in Tables 1 and 2, respectively. Models M2a through M2d are estimated separately for each sample. The dependent variables are dummy variables equalling 1 if the firms has undertaken either a net issuance or net reduction throughout the current year exceeding 5% of the actual amount of either debt or equity. The models are estimated using fixed effects logistic regressions. All variables are winsorised at the 1% and 99% levels. ***, **, and * denote the significance at the 1, 5 and 10% levels.

issuance or redemption decisions. Financing choices through equity are only marginally affected. The coefficient on the upgrade dummy variable becomes insignificant for equity reductions but significantly negative for equity issuances. Contrary to the U.S. sample based on genuine ratings, a downgrade to investment grade levels does not impact equity reductions. The negative coefficient on upgrades for equity issuances is attributable to upgrades to non-investment grade levels.

B.3. German estimated ratings: listed firms

For listed German firms, the likelihood to issue equity is higher after a downgrade to non-investment grade levels. The remaining coefficients are statistically insignificant. These findings are consistent with the results already presented in Table 2, i.e., the relationship between credit rating changes and financing decisions is weak. Given their strong relationship to banks and their access to financing through capital markets, the financing activities of listed firms are largely independent from rating changes.

B.4. German estimated ratings: non-listed firms

Similar to the U.S. results, downgrades of privately-held firms in Germany significantly affect financing choices through debt; it is more (less) likely that firms reduce (issue) debt following a rating downgrade. The coefficients on the upgrade dummy variable indicate that it is less likely that a firm will reduce debt and more likely that it will issue debt and reduce equity. Furthermore, as shown in Panel B of Table 3, a downgrade to investment grade levels negatively affects debt issuances. A downgrade to speculative grade levels raises the likelihood for debt reductions and reduces the likelihood for debt issuances. In contrast, it is less (more) likely that firms reduce (issue) debt after an upgrade, both to investment grade and speculative grade levels. In addition, equity reductions (issuances) are more likely following upgrades to non-investment (investment) grade levels.

Our results for downgrades are again consistent with Table 2, where a downgrade to speculative grade levels significantly affects subsequent financing choices and has a negative aggregate effect (lower net debt relative to net equity issuances) on the changes in a firm's capital structure. A downgrade to investment grade levels only marginally impacts financing decisions. The leverage increasing financing transactions following upgrades to investment grade levels may be balanced out by subsequent equity issuances, resulting in an insignificant aggregate effect on capital struc-

ture choices. However, our findings for upgrades to speculative grade levels are in contrast to those in Table 2, suggesting a negative association between credit rating changes and capital structure decisions. In fact, the patterns in Table 3 suggest that the aggregate effect of an upgrade on a firm's capital structure (the net debt relative to net equity issuances) could even be positive.

B.5. Summary

The financing choices of listed firms are substantially affected by previous year's credit rating changes. In the U.S. sample, downgrades primarily affect financing choices through debt. Our results show that firms react strongest to downgrades to non-investment grade levels and subsequently implement debt-related financing activities, arguably to strengthen their capital structure. We further conjecture that a lower likelihood of debt issuances for those firms partly results from a restricted access to external financing (financial constraints), i.e., they issue less debt not only because they seek to reverse that downgrade but rather because capital markets provide less external capital to these firms due to risk-averse investment strategies or regulatory restrictions. These findings support the interpretation from our capital structure decisions tests that there exists a minimum target rating, and this target behaviour is more pronounced when the cost of capital sharply increases at lower rating levels. Changes in a firm's equity are only marginally driven by downgrades. While German listed companies are least sensitive to changes in their creditworthiness, we find different patterns for German privately-held firms. High creditworthiness firms in the latter group, both downgraded and upgraded ones, exhibit comparable patterns; their financing activities only have a marginal impact on their capital structure either because the overall effect is weak or because individual effects are opposing. The financing choices of low creditworthy firms differ. Our results for downgrades to non-investment grade levels are similar to the U.S., i.e., these firms try to avoid any subsequent negative implications related to that downgrade by reducing leverage. Our findings for the financing choices of firms that have been upgraded to speculative grade levels are inconsistent with those shown for capital structure decisions. While the capital structure decision test in Table 2 indicates a negative relationship, the financing choices test in Table 3 rather suggests a positive aggregate effect (net debt relative to net equity issuances) on the capital structure.

C. Speed of adjustment

C.1. U.S. genuine ratings

The adjustment speed for U.S. firms in Panel A of Table 4 is slightly lower than that reported in Flannery and Rangan (2006) for book debt ($1 - 0.719 = 0.281$ versus 0.361). Moreover, compared to Kisgen (2009), we report different patterns for the speed of adjustment of downgraded and upgraded firms using the system GMM approach. In particular, our findings suggest that firms, which have been downgraded in the previous year exhibit a substantially lower speed of adjustment than firms subsequent to an upgrade. This result stands in contrast to Kisgen (2009) who reports higher adjustment speeds for downgraded firms.

A higher adjustment speed following an upgrade implies that these firms are more active in adjusting their capital structure than downgraded firms. Upgrades ease the access to external financing (and new debt issuances) and are indispensably related to a stable and high operating and financial performance, further allowing these firms to redeem outstanding debt. As a result, they can more easily close the gap between their actual debt ratio and target leverage; this is also consistent with our earlier findings for capital structure decisions and financing choices in that upgraded firms are less sensitive to this rating change. In contrast, we expect that the operating and financial performance of downgraded firms is more volatile and fragile. They cannot easily redeem outstanding debt and access to external financing is more restricted, thus their speed of adjustment is lower.

Panel B of Table 4 further shows that downgraded firms whose actual debt ratio is above their target debt ratio exhibit a higher speed of adjustment than firms with a below-target debt ratio, indicating that redeeming debt is still easier than issuing new debt for this group of firms. There is little difference between above-target and below-target firms following an upgrade. When we further split the full sample into investment grade and non-investment grade ratings in Panel C of Table 4, our results show that the adjustment speed is lowest for firms that were downgraded to speculative grade levels; this pattern is consistent with their capital structure decisions and financing choices. These firms are least likely to implement leverage-increasing financing activities and more likely to redeem outstanding debt, although their ability to redeem

Table 4 - Speed of adjustment and credit rating changes

Panel A - Credit rating changes

	U.S. genuine ratings				*U.S. estimated ratings*			
Book debt ratio	All firms	Downgrade firms	Upgrade firms	No change firms	All firms	Downgrade firms	Upgrade firms	No change firms
bdr	0.719***	0.903***	0.569***	0.624***	0.735***	0.784***	0.654***	0.752***
ebit_ta	-0.137**	0.176	-0.098	-0.167*	-0.088**	0.122*	0.090	-0.098**
da_ta	0.577	-0.392	0.757	0.640	-0.131	-0.379	-0.504	-0.145
log_ta	0.019***	0.012***	0.014***	0.026***	0.012***	0.009***	0.010**	0.013***
ppe_ta	-0.157	-0.139	-0.065	-0.183*	0.022	0.099	0.044	0.012
F-Test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No obs	2,354	664	449	1,241	14,021	2,853	3,336	7,832
Adjustment speed	0.281	0.097	0.431	0.376	0.265	0.216	0.346	0.248

Panel B - Credit rating changes of underleveraged/overleveraged firms

	U.S. genuine ratings				*U.S. estimated ratings*			
Book debt ratio	Downgrade firms below target	Downgrade firms above target	Upgrade firms below target	Upgrade firms above target	Downgrade firms below target	Downgrade firms above target	Upgrade firms below target	Upgrade firms above target
bdr	0.825***	0.683***	0.445***	0.428***	0.672***	0.338***	0.628***	0.447***
ebit_ta	0.349***	0.401**	-0.137	-0.208**	0.072	0.224***	0.213	-0.028
da_ta	-0.918	-0.267	1.155*	0.202	-0.421	-0.966***	-0.003	-0.603***
log_ta	0.037***	0.019***	0.024***	0.011***	0.031***	0.003	0.018**	0.008***
ppe_ta	-0.266**	-0.465***	0.005	0.033	0.215	0.313***	0.074	0.029
F-Test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No obs	223	441	246	203	691	2,162	1,370	1,966
Adjustment speed	0.175	0.317	0.555	0.572	0.328	0.662	0.372	0.553

Panel C - Credit rating changes to investment grade/speculative grade levels

	U.S. genuine ratings				*U.S. estimated ratings*			
Book debt ratio	Downgrade firms investment grade	Downgrade firms non-investment grade	Upgrade firms investment grade	Upgrade firms non-investment grade	Downgrade firms investment grade	Downgrade firms non-investment grade	Upgrade firms investment grade	Upgrade firms non-investment grade
bdr	0.676***	0.913***	0.863***	0.534***	0.822***	0.778***	0.726***	0.675***
ebit_ta	0.247	0.177	-0.082	-0.165	0.162	0.134**	-0.099	0.105
da_ta	0.647	-0.594	0.32	0.819	0.237	-0.398	0.026	-0.630*
log_ta	0.006	0.017***	0.002	0.021***	0.005*	0.009**	0.015**	0.009**
ppe_ta	-0.016	-0.213	0.062	-0.107	-0.110	0.112	-0.152	0.075
F-Test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No obs	169	495	146	303	179	2,674	628	2,708
Adjustment speed	0.324	0.087	0.137	0.466	0.178	0.222	0.274	0.325

Table 4 - Speed of adjustment and credit rating changes (cont'd)

Panel A - Credit rating changes (cont'd)

	German estimated ratings: listed firms				*German estimated ratings: non-listed firms*			
Book debt ratio	All firms	Downgrade firms	Upgrade firms	No change firms	All firms	Downgrade firms	Upgrade firms	No change firms
bdr	0.788***	0.620***	0.600***	0.760***	0.630***	0.531***	0.313***	0.599***
ebit_ta	-0.094***	0.095	-0.099	-0.164***	-0.019*	0.256***	0.012	-0.051**
da_ta	0.337***	0.892***	0.386*	0.052	-0.059	0.377***	0.042	-0.115
log_ta	0.010***	0.013***	0.018***	0.012***	0.006***	0.008***	0.006***	0.005***
ppe_ta	-0.004	0.009	-0.116	0.088	0.047***	-0.012	0.193***	0.110***
F-Test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No obs	2,930	650	828	1,452	55,729	15,128	16,648	23,953
Adjustment speed	0.212	0.380	0.400	0.240	0.370	0.469	0.687	0.401

Panel B - Credit rating changes of underleveraged/overleveraged firms (cont'd)

	German estimated ratings: listed firms				*German estimated ratings: non-listed firms*			
Book debt ratio	Downgrade firms below target	Downgrade firms above target	Upgrade firms below target	Upgrade firms above target	Downgrade firms below target	Downgrade firms above target	Upgrade firms below target	Upgrade firms above target
bdr	0.511***	0.307***	0.603***	0.418***	0.492***	0.142***	0.110***	0.658***
ebit_ta	-0.261**	0.303***	-0.102	-0.107*	-0.034	0.288***	0.284***	-0.022
da_ta	1.581***	0.523*	0.963***	0.097	0.020	0.307***	0.284***	-0.140***
log_ta	0.036***	0.017***	0.032***	0.010***	0.019***	0.003***	0.019***	0.001
ppe_ta	0.045	-0.102	-0.237**	0.001	0.078***	-0.006	0.223***	0.008
F-Test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No obs	197	453	372	456	5,708	9,420	6,528	10,120
Adjustment speed	0.489	0.693	0.397	0.582	0.508	0.858	0.890	0.342

Panel C - Credit rating changes to investment grade/speculative grade levels (cont'd)

	German estimated ratings: listed firms				*German estimated ratings: non-listed firms*			
Book debt ratio	Downgrade firms investment grade	Downgrade firms non-investment grade	Upgrade firms investment grade	Upgrade firms non-investment grade	Downgrade firms investment grade	Downgrade firms non-investment grade	Upgrade firms investment grade	Upgrade firms non-investment grade
bdr	0.519***	0.706***	0.333***	0.620***	0.564***	0.482***	0.233***	0.503***
ebit_ta	0.537***	0.034	0.116	-0.059	-0.008	0.355***	0.043**	0.017
da_ta	-0.134	0.839**	0.054	0.860*	0.196*	0.429***	0.002	0.001
log_ta	0.011**	0.013***	0.018***	0.030*	0.004***	0.010***	0.004***	0.009***
ppe_ta	-0.067	0.053	-0.100	-0.158	0.061	-0.014	0.173***	0.176**
F-Test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No obs	319	331	668	160	5,159	9,969	11,214	5,434
Adjustment speed	0.481	0.294	0.667	0.380	0.436	0.518	0.767	0.497

The sample selections are the same as described in Table 1. Each sample is further subdivided according to different criteria. In Panel A, firms are classified according to the previous year's change in their credit rating. The sample split in Panel B is based on the level of deviation from the target debt ratio in the previous year. In Panel C, the respective sample is subdivided with respect to the level of creditworthiness in year t-1. Model M3 is separately estimated for each subsample. ebit_ta is the profitability in year t-1, as defined through earnings before interest and taxes over book total assets; da_ta denotes depreciation and amortisation throughout the previous year over book total assets; log_at is logarithmic book total assets in year t-1; ppe_ta is the previous year's portion of tangible fixed assets, as defined through property, plant and equipment over book total assets. bdr denotes the book debt ratio in year t-1, as defined through total debt over book total assets. The dependent variable is the current year's book debt ratio. The model is estimated using system GMM. All variables are winsorised at the 1% and 99% levels. ***, **, and * denote the significance at the 1, 5 and 10% levels.

debt might be limited due to their lower operating and financial performance. We again conclude that there exists a minimum target rating as suggested by the CR-CS hypothesis. However, the implications of the CR-CS hypothesis are weakened because credit rating upgrades affect firms' speed of adjustment and, thus, their subsequent capital structure choices. Our results are – at least to a certain extent – driven by differences in the operating and financial performance between downgraded and upgraded firms.

C.2. U.S. estimated ratings

Our U.S. results are qualitatively similar for estimated ratings (rather than the genuine ratings). Most important, the speed of adjustment of downgraded firms is lower than that of upgraded firms. A downgrade may prevent firms to partially adjust their capital structure over time due to their low operating and financial performance that is usually related to a downgrade. The results for investment grade and speculative grade downgrades are slightly different to those in the genuine ratings sample as the speed of adjustment at investment grade levels is lower than at non-investment grade levels, albeit the difference is low. Also in contrast to the findings for U.S. genuine ratings, over- and underleveraged firms subsequent to a credit rating upgrade exhibit a more pronounced difference in their adjustment speeds (overleveraged firms adjusting faster than underleveraged firms; Byoun, 2008). This result indicates that upgraded firms try to lock in their achieved rating level by subsequently reducing leverage.

C.3. German estimated ratings: listed firms

The speed of adjustment of listed German firms following an upgrade is similar to that in the U.S. However, downgraded German firms can more easily adjust their capital structure as their speed of adjustment is about four (two) times as high as that in the genuine (estimated) ratings U.S. sample. Most important, listed firms in Germany exhibit a symmetric behaviour with respect to rating changes as their adjustment speed differs only marginally between downgrades and upgrades; this observation is consistent with the interpretation of our findings for their capital structure and financing choices. Finally, our results for the adjustment speed of German listed firms subsequent to downgrades (upgrades) to investment and speculative grade levels as well as for firms with below-target and above-target debt ratios are similar to the U.S. results.

C.4. German estimated ratings: non-listed firms

Privately-held German firms exhibit the highest speed of adjustment across all firms in our sample; this observation holds for both, downgraded and upgraded firms. Upgraded firms are again able to adjust faster towards their target leverage ratio than downgraded firms. Presumably, this effect is attributable to these firms' superior operating and financial performance. Surprisingly, the speed of adjustment is lower after downgrades to investment grade levels but the difference to non-investment grade levels is small. This result is consistent with our earlier finding that the financing choices between firms, which were downgraded to investment grade or non-investment grade levels differ only marginally, although the aggregate effect on their capital structure decisions is more pronounced for the latter group of firms. Our findings for the financing choices of low and high creditworthy firms following a downgrade may be explained by the close relationship to banks and other financial intermediaries, even allowing low creditworthy firms to implement financing activities that help them to adjust their actual capital structure towards the target. The adjustment speed of below-target firms following an upgrade is much higher than that of above-target firms, indicating that they are more likely to issue debt (if underleveraged) rather than repay it (if overleveraged). Similar to listed German firms, privately-held firms' adjustment speed is lower after upgrades to non-investment grade levels. This result is consistent with our findings in Table 3 that firms will issue debt rather than reduce debt after an upgrade. However, it again stands in contrast to the results in Table 2, indicating that firms exhibit negative net debt relative to net equity issuances after an upgrade to non-investment grade levels.

C.5. Additional sample splits

We investigate these conflicting patterns for privately-held firms in Germany by further dividing the estimates for capital structure and financing choices with respect to the deviation from the target debt ratio in Panels A and B of Table 5. In particular, we split the sample into firms with a deviation of at least 20% (both, below-target and above-target) and those with a deviation not exceeding 20%.[33] We find similar pat-

[33] The results remain qualitatively unchanged when we apply alternative thresholds. However, the findings are more pronounced for greater thresholds. Control variables are included in the regressions but not reported.

Table 5 - Capital structure decisions and financing choices of German non-listed firms subject to the deviation from target debt ratio and credit rating changes

Panel A - Capital structure decisions

	Deviation greater than 0.2		*Deviation smaller than 0.2*	
Net debt issuance-net equity issuance	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year
downgrade_ig	0.020	0.003	0.012	0.010
downgrade_nig	-0.039*	-0.002	-0.027***	-0.015**
upgrade_ig	0.021	0.016**	0.006	0.005
upgrade_nig	-0.003	0.023***	-0.028**	-0.014*
R-sq	0.54	0.07	0.46	0.05
No obs	37,125	37,125	44,899	44,899

Panel B - Financing choices

	Deviation greater than 0.2				*Deviation smaller than 0.2*			
Dependent variable =0/1	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity
downgrade_ig	-0.087	-0.137	-0.319	-0.336	0.069	-0.143*	-0.348	0.080
downgrade_nig	0.222***	-0.317***	0.023	-0.016	0.180***	-0.237***	-0.355	-0.086
upgrade_ig	-0.187	0.262*	0.625	0.211	-0.274***	0.214***	0.096	0.256
upgrade_nig	-0.118	0.182**	0.345	-0.014	-0.218***	0.250***	0.472*	-0.022
Pseudo R-sq	0.04	0.07	0.13	0.05	0.08	0.10	0.11	0.04
No obs	6,178	6,262	391	862	11,768	10,683	1,077	1,292

Panel C - Capital structure decisions

	Deviation smaller than 0.2 & below target		*Deviation smaller than 0.2 & above target*	
Net debt issuance-net equity issuance	Firm fixed effects	Industry effects by year	Firm fixed effects	Industry effects by year
downgrade_ig	-0.005	0.001	0.034	-0.022
downgrade_nig	-0.018**	-0.019***	-0.038*	-0.047***
upgrade_ig	0.002	0.017***	0.047**	-0.012
upgrade_nig	-0.025***	-0.010	-0.015	-0.018
R-sq	0.65	0.05	0.82	0.18
No obs	32,092	32,092	12,807	12,807

Panel D - Financing choices

	Deviation smaller than 0.2 & below target				*Deviation smaller than 0.2 & above target*			
Dependent variable =0/1	Reduce debt	Issue debt	Reduce equity	Issue equity	Reduce debt	Issue debt	Reduce equity	Issue equity
downgrade_ig	0.035	-0.015	-0.387	-0.375	-0.033	-0.201	-1.034*	0.804*
downgrade_nig	0.129	-0.148	-0.879**	-0.169	0.285***	-0.447***	-0.295	0.233
upgrade_ig	-0.231**	0.129	-0.628*	-0.123	-0.452***	0.324***	-0.137	0.641**
upgrade_nig	-0.122	-0.209	0.704	0.489	-0.082	0.169	0.121	-0.080
Pseudo R-sq	0.13	0.15	0.17	0.04	0.25	0.32	0.13	0.09
No obs	4,542	3,813	380	520	5,030	4,876	367	530

Results for the non-listed German firms sample are provided. This sample is further subdivided according to different criteria. In Panels A and B, firms are classifided according to the previous year's deviation from the target debt ratio with a threshold of 20%. The sample split in Panels C and D is based on the level of deviation from the target debt ratio for firms with a deviation smaller than 20% from target leverage in year t-1. In Panels A and C, models M1a and M1b are estimated; in Panels C and D, models M2a through M2d are estimated. All variables are winsorised at the 1% and 99% levels. ***, **, and * denote the significance at the 1, 5 and 10% levels.

terns for downgrades in both subsamples. Following an upgrade to both, investment grade and speculative grade levels, however, firms with a deviation from the target debt level greater than 20% exhibit a positive net debt relative to net equity issuance in the industry effects by year specification (Panel A). These firms are also more likely to issue debt rather than to redeem it (Panel B). This result indicates that upgraded firms generally benefit from the allocation of external financing due to the extensive monitoring in the German bank-based system.

Our results for firms whose actual debt ratio deviates less than 20% from their target still exhibit some contradictory patterns. An upgrade to investment grade levels does not affect firms' subsequent capital structure decisions, while the financing choices imply increasing leverage. Moreover, while the financing choices of firms upgraded to speculative grade levels in Panel B of Table 5 also suggest a positive net debt issuance after the upgrade, this latter relationship is significantly negative in Panel A (negative net debt relative to net equity issuance). In Panels C and D, we, thus, split the subsample of firms with a target deviation less than 20% into underleveraged and overleveraged firms. For both groups of firms (under- and overleveraged), we find patterns for downgrades, which are similar to those shown in Panels A and B, indicating that the capital structure and financing choices of downgraded firms are essentially independent from the level of deviation from target leverage. However, the relationship between capital structure decisions and debt financing choices after downgrades to speculative grade levels of underleveraged firms is less pronounced compared to this same association for firms with a deviation greater than 20% as well as overleveraged firms with a deviation lower than 20%, possibly due to their small degree of deviation, which results in limited debt-based financing choices. Moreover, given their limited access to external financing, these firms may be forced to adjust their capital structure using equity as a last resort, e.g., through their general or limited partners. An upgrade to investment grade levels leads to a positive net debt relative to net equity issuance for below- and above-target leverage firms. Most important, for upgrades to non-investment grade levels, the net debt relative to net equity issuance becomes insignificant for underleveraged (in the industry effects by year specification) and overleveraged firms. Our conflicting results between financing choices and capital structure decisions are, thus, mitigated by this additional sample split, suggesting that an upgrade to non-investment grade ratings does not significantly affect sub-

sequent capital structure decisions. Firms adjust their capital structure more actively subsequent to an upgrade to investment grade levels than to speculative grade levels. The results are also consistent with our findings for the partial adjustment speed in Panel C of Table 4, where upgrades to non-investment grade levels exhibit a lower speed of adjustment.

C.6. Summary

We conclude that privately-held companies in Germany are relatively insensitive to changes in their creditworthiness possibly due to their close relationships to banks and strong monitoring activities (Diamond, 1991). This conjecture is supported by a relatively weak relationship between credit ratings and changes in firms' leverage ratios in bank-based systems (Huang and Shen, 2012) and high recovery rates for bank loans due to the closer monitoring (Grunert and Weber, 2009; Mora, 2012). In addition, these firms exhibit a tendency to increasing leverage subsequent to an upgrade, indicating that the implications of the CR-CS hypothesis may not fully hold as firms react – at least to a certain extent – symmetrically to rating changes.

V Conclusions

The credit rating-capital structure hypothesis (CR-CS hypothesis) proposed in Kisgen (2006) and expanded in Kisgen (2009) implies that there is a relationship between capital structure choices and credit ratings. In particular, the CR-CS hypothesis suggests that firms near a credit rating upgrade or downgrade exhibit lower net debt relative to net equity issuances. It assumes that firms close to a rating upgrade will try to benefit from the lower costs of external capital and a better access to external financing; a rating downgrade has the opposite effect. Kisgen (2009) studies whether capital structure decisions are affected by explicit changes in a firm's credit rating. The related CR-CS hypothesis assumes that there is no effect of a realised upgrade because a company will not try to reverse any benefits caused by the upgrade. However, a downgrade will have a leverage-decreasing effect. Kisgen (2006, 2009) concludes that firms target minimum rating levels and that credit ratings are not only related to financial distress concerns.

We expand this framework and provide evidence on the relationship between credit rating changes and capital structure decisions for listed U.S. firms as well as listed and privately-held firms in Germany. To determine credit rating changes, we use Standard & Poor's long-term corporate credit ratings for U.S. firms. The number of outstanding credit ratings for publicly listed firms in Germany is comparably low, and there exist only few credit ratings for non-listed firms. Therefore, we use credit rating estimates. As only few privately-held firms issue public debt and have outstanding credit ratings but borrow from banks (implying extensive monitoring by financial intermediaries), the rationale for using estimated credit ratings to these firms is to mimic a bank-internal assessment of the firm's creditworthiness.

Our U.S. findings indicate that the effect of rating changes on capital structure decisions and individual financing choices is more pronounced for rating downgrades – particularly at non-investment grade levels – than for upgrades. This result, which corroborates Kisgen's (2006, 2009) CR-CS hypothesis suggests that there exists a minimum target rating and that financial distress concerns are only of secondary importance. Furthermore, we use a system GMM approach to estimate the speed of capital structure adjustment. Our results show that the CR-CS hypothesis may not fully hold; in fact, financing activities could also be directly affected by the access to external financing and the remaining debt capacity (as well as the related financial distress concerns). In sharp contrast, publicly listed firms in Germany are widely independent from changes in their creditworthiness due to extensive bank-internal monitoring in a bank-based financial regime and their access to public capital markets. Similarly, the capital structure choices of high creditworthiness privately-held firms in Germany are more or less independent from credit rating changes; nonetheless, we observe that investment grade rated firms are relatively more proactive following an upgrade, i.e., they tend to increase leverage. However, firms at non-investment grade rating levels implement financing activities, which strengthen their capital structure subsequent to a downgrade. Both findings are supported by our results for the speed of adjustment and they indicate that their close relationship to banks helps firms mitigating otherwise substantial effects of changes in their creditworthiness. The empirical evidence for upgrades to lower rating levels remains to some extent contradictory, although it may be explained on the basis of the different levels of target leverage deviation.

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Conclusions and Remarks

The empirical results in this dissertation indicate that credit ratings and even more quantitatively oriented credit risk assessments might be helpful measures of financial constraints. One of the implications caused by the 2008 financial crisis was the increased regulation of capital markets. This process is by far not finalised and firms and investors will face more severe requirements resulting in even stronger financial constraints.

Regulatory authorities plan to reduce the impact of credit ratings offered by external rating agencies on investment decisions by institutional investors throughout the coming years. Alternatively, investors' decisions shall increasingly rely on internal credit risk assessments. Basically, internal credit risk assessments and external credit ratings mainly differ in that internal assessments are more standardised and model-driven.

These regulatory requirements are likely to make quantitative and standardised models even more important in assessing firms' credit risk and the supply of external financing will more closely depend on theses types of credit risk assessment. This development will also affect future research on financial constraints. If external financing is more dependent from credit risk assessments based on quantitative models, financing decisions through investors will become more dependent from the outcome of these models.

If researchers are able to rebuild these quantitative models, they will more likely be able to investigate the mechanisms of the supply with external financing and to get a less-biased insight into the nature of financial constraints. Consequently, this will also help policymakers and regulatory authorities to better understand the impact of their regulatory requirements on capital markets and real economy.