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The price impact of lending relationships

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Abstract

This study analyzes the impact of bank relationships on a firm's cost of debt. We focus on relationships with the main bank. We find that a firm's cost of debt decreases with relationship strength, proxied by the share of bank debt provided by the main lender, but rises with relationship length. While the increase over time is weak on average, bank-dependent borrowers face a significant premium after several relationship years. Moreover, cost of debt increases with concentration in the lender's portfolio. Switching the main lender initially leads to only a small price discount on average. However, the discount is considerable for borrowers that switch and had a strong relationship to the previous main lender. Our results indicate that the information advantage acquired by the relationship bank leads to benefits for the firm, but also to potential hold-up costs in the long-term. Moreover, additional costs may result from concentration risks faced by the lender, inducing borrowers to switch to larger relationship banks.

JEL classification: G21; G32

Keywords: Lending relationship; SME; German banking system

Non-technical summary

From a theoretical perspective, existing lending relationships can affect loan conditions in two ways: First, relationship borrowers may have better access to credit and may have to pledge less collateral. Second, lending relationships may have an impact on the price. With respect to credit quantity conditions, most empirical studies find similar results. However, results considerably differ concerning price contract terms. Different results may be explained by the fact that most studies use cross-sectional data. The studies can therefore only partly control for developments over the course of the relationship. Panel data could capture the effects to a larger degree.

The frequent lack of adequate data is the starting point of this study. Using panel data over 12 years, we analyse the price impact of existing lending relationships. We consider the influence of relationship strength - proxied by the share of bank debt provided by the lender - and relationship length. Moreover, we also examine how cost of debt develops around switching the main lender.

We find that cost of debt decreases with relationship strength, but rises with the duration of the lending relationship. However, the increase over time is rather weak, i.e. companies with a strong and long relationship still face a financing advantage. This finding is, however, only valid for average borrowers since the financing advantage also depends on the position of non-bank lenders. For bank-dependent borrowers, i.e. borrowers with a high fraction of total bank debt, there is a considerable interest rate premium after several relationship years. Overall, these results suggest that relationship banks are able to reduce information asymmetries, leading to benefits for borrowers. However, the information advantage of the relationship bank (compared to other lenders) enables the bank to tie the borrowers and hold them up in the medium to long term. Results for cost of debt development around switching the lender are in line with this interpretation. Switching the main lenders initially leads on average to a small price discount. However, this price discount is large for borrowers that had a strong relationship to the previous lender since the lender was then better able to hold-up the borrower.

We also examine how characteristics of the lender affect cost of debt. We find that cost of debt increases if the loan provided by the lender is large relative to the lender's capital.

The bank then faces concentration risks and may increase the price of the loan. Moreover, companies switching to a larger bank also receive a significant price discount, while there is no price discount for borrowers switching to a smaller bank or a bank of equal size. The findings support the graduation hypothesis, according to which companies switch to larger bank to improve their access to credit.

Nichttechnische Zusammenfassung

Aus theoretischer Sicht kann eine bereits vorhandene Beziehung zu einem Kreditgeber die Kreditkonditionen auf zwei Wegen beeinflussen: Zum einen ist der Kreditgeber unter Umständen eher bereit, einen Kredit zu bewilligen, und verzichtet eher auf Sicherheiten. Zum anderen kann die Kreditbeziehung einen Einfluss auf den Zins haben. Die empirische Literatur findet bezüglich der Konditionen für die Kreditmenge überwiegend ähnliche Ergebnisse. Hinsichtlich der Zinskonditionen unterscheiden sich jedoch die Ergebnisse stark. Eine Erklärung für die unterschiedlichen Ergebnisse könnte sein, dass die Studien häufig Querschnittsdaten verwenden. Dadurch sind sie nur zum Teil in der Lage, für Entwicklungen während der Kreditbeziehung zu kontrollieren. Hierfür wären Paneldaten besser geeignet.

Der häufige Mangel an adäquaten Daten ist der Ausgangspunkt für diese Studie. Wir untersuchen anhand von Paneldaten über einen Zeitraum von 12 Jahren, welchen Einfluss bereits vorhandene Kreditbeziehungen zu einer Bank auf den Preis haben. Wir berücksichtigen dabei die Stärke der Kreditbeziehung (gemessen über den Anteil der Bank an der gesamten Kreditaufnahme über Banken) und die Dauer der Beziehung. Darüber hinaus untersuchen wir, wie sich die Kreditkosten bei einem Wechsel des wichtigsten Kreditgebers entwickeln.

Wir finden, dass die Zinskosten sinken, je stärker die Kreditbeziehung ist, aber ansteigen, je länger die Beziehung dauert. Der Anstieg der Kosten über die Zeit ist allerdings relativ schwach, d.h. Firmen mit einer langen und starken Beziehung haben trotzdem einen Finanzierungsvorteil. Diese Aussage gilt allerdings nur im Durchschnitt, da die Zinskosten auch wesentlich von der Bedeutung anderer Kreditgeber abhängen. Für Kreditnehmer, die sich insgesamt stark über Banken finanzieren, entsteht hingegen nach mehreren Jahren ein erheblicher Finanzierungsnachteil. Insgesamt sprechen die Ergebnisse dafür, dass vorhandene Kreditbeziehungen dazu beitragen, Informationsasymmetrien zu reduzieren, was zu Vorteilen für den Kunden führt. Der Informationsvorsprung der Bank gegenüber anderen Kreditgebern versetzt die Bank jedoch mittel- bis langfristig in die Lage, Firmen an sich zu binden und höhere Preise durchzusetzen (Hold-up). Die Entwicklung der Finanzierungskosten bei einem Wechsel des Hauptkreditgebers stehen mit dieser Interpretation im Einklang: Nach einem Wechsel des wichtigsten Kreditgebers gehen die Finanzierungskosten zunächst leicht zurück. Der Finanzierungsvorteil ist jedoch erheblich, wenn die Firma mit der vorhergehenden Bank eine enge, starke Beziehung hatte und die Bank daher auch gute Möglichkeiten hatte, höhere Preise durchzusetzen.

Darüber hinaus untersuchen wir, wie die Eigenschaften des Kreditgebers die Zinskonditionen beeinflussen. Wir finden, dass die Zinskosten ansteigen, wenn die von der Bank gewährte Kreditsumme im Vergleich zum Eigenkapital der Bank hoch ist. In diesem Fall hat die Bank Konzentrationsrisiken und wird daher den Kredit verteuern. Ferner finden wir, dass Firmen, die zu einer größeren Bank wechseln, einen signifikanten Finanzierungsvorteil erhalten. Firmen, die hingegen zu einer kleineren oder einer gleich großen Bank wechseln, haben keinen Finanzierungsvorteil durch den Wechsel. Diese Ergebnisse stützen das sog. Graduation-Argument, wonach Firmen zu größeren Banken wechseln, um ihren Kreditzugang zu verbessern.

Contents

The price impact of lending relationships

1 Introduction

There is an extensive theoretical literature about how lending relationships affect price and non-price conditions of loans. With respect to non-price conditions, most empirical studies find that relationship borrowers pledge less collateral and have better access to credit and therefore show similar results (see the literature overview in Degryse et al. [2009]). However, with regard to the price impact of lending relationships, results in the empirical literature are contradictory. For instance, Berger and Udell [1995] and Brick and Palia [2007] find that loan rates decrease with the duration of lending relationships, while D'Auria et al. [1999] and Degryse and Cayseele [2000] find the opposite. Conflicting results are also found for how the exclusivity of the lending relationship impacts cost of debt (see, for example, Angelini et al. [1998] and Petersen and Rajan [1994]). Apart from different countries included and differences in the empirical specification and definition of variables a further reason for conflicting results may be that most studies are based on cross-sectional data. These studies may therefore not be able to fully capture the dynamic pattern of lending relationships.

This frequent lack of adequate data is the starting point of our study. We analyse the price impact of lending relationships by using panel data of bank-firm relationships over 12 years. This allows us to observe the development of lending relationships over time. Specifically, we examine how relationship strength - proxied by the share of debt provided by the lender - and relationship length affect cost of debt. In doing this, we focus on relationships with the main bank. Moreover, we also examine how cost of debt develops around switching the main lender.

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We use a unique dataset for Germany. Germany, often cited as the classical example of a bank-based system (see, for example, Elsas and Krahnen [1998]), offers an ideal environment for studying the impact of lending relationships. Bank finance in Germany plays an important role for both small and large firms. At the same time, there is substantial variance in the nature of lending relationships (for instance, with respect to the number of relationships). Our database is comprehensive and contains around 18,000 observations. Moreover, our dataset consists of firms of all size classes, which allows us to derive more general results.

Our key findings are as follows. Cost of debt decreases with relationship strength, but rises with the duration of the lending relationship. However, the increase over time is rather weak. Companies with a strong and long relationship still face a financing advantage. This finding is, however, only valid for average borrowers since the financing advantage also depends on the position of non-bank lenders. For bank-dependent borrowers, i.e. borrowers with a high percentage of total bank debt, there is a considerable interest rate premium after several relationship years. These results suggest that relationship banks are able to reduce information asymmetries, leading to benefits for borrowers, but also implying potential larger costs in the medium to long term. Cost results from the information advantage acquired by the relationship bank, which enables the bank to hold-up the borrower. Our results for cost of debt development around switching the main lender are in line with this interpretation. We find that switching the main lender leads, on average, to a small price discount in the year of the switch. However, this price discount is larger for borrowers that had a strong relationship with the previous lender, while the discount is not significant for borrowers without a strong relationship.

We also examine how the lender's characteristics affect cost of debt. We find that cost of debt increases with the size of the firm relative to the size of the lender. In addition, companies switching to a larger bank also receive a significant price discount, while there is no price discount for borrowers switching to a smaller bank or a bank of equal size. We interpret this finding as evidence for the graduation hypothesis (Gopalan et al.). The graduation hypothesis postulates that companies switch to a larger bank to improve their access to credit.

Our paper is closely related to Ioannidou and Ongena [2010] and Gopalan et al.. Using data for Bolivia, Ioannidou and Ongena [2010] find that loans granted by a new (outside) lender carry significantly lower loan rates than the rates on comparable loans from the firm's current (inside) banks. However, over time, the new bank increases the loan rate so that the initial advantage is offset. In our study, we find a similar dynamic pattern. However, we do not find that the advantage of switching the lender vanishes after some years (for the average borrower). Moreover, we differ from Ioannidou and Ongena [2010] in studying the price conditions for an industrial country with a much more developed and competitive banking market. In addition, while their sample consists mainly of small companies, our sample also contains a significant percentage of medium-sized and large firms (but does not comprise very small firms). Apart from differences in the method and in the measurement of cost of debt, these two differences may also explain the different finding with respect to the long-run effect of switching.

Gopalan et al. find that switching to a larger non-relationship banks improves non-price conditions of loans. However, they do not find a price-reducing effect of switching. By contrast, we find that switching the lender reduces cost of debt (for certain groups of borrowers). Unlike Gopalan et al., our sample contains a far larger percentage of smaller and medium-sized companies. Moreover, while Gopalan et al. contains more information about the lender's capital market services of the lender, we have information on the lender's capital. This variable is important for determining credit constraints by the lender. In addition, our paper differs from Gopalan et al. and Ioannidou and Ongena [2010] since we combine both arguments (hold-up and graduation) in a single paper while Ioannidou and Ongena [2010] focus on the hold-up cost and Gopalan et al. on the graduation effects. We find evidence that both arguments have an impact on cost of debt, but that hold-up costs are quantitatively more important.

The paper is organized as follows. Section 2 discusses related literature and outlines the hypotheses. In Section 3 we describe the underlying data set and the construction of our main variables. Section 4 contains descriptive statistics and first results. Results of the regressions are presented in Section 5. Finally, section 6 concludes.

2 Theory and Hypotheses

From a theoretical perspective, the impact of lending relationships on a firm's cost of debt is unclear. There are two major reasons why a firm's financing cost may decrease with the length and the strength of the lending relationship. Both reasons are related to the information production of the lender. First, by regularly monitoring their borrowers, lenders accumulate information over time. This implies that repeated borrowing should be associated with lower cost for the lender. If the lender shares these savings with the borrower, lending rates should decrease over the lending relationship (Boot and Thakor [1994]).

Moreover, according to the model of Bris and Welch [2005], lending rates should also be lower if the firm borrows a large fraction from one lender. The reason is as follows: Due to free-rider incentive problems, the bargaining power of a single creditor (or a creditor with a large share of debt) is higher than the bargaining power of a large number of dispersed banks. In the event of financial distress, a creditor with a dominant debt share is likely to be relatively more successful in enforcing its claim. By borrowing the bulk from one lender, a firm can therefore signal its quality and its confidence not to become bankrupt. This should lead to a lower lending rate (given public information on firm's creditworthiness). We call a lender's share of debt the strength of a lending relationship. Hypothesis 1 summarizes the predictions:

Hypothesis 1: (H1) A firm's cost of debt decreases with the strength of a lending relationship (proxied by a lender's share of debt) and the length of the lending relationship.

Hypothesis 1 therefore states that relationship banks, i.e. banks that have a strong and/or long relationship with their borrower, decrease a firm's cost of debt. Sharpe [1990] and Rajan [1992] come to a different conclusion, emphasizing the possible costs of relationship lending. They argue that relationship lenders gain an information advantage compared to outside lenders over time, leading to adverse selection problems for outside uninformed lenders. Inside lenders are therefore able to hold-up their borrowers and enforce higher lending rates as time passes. However, over the total length of a bank borrower relationship, relationship borrowers do not necessarily pay higher average rates than non-relationship borrowers since relationship banks may subsidize borrowers at the beginning of a relationship (see Sharpe [1990] and Petersen and Rajan [1995]). In any case, the hold-up argument implies an increase in cost of debt over the relationship. Moreover, theory also suggests that cost of debt rises with the share of the relationship bank, since this variable determines the incentive of other banks to gather information and thus the information advantage of the relationship lender.

Rajan [1992] and von Thadden [2004] show, however, that borrowers are, in general, not "locked-in" to the relationship bank with probability 1. Outside lenders face a winner's curse problem when bidding for the company. Outside lenders therefore play a mixed strategy, which makes their bidding behavior non-predictable for the relationship bank. Outside lenders thereby limit the inside bank's rent extraction. Part of the good-type and the bad-type firms receive a loan rate offer from outside lenders that is lower than the offer from the relationship bank and therefore switch to outside lenders. The models of Rajan [1992] and von Thadden [2004] have two testable implications: First, switching to a new (relationship) lender should cause a drop in a firm's cost of debt. Second, the interest rate advantage after a switch should be larger for borrowers that had long, strong ties with their previous lender. The previous lender was then able to charge a large interest rate premium.

Finally, the risk of a hold-up by a relationship bank should also depend on the position of other non-bank lenders. If a company is substantially financed by other financial lenders, such as bond investors or associated companies, the relationship bank's bargaining power is significantly weaker even if the bank holds a large percentage of the company's bank debt. We therefore expect the positive interest rate effect of relationship strength and length to increase with the share of total bank finance.

Hypothesis 2:

(H2a) A firm's cost of debt increases with the strength and the length of the lending relationship.

(H2b) The positive impact of relationship strength and length on a firm's cost of debt increases with the share of total bank debt.

(H2c) Switching the relationship lender reduces cost of debt. The interest rate advantage after a switch is larger for borrowers that had a long relationship with their previous lender and for borrowers that maintained a strong relationship with their previous lender.

An additional factor which may influence a firm's cost of debt is the size of the relationship lender. Gopalan et al. show that firms that are growing switch their relationship lender and start a relationship with a new larger lender in order to improve their access to credit ("graduation"). The previous (smaller) lender may not willing to meet, or meet only against a premium, a firm's financing needs since, for example, the previous lender may consider concentration risks in its credit portfolio to be significant.[1] By switching to a larger lender, a firm should therefore be able to reduce financing cost. This implies that a company acquires an interest rate advantage after a switch if the new lender is larger than the previous one.

Moreover, if concentration risks influence cost of debt, we expect not only an impact at the time of switching, but also over the relationship, i.e. we expect cost of debt to increase with concentration risks in the lender's credit portfolio with respect to the company. We measure concentration risks by the lender's amount of loans to this company divided by the lender's equity.

Hypothesis 3:
(H3a) A firm's cost of debt increases with the amount of loans provided by the lender relative to the lender's capital.
(H3b) Switching the relationship lender reduces cost of debt if the new lender is larger than the previous one.

[1]Gopalan et al. provide evidence that firms also switch to a large bank in order to obtain capital market services such as underwriting and investment banking. Their sample consists of US firms. This additional motivation should be a minor issue for the firms in our sample since the firms in our sample are much smaller than the firms in Gopalan et al.. In addition, the German financial system is bank-based and firms in Germany typically issue bonds at a later stage in their life than firms in the US.

3 Data

3.1 Sample description

We use a unique bank-firm level dataset that contains annual information from 1993 to 2004. The dataset is composed of three different databases compiled by the Deutsche Bundesbank: i) the German credit register (”MiMiK”), containing single bank-firm credit relationships, ii) German firms’ balance sheet data (”Jalys/Ustan”) and iii) German banks’ balance sheet data and audit reports (”BAKIS”). The dataset used for this study thus provides information as to whether a bank grants credit to a specific firm (through dataset i) as well as the characteristics of the corresponding firms (ii) and banks (iii). In our analysis, we focus on the main lender and therefore keep only the information on the largest lender. In the appendix, we provide some information about the single datasets and describe the matching process, which was a precondition for composing the data used in this study. The final data set consists of annual data for 3,741 firms and contains 18,119 observations.

Since the underlying datasets are used for supervisory or monetary policy purposes, the information in our dataset is supposed to be more reliable and of better quality overall than information in publicly available databases or survey data. A limitation of our database is that it predominantly contains large loans, which results from the relatively high reporting threshold in the German credit register. Banks in Germany are required to report credit to the Bundesbank only if their exposures to an individual borrower or the sum of exposures to borrowers belonging to one borrower unit exceeds the threshold of EUR 1.5 million once in the respective quarter. Nevertheless, a large portion of single exposures in the database are below EUR 1.5 million, owing, for example, to the fact that the threshold is applied at the group level (see Schmieder [2006]). In the matched database, 36% of the exposures are below EUR 1.5 million.

To investigate a potential sample bias, we calculate for each observation the ratio of balance sheet indebtedness (according to the credit register) over total bank loans (reported in the firm’s balance sheet). Table 1 shows the distribution of this ratio. Table 1 indicates that the credit register is likely to contain the bulk of banks’ claims for most companies in our sample. However, there are a number of companies where the balance sheet indebtedness in the credit register is higher than the sum of bank loans on a firm's balance sheet. This is due to the fact that the credit register and the balance sheet statistics refer to different definitions of debt. Whereas the balance sheet statistics apply a legal definition of indebtedness, the credit register adopts an economic perspective. For example, a firm's bonds held by a bank are classified as bonds in the corporate balance sheet statistics, but as bank credit in the credit register. Moreover, if a bank grants a loan to a borrower in which it holds a stake, this particular ´loan' is classified as a loan in the credit register, but as a shareholder's loan in the balance sheet statistics.

In other instances, the credit register tends to understate a firm's bank loans: Written-off loans, for example, are not included in the credit register, but are included in the balance sheet statistics. Overall, the different concepts of debt make comparisons difficult. We will consider this issue subsequently.

3.2 Construction of main variables

3.2.1 Measuring cost of debt

Cost of debt is derived from a firm's balance sheet data by means of an implicit firm-specific interest rate spread. It is calculated as follows (where i indicates the firm and t the year):

$$spread_{it} = \frac{interest\ expenses_{it}}{average\ financial\ debt_{it}} - yield\ on\ German\ industrial\ bonds_t$$

Average financial debt (i.e. interest bearing debt) in year t is calculated as the mean of financial debt at the beginning and the end of year t.To deal with outliers, values below the 2th percentile and values above the 98th percentile are excluded from the sample.

Our measure of cost of debt does not distinguish between cost of debt associated with bank loans and cost of debt associated with other financial debt instruments, such as bonds or loans from associated companies, as we do not have access to such data. However, since for the median firm, 55% of financial debt is provided by banks, our measure of cost of debt is strongly influenced by banks. In the regressions, we control for the share of other debt instruments.

3.2.2 Measuring strength and duration of lending relationships

For the empirical analysis, we consider only relationships with the main bank, i.e. the bank granting the largest share of loans to the firm (measured by stock of loans).[2] By focusing on relationships with the main lender we expect the impact of potential benefits of lending relationships (reduction of information asymmetries) and costs (hold-up, credit restrictions due to an increase of concentration risks) to become particularly clear. This approach follows Herrera and Minetti [2007] and is also similar to papers using the LPC Dealscan database that focus on relationships with the lead investor (see, for example, Bharath et al. and Gopalan et al.).

i) strength of lending relationship

We measure the strength of the (main) lending relationship using the share of bank debt provided by the (main) lender. A high fraction of debt has proved to be the most important and reliable indicator for relationship lending, i.e. for the existence of close ties between borrower and lender (see Elsas [2005]). An alternative measure would be the breadth of the relationship, i.e. the number of different services the firm purchases from the bank. Unfortunately, we do not have information concerning the breadth.

The main lender's share of bank debt is calculated by dividing the amount of loans of the respective bank (to the firm) by the firm's total borrowing from banks (both variables as stock values at time t). We transform this variable into a dummy variable and classify a relationship as strong if the bank holds a share of at least 80% ($StrongRel = 1$). We choose a threshold of 80% to indicate a dominant exposure of the main lender. The threshold is to some extent discretionary. As robustness checks, we vary the threshold for the dummy variable and take alternative levels, for example, of 70%.

The indicator is determined based on information from the credit register. This offers the advantage that we not only capture lending by traditional loans, but that we also have information on off-balance sheet lending. We are therefore able to apply a broader measure for the importance of a bank. As the amount of total bank borrowing (denominator) is

[2] At every point in time t, there is only one main lender.

also derived from the credit register, this approach has the shortcoming that the variable is affected by truncation in the database and may thus overstate the importance of the largest lender. To account for this fact, we apply relatively strict measures for *StrongRel* (minimum share of a firm's bank loans of 80%), which means that the identified strong relationships are likely to be those found via more common definitions and "full" information on the credit side. Moreover, as we showed in section 3, definitions of bank loans differ significantly between the credit register and firm balance sheets. It is therefore difficult to construct an indicator that combines the two statistics in a consistent way.[3] We take account of truncation effects in the database by various robustness checks below.

ii) duration of lending relationship

The duration of a lending relationship reflects the interaction of borrower and lender over time and is also a common indicator of relationship lending (see, for example, Berger and Udell [1995] or Petersen and Rajan [1994]). Following Herrera and Minetti [2007], we measure the duration of the relationship with the main lender (*Duration*) as the number of subsequent years for which a bank has been a firm's main lender. The value of *Duration* is thus closely related to switching the main lender. The variable *Switch* equals 1 if the largest lender in the current period is not equal to the largest lender in the previous period. If *Switch* equals 1, we set the value of *Duration* to 1.

Please note that *Duration* is less than or equal to the number of subsequent years for which a firm has maintained a relationship with its main lender, since the firm may have started the relationship with the main lender at a time when another bank was its main lender. By using this proxy, we expect (as above) that the benefits and costs of lending relationships resulting from the information production by the main lender become especially clear. In contrast to smaller lenders, a firm's main lender has a high incentive to collect information and cannot easily free-ride on screening and monitoring activities of other lenders. From a theoretical perspective, a firm's main lender therefore

[3]Relating the largest loan in the credit register to bank debt according to the balance sheet statistics would lead to a ratio above 100% in roughly 15% of the observations, even if we were to restrict the credit register exposure to balance sheet loans. Moreover, this approach would reduce the sample significantly as information about balance sheet indebtedness has been available only since mid-1996.

functions as a delegated monitor of the other lenders (Diamond [1984]). The main lender thus accumulates a significant information advantage over time, implying that the risk of a hold-up by the main lender is also more pronounced. Hence, the theoretical arguments related to information production should be more easily testable.

With respect to measuring duration, three types of data issues arise. First, we do not have separate information on the length of relationships, but measure the duration by counting the number of years over the sample period. The value of duration is therefore downward-biased. However, since we measure duration by the number of subsequent years for which a bank has been a firm's main lender (and not by the number of subsequent years a bank has a relationship with the firm), our measure of duration is shorter and the issue of censoring is less acute. In the regressions, we consider only companies for which we have at least six years of observations, i.e. we include companies only from the sixth observation onwards. Moreover, we control for the number of years a company has been included in the sample up to the current year. We carry out additional robustness checks.

Second, for some firms, we cannot determine the largest lender for the total period in which the firm is included in the sample since the credit register does not contain information on the firm for some years. This issue affects the measurement of *Duration* since this variable counts the number of years for which a bank has been the largest lender. With regard to such gaps in our data, i.e. if data are missing for some years, we proceed as follows. If the largest lender before an information gap remains the largest lender after a gap, we assume that the firm has not changed its main lender in between. If, however, the largest lender before a gap is not the largest lender after a gap and the gap is no longer than two years, we assume that the firm has switched to the new main lender in the middle of the data gap.

Third, in the sample period, banks were frequently involved in mergers. We therefore examine whether a firm's main lender was taken over. If we observe that a firm has a new main lender in period t that has acquired the firm's previous main lender in period t or t-1 (or if there is a data gap in the time span between t and the previous observed period), we do not classify this event as a switch of the main lender (i.e. the relationship with the main lender does not end).

4 Descriptive statistics and first results

Table 2 summarises descriptive statistics for our dependent variable and the explanatory variables. Cost of debt, measured by a firm's interest *spread*, is, on average, slightly negative (-24 basis points). 58.5% of the companies in the sample have a strong relationship with their main lender (*StrongRel* =1), i.e. raise at least 80% of their bank loans from one bank. If we vary the threshold above which a relationship is defined as strong (see $StrongRel_{90\%}$ and $StrongRel_{70\%}$), the value changes only by a few percentage points. 15.8% of the companies switch their main lender on average per year.

With respect to the relative size of the main lender, the table reveals a large variance in the loan to bank capital ratio (i.e. the amount of loans provided by the main lender relative to the main lender's capital). For most companies in the sample the ratio is less than 1% (the median equals 0.2%, not included in the table). The high average of 1.5% is driven by relatively large values above the 90th percentile (which equals 4.5%). Table 2 also contains information about additional explanatory variables. 75% of the companies in our sample reach a volume of sales of EUR 41 million or less. The bulk of companies in our sample is therefore small and medium-sized. To control for company default risk, we use a probability of default measure which is calculated from firm balance sheet data.[4] The average probability of default (over a one-year horizon) equals approximately 2%. To deal with potential data outliers, we censorized some variables (probability of default and the loan to capital ratio) at the 99% level.[5]

Before going forward to the regressions, we discuss some descriptive evidence concerning our hypotheses outlined above. We examine the impact of the three key factors considered in our hypotheses, namely relationship strength, duration and the loan to bank capital ratio, on cost of debt. Figure 1 shows evidence with respect to relationship strength (considered in hypotheses H1 and H2a). The figure contains the main parameters of the spread distribution (median, 25th quantile and 75th quantile) subject to the strength of the relationship (*StrongRel*) and different firm size classes (measured by firm assets). We

[4]This PD is derived from a binary logistic regression model. The explanatory variables are capital ratio, short-term assets/short-term liabilities, profitability, size and industry dummies. See Gerke et al. [2006] for further information.

[5]This means that we set those values above the 99th quantile exactly equal to the 99th quantile.

control for firm size, since size strongly interferes with relationship strength. As Figure 1 shows, firms with a strong relationship to their main lender exhibit lower cost of debt than firms without a strong relationship. The difference between firms with and firms without a strong relationship is observed for each size class as well as for each quantile (median, 25th quantile, 75th quantile). This striking difference suggests that strong relationships help to reduce cost of debt (in line with hypothesis 1).

In Table 3, we investigate whether relationship duration works in the same direction as relationship strength (as assumed in hypothesis H1). However, Table 3 rather suggests that cost of debt increases with duration (consistent with hypothesis H2a): A firm's cost of debt is lowest if a firm has switched to a new main lender in the current period. Cost of debt is in a medium range if *Duration* is between two and four years and is highest if the relationship between the firm and its main lender has been close for at least five years. This relationship between duration and cost of debt is found once again for different quantiles of the interest rate spread. Overall, information from descriptive statistics gives a first hint that relationship strength and relationship length work in opposite directions.

Finally, Table 4 contains information with respect to hypothesis H3a. Hypothesis H3a postulates that financing cost increases if the amount of loans granted by the main lender is large relative to the main lender's capital since (s)he may then charge a compensation for the significant concentration risk. The descriptive statistics are consistent with this idea. For each quantile of the interest rate spread, cost of debt is lowest if the amount of loans granted by the main lender (relative to the capital) is small. Cost of debt increases if the loan to bank capital ratio is in the medium range and is highest if the loan to bank capital ratio is large.

5 Regressions

5.1 Econometric specification

We use two models to test our above hypotheses. Both models are panel data models and estimated by OLS regressions. Standard errors are corrected for heteroscedasticity and firm-level clustering. Model A is of the following form:

$$\begin{aligned} Spread_{it} &= \alpha + \beta_1 StrongRel_{it} + \beta_2 Duration_{it} + \beta_3 StrongRel_{it} * Duration_{it} \\ &\quad + \beta_4 SizeBank_{it} + \delta controlvar_{it} + \epsilon_{it} \end{aligned}$$

where *StrongRel* indicates a strong relationship with the main lender and *SizeBank* reflects the relative size of the main lender. *SizeBank* is captured by the amount of loans provided by the main lender relative to its capital. Control variables are firm size, firm credit quality, firm debt structure and year dummies.

Model B is a modification of the above specification, which is designed to examine in more detail the development of cost of debt around a switch of the main lender. The basic model is of the following form:

$$\begin{aligned} Spread_{it} &= \alpha + \beta_1 StrongRel_{it} + \beta_2 SizeBank_{it} + \zeta Switch_{it} \\ &\quad + \delta controlvar_{it} + \epsilon_{it} \end{aligned}$$

where *Switch* is a dummy variable that equals 1 if the firm has switched to a new main lender in the current period. We augment the basic model B by including characteristics of the relationship with the *previous* main lender. For instance, we include interaction terms of *Switch* and $StrongRel_{t-1}$:

$$\begin{aligned} Spread_{it} &= \alpha + \beta_1 StrongRel_{it} + \beta_2 SizeBank_{it} \\ &\quad + \gamma_1 Switch_{it} * [StrongRel_{i,t-1} = 1] + \gamma_2 Switch_{it} * [StrongRel_{i,t-1} = 0] \\ &\quad + \delta controlvar_{it} + \epsilon_{it} \end{aligned}$$

We derive dummy variables from *Duration* and *SizeBank* with respect to the relationship with the previous main lender, create interaction terms with *Switch* and include them as well.

5.2 Empirical results

Cost of debt development over the relationship

Table 5 shows the results of our regressions for model A (see section 5.1). In addition to the variables of interest, we control for firm size, firm credit quality and debt structure.

We find that larger companies (as measured by the log of assets) and firms of high credit quality (as measured by the probability of default) have significantly lower cost of debt. Moreover, the interest rate spread decreases with the share of short-term liabilities, reflecting the fact that, in most times, short-term interest rates are below long-term rates. Furthermore, cost of debt decreases with the share of loans from associated companies as well as with the share of loans from owners. Loans from parties inside the company (i.e. loans from associated firms) or loans from owners are therefore cheaper than bank loans, probably on account of lower information asymmetries of those parties.[6] A company's share of debt securities does not have a clear impact on cost of debt. Finally, we also include year dummies to control for the time trend in our data set (not reported). The dummies are mostly significant, reflecting the interest rate trend during the sample period.

If relationship lending, measured by relationship strength and length, helps to reduce financing cost, we should observe that firms that maintain a strong relationship with their main lender face lower cost of debt (hypothesis H1). The interest rate discount follows from the argument that tying to a creditor that holds a dominant fraction of a company's debt should signal that the firm has a high credit quality (see Bris and Welch [2005]). Moreover, we would expect cost of debt to decrease with the duration of the lending relationship, since relationship lenders should pass on cost savings to their borrowers (Boot and Thakor [1994]). If, by contrast, we find that cost of debt increases with the strength and the duration of the lending relationship (hypothesis H2a), then this result indicates that relationship lenders hold-up their borrowers.

Results for the two conflicting hypotheses are presented in Table 5. In addition to the above-mentioned control variables, the basic regression model A1 includes the loan to bank capital ratio (to test the graduation hypothesis, see below) and the dummy variable *StrongRel*. Model A2 differs from model A1 in including firm fixed effects. Models A3 to A5 augment the basic model by considering different variables for the duration of the lending relationship. Models A3 to A5 are based on a subsample of companies for

[6] Most companies in the sample are organized in legal forms with, typically, a small number of owners, such as GmbHs or KGs. In general, owners then have better information and control rights than creditors and are sometimes directly involved in management.

which we have at least six years of observations. Specifically, we include companies only from the sixth observation onwards. The reason for this is that we do not have separate information on the duration of lending relationships, but can measure duration only by observing relationships over the sample period. We therefore focus on the second half of the sample in order to gain a meaningful and sufficient variation in duration. Besides, it is important to keep in mind that we measure duration by the number of subsequent years for which a bank has been a firm's main lender (and not by the number of subsequent years a bank has a relationship with the firm). Our measure of duration is thus shorter and the issue of censoring is less acute. Moreover, in our regressions we always control for the number of years a company has been included in the sample up to the current year (see the variable *Years in sample*), in order to differentiate between the impact of *Duration* and potential effects resulting from the inclusion in the sample.

Table 5 shows that relationship strength and duration differ in their impact on cost of debt, as already suggested by the descriptive evidence in section 4. Firms that maintain a strong relationship with their main lender have significantly lower financing cost. They obtain, on average, an interest rate discount of approximately 40 basis points compared to firms without a strong relationship (see models A1, A3 and A4). If we include firm fixed effects, the interest rate discount goes down considerably to 21 basis points (since a large fraction of the variance is taken out), but the variable is still significant (see model A2).

By contrast, duration has a positive impact on cost of debt, although the impact is generally weak. The positive sign is consistent with the prediction of a hold-up. If duration is considered as a linear term (see model A3), the influence is not significant. Duration exerts a significantly positive impact (at the 10% level) in model A4 where we consider it as a dummy variable. The variable *LongDuration* equals 1 if a bank has been a firm's main lender for at least five years. In model A5, we include an interaction term of *Duration* and *StrongRel* to test whether the influence of *Duration* interferes with the strength of the lending relationship.[7] The interaction term is indeed positively significant (at the 1% level). This shows that the interest rate discount granted to very close borrowers

[7]We omit the linear term of duration to simplify the interpretation of the quantitative results. If we include the linear term of duration, the variable has a positive sign, but is insignificant.

(i.e. relationships with $StrongRel = 1$) decreases over time. The combined effect of the variable $StrongRel$ and of the interaction term $Duration * StrongRel$ therefore indicates an intertemporal smoothing of interest rate conditions (in line with Sharpe [1990] and Petersen and Rajan [1995]). The coefficients of the two variables suggest, however, that the interest rate discount will vanish only after more than ten years.

One caveat to our results is that, due to the rough measurement of duration, our results may be noisy. We carry out robustness checks with respect to this issue below. Overall, the value of duration is downward-biased. This suggests that the interest rate advantage would disappear even later if duration could be measured accurately.

A further prediction of the hold-up hypothesis is that the impact of relationship strength and length on the spread depends on the position of other non-bank financial lenders, i.e. the share of debt which the company receives from other financial lenders. Specifically, for bank-dependent borrowers (i.e. if the fraction of non-bank lenders is low), we expect the cost-increasing effect of duration to be larger. Likewise, the cost-decreasing impact of strength should be smaller. Bank-dependent firms have less viable alternative financing sources, which should imply that the main bank has a greater bargaining power (hypothesis H2b). To investigate this hypothesis, we classify borrowers above the 75th (below the 25th) percentile of the ratio of total bank debt to financial debt as bank-dependent (not bank-dependent) borrowers. We successively restrict the sample to each group of borrowers and repeat regression models A1 and A4 (see models A6 to A9).

The evidence in Table 5 supports our prediction. For bank-dependent borrowers, the coefficient of the dummy variable *StrongRel* turns from negative into slightly positive and the variable is no longer significant (see models A6 and A8). Relationship strength then no longer has a cost-reducing effect. In addition, the coefficient of duration roughly doubles. This implies that bank-dependent borrowers that have a long relationship with their main lender face a clear net disadvantage. The interest rate premium equals more than 30 basis points (according to model A8).

By contrast, for non bank-dependent borrowers (see models A7 and A9), the cost-reducing impact of relationship strength is much more pronounced than in the reference models (models A1 and A4). Likewise, the cost-increasing effect of duration is considerably smaller than in the reference model (model A4). Companies with a long relationship to their main lender pay only a modest premium of 9 basis points. Together with the strong negative effect of relationship strength, non bank-dependent companies thus receive a substantial net advantage of tying to a relationship lender (of more than 60 basis points according to model A9).[8] This implies a difference of nearly 100 basis points between bank-dependent and non bank-dependent companies.

Finally, table 5 also provides evidence with respect to the *graduation* hypothesis. Accordingly, cost of debt depends positively on the size of the firm relative to the size of the bank. When firms are growing and their financing needs increase, small banks may not be willing to fulfil their loan demand or do so only against a premium. For small banks, larger loans imply concentration risks, whereas large banks still manage to be well diversified. The key factor is the ratio of the bank loan supply to the bank's capital, since capital restricts credit granting.

Regressions results are consistent with the graduation hypothesis. There is a significantly positive relationship between the interest spread and the loan to bank capital ratio (see models A1 - A5). The impact of the main bank's capital is also significant in economic terms: An increase by one standard deviation in the loan to bank capital ratio raises the interest rate spread by 17 to 26 basis points, depending on the model. This suggests that firms may want to switch to larger banks in order to avoid such an interest rate premium. The variable is not significant in models A6, A8 and A9, which are based on subsamples including only observations with a high or low share of bank debt. This restriction also limits the variance in the loan to bank capital ratio.

Cost of debt development around switching the main lender

In Table 6, we examine how the interest spread develops when the borrower switches to a new main lender (model B). In line with the above results, we find an interest rate discount in the year of the switch of the main lender. The interest rate discount is rather small in model B1 (4 basis points), but is somewhat larger and significant in model B2 including firm fixed effects (11 basis points). An interest rate advantage after a switch is consistent with a hold-up by the previous main lender (hypothesis H2c) as well as with the graduation hypothesis (hypothesis H3b). To differentiate between the two explanations,

[8] The spread premium/discount according to models A8 and A9 changes only slightly if we include an interaction term of *StrongRel* and *LongDuration*.

we subsequently examine how the characteristics of the previous main lender (before the switch) influence cost of debt (see models B3 - B6).

If the graduation hypothesis is true and borrowers switch lenders to improve their access to credit, we expect the interest rate advantage to be larger for borrowers that switch to a larger new main lender. Model B3 is in line with this prediction. Borrowers that change to a larger new main lender receive a significant interest rate advantage in the year of the switch. The discount equals 14 basis points. Switching to a main lender that is smaller than or of equal size to the previous one does not affect cost of debt at all.

We test the hold-up hypothesis in models B4 and B5. The hold-up hypothesis implies that the interest rate advantage after a switch is larger for i) borrowers that had a long relationship with their previous main bank as well as for ii) borrowers that maintained a strong relationship with their previous main bank. We find evidence that is consistent with both predictions. Borrowers that maintained a strong relationship with their previous main lender acquire a substantial interest rate discount after the switch (25 basis points, see model B4). By contrast, for borrowers that did not have a strong relationship with their previous main lender, financing cost does not change significantly after a switch. Finally, companies that have a long relationship with their previous main lender also acquire a considerable discount after a switch (17 basis points, see model B5), while companies with a short relationship face a slight increase. The discount for the first group is, however, not statistically significant.[9]

In model B6, we include both significant interaction terms of models B3 and B4 (in addition to the dummy variable *Switch*). The coefficient for borrowers that switch and had a strong relationship with the previous main lender remains roughly constant[10] and the variable remains statistically significant. However, the coefficient for borrowers switching to a larger bank goes down and is no longer significant. Our results concerning switching

[9]The fact that the interest rate discount is not statistically significant may be due to the smaller sample size for model B5 than for models B3 and B4.

[10]Please note that model B6 contains the dummy variable *Switch* which is not included in model B4. The marginal effect for borrowers that switch and had a strong relationship with the previous main lender therefore equals -26 basis points (-34+8) in model B6 , which is approximately -25 basis points as in model B4.

therefore support the hold-up hypothesis and provide some, albeit non-robust, evidence for the graduation argument. Overall, hold-up costs seem quantitatively to be more important than costs due to concentration risks in the lender's portfolio.

Comparison with recent literature

There are some recent related papers about duration and switching. Bharath et al. find that repeated borrowing from the same lender reduces cost of debt. Gopalan et al. document that firms switch banks to improve non-price conditions of loans (such as access to credit), but do not find a price-reducing impact of switching (as we found). Their results rather support the findings of Bharath et al.. Unlike the two papers, we find that cost of debt increases over the relationship. While our sample consists mainly of small and medium-sized companies, the sample of Bharath et al. and Gopalan et al. primarily comprises large firms.[11] In general, large firms have much better alternative funding sources than small and medium-sized ones and are hardly exposed to the risk of a hold-up. Potential price-decreasing effects from relationship lending may then become clearer. Overall, the results of Bharath et al. and Gopalan et al. are consistent with our finding that not bank-dependent borrowers benefit much more from relationship lending than bank-dependent ones.

Ioannidou and Ongena [2010] find that borrowers receive a discount after switching the lender. Over time, the new lender increases loan rates, so that the borrower has to pay a premium after some relationship years. This dynamic pattern is qualitatively in line with our findings. The quantitative effects, however, are much smaller in our study; in particular, the increase of loan rates over time is much slower.[12] Moreover, average

[11]Median firm assets equal USD 360 million in Bharath et al., in contrast to EUR 9 million in our sample.

[12]A comparison of results is generally difficult, owing, for example, to different methods and different measures. In Ioannidou and Ongena [2010], the interest rate discount equals 36 basis points 13 to 18 months after the switch. After a period of 37 months or longer, there is an interest rate premium of 191 basis points. In our study, the interest rate advantage after a switch equals 4 basis points (11 in the fixed effects model). After a period of 37 months or longer, there is an interest rate premium of only 8 basis points (calculated by a dummy variable, not reported in Table 5). Please note that, in Ioannidou and Ongena [2010], the interest rate development is derived from firm-bank loan level data and refers to new loans only. Since we do not have access to such detailed data, our measure is calculated on a higher

borrowers that have a strong relationship with their main lender receive a considerable interest rate advantage even after several relationship years. One reason for the different findings is that firms in our sample are larger than in Ioannidou and Ongena [2010] and are therefore less exposed to the risk of a hold-up. Moreover, while the two authors study the loan rate dynamics in an emerging market, we focus on an industrialized country with a much more competitive banking market. This implies that enforcing higher loan rates is much more difficult for the banks in our sample (see Petersen and Rajan [1995]).

5.3 Robustness checks

We carry out a number of robustness checks with respect to the measurement of relationship strength and duration. Since the main difference between regression model A (Table 5) and model B (Table 6) consists in the different interactions terms in model B, we focus for the tests of model B on the sensitivity of these terms.

Measuring relationship strength

Our proxy for relationship strength may be affected by truncation in the credit register. The variable *StrongRel* (derived from the largest bank loan divided by the total amount of bank debt) is based only on information from the credit register (due to the different definitions of debt in the credit register and the balance sheet statistics). However, since loans of less than EUR 1.5 million are reported only in part of the cases in the credit register (see Section 3), the variable may be biased and may overstate the importance of the largest lender. We therefore carry out several robustness checks with respect to our measure of relationship strength *StrongRel* in model A (see Table 7) as well as to the interaction term between *StrongRel* and *Switch* in model B (see Table 8). In Table 7, we repeat the most important regression models of Table 5 (namely model A1, A4 and A5), Table 8 shows the corresponding robustness checks for regression model B4 of Table

aggregation level. Our measure includes loans of banks and other financial debt and contains new loans and existing ones. If we assume that other financial lenders hold their financing conditions constant and adjust for the maturity of loans, the interest rate cut carried out by the main lender after a switch is, in our sample, smaller than or of equal size to that in Ioannidou and Ongena [2010], but the interest rate premium after a period of 37 months is substantially smaller (41 basis points).

6 (which includes the interaction term between *StrongRel* and *Switch*).[13]

First, as especially small companies are exposed to the problem of truncation, we exclude small companies (sales below median) from our sample (see models RobA1 to RobA3 in Table 7 and model RobB1 in Table 8). The coefficient of relationship strength tends to increase somewhat. The coefficient of the interaction term between *Switch* and *StrongRel* increases as well. In the regression models RobA2 and RobA3 in Table 7, the loan to bank capital ratio is no longer significant. This finding is somehow consistent with Gopalan et al. who, based on a sample including primarily companies, do not find a price-reducing effect of switching (as expected from the graduation argument).

Our second robustness check refers to a comparison of the debt level in the credit register and on the balance sheet. The idea is that the credit register shows a more reliable picture for those companies for which the sum of loans across all banks (according to the credit register) is relatively high compared to the debt on the balance sheet. Therefore, we restrict our observations to those companies for which the sum of loans in the credit register is at least 90% of the corresponding amount in the balance sheet statistics (see models RobA4 - RobA6 in Table 7 and model RobB2 in Table 8). Once again, the impact of relationship strength increases, as indicated by the coefficients of *StrongRel* and of the interaction term. Moreover, the profile over time (advantage at the beginning and increase over time, see model RobA6) becomes also more pronounced. Overall, results become clearer.

Third, we carry out an additional robustness check with respect to truncation by constructing an indicator of relationship strength which combines information from the credit register (CR) with the balance sheet statistics (BS). Data from these two data sources may differ because i) loans of less than EUR 1.5 million are reported only in part of the cases in the credit register and ii) data sources apply different definitions of debt. As we are interested only in the effects of truncation (i.e. i), we construct a new indicator in two steps. In the first step, we create an auxiliary variable which classifies a relationship as strong if

[13]Results remain qualitatively similar if we use model B6 instead of B4 as reference model.

$$StrongRel_{temp,it} = 1 \; if \frac{largest\ loan_{it}\ according\ to\ CR}{\sum bank\ loans_{it}\ according\ to\ BS} > 80\%.^{14}$$

$$StrongRel_{temp,it} = 0 \; otherwise$$

When we compare $StrongRel_{temp}$ with the indicator according to the original definition ($StrongRel$), three cases are possible. In the best case (i), the two variables are identical. If $StrongRel_{temp} = 0$ and the indicator according to the original definition is 1 (ii), this is probably due to truncation in the credit register as, for example, smaller exposures of other banks are not shown in the credit register. However, if $StrongRel_{temp} = 1$ and $StrongRel = 0$ (iii), this combination results from the fact that the balance sheet statistics in general apply a narrower definition of bank debt than the credit register. In this case, the new indicator would overstate the importance of the largest lender. We thus combine the two indicators in a single variable which contains the value of $StrongRel_{temp}$ in case ii and the value of $StrongRel$ in case iii:

$$StrongRel_{BSCR} = min[StrongRel, StrongRel_{temp}]$$

In models robA7 - robA9, $StrongRel$ is replaced by the new indicator $StrongRel_{BSCR}$. The effects of relationship strength generally decrease, but relationship strength remains significant at the 1% level. The profile over time is somewhat less pronounced (see model robA9). We also replace the interaction term between $Switch$ and $StrongRel$ by a new interaction term based on $StrongRel_{BSCR}$ (see model robB3 in Table 8). The coefficient of the interaction term roughly doubles, implying a larger difference between companies with and without a strong relationship with their main lender. Overall, the analyses concerning truncation in the credit register thus support the robustness of our results.

Another potential critical issue with respect to our measure of relationship strength is the threshold above which a relationship is classified as strong. We vary this threshold and increase (decrease) the threshold to 90% (70%), i.e. relationships are considered as strong

[14] We apply a narrow definition of debt and include only bank loans in the denominator (see discussion in Section 3)

if the main bank holds at least 90% (70%) of a company's total bank debt. The results for regressions carried out in Tables 5 and 6 do not change much (not reported).

Measuring relationship length

When we examine the influence of duration, we face the problem that we can measure duration only by observing relationships over the sample period. We therefore cannot accurately quantify the variable in all cases. In the first years of the sample, this issue is particularly relevant since the variation in duration is also much lower than in the last years of the sample. In our above regressions, we tried to tackle this problem in two ways: Firstly, we restricted the sample to companies for which we have at least six years of observations, i.e. we included the companies only from the sixth observation onwards. Secondly, we controlled for the number of years a company has been included in the sample up to the current year. Overall, it is important to keep in mind that our measure of duration is shorter than in other studies, since we measure duration by the number of subsequent years for which a bank has been a firm's main lender (and not by the number of subsequent years a bank has a relationship with the firm). This implies that we observe more switches and the issue of left and right censoring is less acute.

To test the sensitivity of our results with respect to the measurement of relationship length, we carry out an additional robustness check. We are able to correctly measure the value of duration for relationships which were established after the start of our sample. We therefore focus on firms that switched their main lender at least once over the sample period and confine the sample to the observations after the first observed switch. Moreover, the regressions include only those observations where no data gap occurred (see section 3). Results for models A3 - A5 of Table 5 are presented in Table 7 as models robA10 - robA12. As above, duration (measured as linear term) is not significant. If duration is captured as a dummy variable, duration is now not significant either (see model robA11). However, according to model robA12, the dynamic profile of relationship lending (i.e. discount at the beginning and increase over time) does not change. This pattern therefore seems to be robust.

We apply this robustness check also to model B5 of Table 6, which contains interaction terms of *Switch* and *LongDuration* (presented as model robB4 in Table 8). Results are similar to those above, i.e. differences between companies with and without a long relationship with their main lender can be observed, but are not statistically significant.

6 Conclusion

In this study, we examine how lending relationships affect a firm's cost of debt. We focus on the relationship with the main lender. We consider the impact of relationship strength - proxied by the share of debt provided by the main lender - and relationship length. Moreover, we also examine how cost of debt develops around switching the main lender. We use a unique, comprehensive dataset for Germany. The dataset consists of panel data of bank firm relationships over 12 years and contains firms of all size classes.

We find that cost of debt decreases with relationship strength, but rises with the duration of the lending relationship. However, the increase over time is rather weak. Companies with a strong and long relationship still enjoy a financing advantage. This finding is, however, only valid for average borrowers since the financing advantage also depends on the position of non-bank lenders. For bank-dependent borrowers, i.e. borrowers with a high percentage of total bank debt, there is a considerable interest rate premium after several relationship years. These results suggest that relationship banks are able to reduce information asymmetries, leading to benefits for borrowers, but also implying potentially larger costs in the medium to long term. Costs result from the information advantage acquired by the relationship bank, which enables the bank to hold-up the borrower. Our results for cost of debt development around switching the lender are consistent with this interpretation. We find that switching the main lender initially leads, on average, to a small price discount. However, this price discount is larger for borrowers that had a strong relationship with the previous lender, while the discount is not significant for borrowers without a strong relationship.

We also examine how the lender's characteristics affect cost of debt. We find that cost of debt increases with the amount of loans provided by the lender relative to the lender's capital. In addition, companies switching to a larger bank also receive a price discount, while there is no price discount for borrowers switching to a smaller bank or a bank of equal size. We interpret this finding as evidence for the graduation hypothesis, according to which companies switch to a larger bank to improve their access to credit.

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Appendix 1

The final dataset used in this study is composed of three different data sources. This appendix gives an overview of the single datasets and describes the matching process. For more detailed information on the single datasets, see Schmieder [2006], Stoess [2001] and Memmel and Stein [2008], for the matched dataset, see Memmel et al. [2007].

(i) *Credit register (MiMiK)*

The credit register contains quarterly data on large exposures of banks to individual borrowers or single borrower units (e.g. groups). Banks located in Germany are required to report if their exposures to an individual borrower or the sum of exposures to borrowers belonging to one borrower unit exceed the threshold of EUR 1.5 million once in the respective quarter.

In the credit register, the concept of indebtedness is broadly defined, i.e. the concept of credit encompasses a wide range of on-balance and off-balance sheet loans and bonds, but positions from the trading book are not included. In the database, several types of double-counting occur, primarily due to loans to civil-law associations ("Gesellschaften bürgerlichen Rechts"). The indebtedness of such associations is not only shown in the data of the respective association, but is also reflected in the indebtedness of individual borrowers that are partners of the civil-law association and liable for the association's debt. To prevent double-counting of exposures, we calculate the borrowers' indebtedness excluding their liabilities to civil-law associations. For the underlying study, the different sources for double-counting have been systematically investigated and taken into account in order to avoid misleading results.

(ii) *Corporate balance sheet data (Jalys/USTAN)*

Jalys/USTAN is one of the most comprehensive databases for German non-financial firms. The database was established for the Deutsche Bundesbank' s rediscount business. For the 1990s, the database contains annual data for up to 60,000 firms. Since 1998, the number of balance sheets in the sample has decreased, reaching a level of about 18,000 in 2004. This drop is connected to the fact that the discount credit facility in the context of bill-based lending was not included in the European Central Bank's set of monetary policy instruments (see Deutsche Bundesbank [2001]).

Two aspects are of special interest. While small SMEs tend to be underrepresented in the dataset, the data are extensive for both medium-sized and large companies. Second, as a result of the collection mechanism, a certain quality bias seems to exist. For the purpose of our study (where we predominantly use information for medium-sized and large companies), the bias is relatively limited (see Stoess [2001]).

(iii) *The balance sheet data of the German banks (BAKIS)*

This database comprises the annual balance sheets and profit and loss accounts of all German banks and of some types of financial service providers. In addition, it contains the yearly quantitative audit reports, which include information about the bank's loan quality. Due to the ongoing consolidation in the German banking sector, the number of institutions included in BAKIS went down from about 3,900 in 1993 to roughly 3,000 in 2004.

(iv) *Matched dataset*

For the purpose of this study, we merged data from all three data sources. Whereas the German credit register and the banks' balance sheet data (BAKIS) are linked by a common identifier for banks, the match between the credit register and the corporate balance sheet data (Jalys/USTAN) had to be carried out by comparing firm related information from the two data sources. The firms were matched based on six criteria: i) their name, ii) location, iii) legal form, iv) their industry, v) ratio of a firm's balance sheet indebtedness (as stated in the credit register) to bank loans (shown in the balance sheet data) and vi) ratio of a firm's total indebtedness (according to the credit register) to total debt (according to the balance sheet data). The last three criteria were primarily used as additional criteria in case of uncertainty about the validity of the match.[15] If information in the credit register and in the balance sheet database differed only to a minor extent regarding the first three criteria, we checked whether the respective firm changed its name, legal form or domicile. Furthermore, additional information from the internet was used to check the correctness of the match.

As mentioned above, we also compared a firm's indebtedness according to the credit register with a firm's indebtedness according to Jalys/USTAN for the match (criteria v and

[15]The industry classification is, to some extent, discretionary. For comparisons of indebtedness, see the discussion below.

vi). While these comparisons are generally meaningful, two caveats have to be mentioned: First, Jalys/USTAN contains only bank loans included in the balance sheet, whereas the credit register comprises on and off-balance sheet bank loans, and, information about the type of loan (on/off-balance sheet) is available from only mid-1996. Second, the two data sources apply different definitions of debt (see p. 8). Due to these differences, we used the ratio between the indebtedness according to the credit register and the indebtedness according to Jalys/USTAN only to indicate the correctness of the match.

We excluded 51 firms from our sample where two or more banks are equally important (measured by their exposures) and where we cannot determine a unique largest lender. We eliminated all observations from these firms (299 observations). Our matched dataset consists then of annual data for 3,741 firms (18,119 observations). Missing information for some variables reduces the size of the sample to 14,826 observations (or less) in the regressions.

In order to align the frequencies of the different data sources, the higher frequency of the quarterly credit register data was reduced by calculating four-quarter averages. While the alternative aggregation method, taking the values of the quarter to which the balance sheet (Jalys/USTAN) refers, may be more precise, our method may mitigate one of the shortcomings of the credit register, namely that only loans above EUR 1.5 million are included. By referring to averages of quarterly values, smaller loans which exceed the threshold in one quarter only are more likely to be captured.

Table 1: Distribution of coverage ratio

Quantiles				
10th	25th	50th	75th	90th
39.7%	72.2%	96.5%	104.3%	158.4%

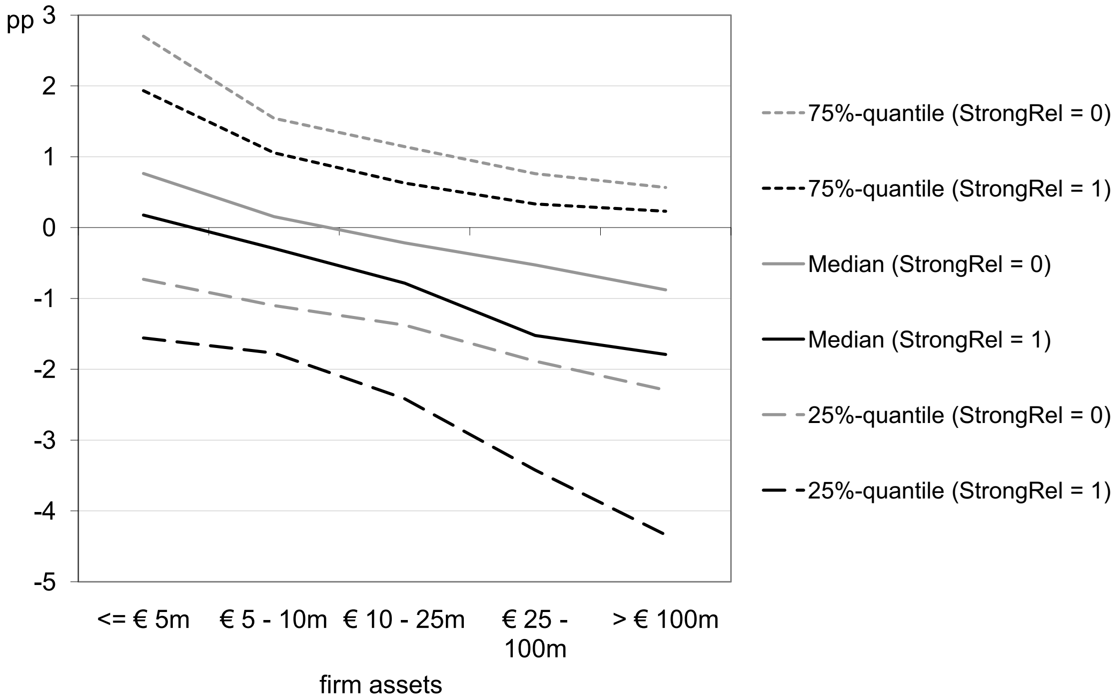
The coverage ratio is the ratio of a firm's total balance sheet indebtedness (according to the credit register) to the sum of bank loans (according to the corporate balance sheet database). The ratio is calculated using the credit register value of the quarter referred to on the balance sheet. The table shows the distribution of the coverage ratio of the observations in the sample. It can only be calculated for values from 1997 to 2004.

Table 2: Descriptive statistics

	25th Pct	Mean	75th Pct	Std. dev.	N
Cost of debt, relationship strength and duration and relative size of bank					
Spread (%)	-1.75	-0.24	1.20	2.41	16008
$\text{StrongRel}_{70\%}$ (%)		64.64		0.48	18119
StrongRel (%)		58.51		0.49	18119
$\text{StrongRel}_{90\%}$ (%)		53.07		0.50	18119
Switch (%)		15.81		0.36	15038
Duration (years)	1.00	3.47	5.00	2.63	18119
Loan to bank capital (%)	0.02	1.50	1.31	3.12	17244
Control variables about firm characteristics					
Total assets (EUR mn)	3.64	112.68	29.73	1460.16	18119
Sales (EUR mn)	5.23	107.94	41.34	890.31	18119
PD (%)	0.34	1.93	2.35	2.43	17522
Short-term loans (%)	44.98	68.61	100.00	29.78	18060
loans from associated companies (%)	0.00	12.40	12.46	23.29	18063
loans from owners (%)	0.00	15.88	22.97	24.23	18063
debt securities (%)	0.00	6.16	4.47	14.21	18063

Spread is a firm's annual average cost of debt minus the yield on German industrial bonds. *StrongRel* ($StrongRel_{70\%}/StrongRel_{90\%}$) is a dummy variable which equals 1 if the bank holds at least 80% (70%/90%) of a firm's total bank debt. *Switch* is a dummy variable which equals 1 if a firm has changed its main lender in the current period. *Loan to bank capital* is the amount of loans provided by the lender to the lender's capital. PD denotes probability of default.

Figure 1: Interest rate spread (in percentage points) for companies with and without strong relationship with their main lender



The figure shows the 25th quantile, the median and the 75th quantile of the interest rate spread, dependent on firm size class and the indicator for a strong relationship with the main lender (*StrongRel*). *StrongRel* equals 1 if a firm concentrates at least 80% of its borrowing at one bank. The interest rate spread is calculated as a firm's annual average cost of debt minus the yield on German industrial bonds.

Table 3: Interest rate spread and relationship length with main lender

	Interest rate spread (in percentage points)		
	25th Quantile	Median	75th Quantile
Switch of main lender in t	-2.28	-0.76	0.66
Duration 2 - 4 yrs	-1.96	-0.50	0.91
Duration $\geq$ 5 yrs	-1.64	-0.32	1.03

The table shows the quantiles of the interest rate spread subject to the length of the relationship with the main lender (= *Duration*), i.e. the sample is divided into three groups with respect to *Duration* and for each group quantiles are determined. The interest rate spread is calculated as a firm's annual average cost of debt minus the yield on German industrial bonds.

Table 4: Interest rate spread and relative size of main lender

loan to bank capital	Interest rate spread (in percentage points)		
	25th Quantile	Median	75th Quantile
small	-2.76	-0.77	0.97
medium	-1.65	-0.23	1.26
large	-1.25	0.03	1.50

The table shows the quantiles of the interest rate spread subject to the loan to bank capital ratio. The loan to bank capital ratio is the amount of loans provided by the main lender relative to the main lender's capital. For the table, the sample is divided into three groups with respect to the latter variable where small (large) indicates that the loan to bank capital ratio is below the 33th percentile (above the 67th percentile) of the distribution of the variable. For each group, quantiles of the interest rate spread are then determined. The interest rate spread is calculated as a firm's annual average cost of debt minus the yield on German industrial bonds.

Table 5: Cost of debt development over the relationship (Model A)

	(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)	(A9)
Loan to bank capital (in %, log)	0.086	0.072	0.059	0.059	0.057	0.032	0.081	-0.023	0.044
	(6.88)***	(7.41)***	(3.22)***	(3.21)***	(3.10)***	(1.37)	(4.03)***	(0.75)	(1.38)
StrongRel	-0.378	-0.211	-0.391	-0.395	-0.705	0.103	-0.653	0.004	-0.747
	(5.82)***	(4.79)***	(4.10)***	(4.18)***	(4.52)***	(1.02)	(4.63)***	(0.02)	(3.47)***
Duration			0.020						
			(1.29)						
LongDuration				0.152				0.324	0.091
				(1.69)*				(2.16)**	(0.42)
StrongRel*Duration					0.057				
					(2.66)***				
Total assets (log)	-0.228	-0.465	-0.200	-0.200	-0.192	-0.290	-0.162	-0.224	-0.169
	(8.24)***	(8.64)***	(5.28)***	(5.28)***	(5.09)***	(6.56)***	(3.51)***	(3.86)***	(2.45)**
PD (in %)	0.097	0.062	0.089	0.089	0.089	0.027	0.077	0.036	0.169
	(7.77)***	(6.03)***	(4.14)***	(4.12)***	(4.09)***	(1.61)	(2.20)**	(1.27)	(2.72)***
Short-term loans (in %)	-0.004	-0.006	-0.005	-0.005	-0.005	0.000	-0.011	-0.000	-0.015
	(4.04)***	(6.78)***	(3.16)***	(3.17)***	(3.13)***	(0.21)	(4.55)***	(0.13)	(4.31)***
Loans from assoc. comp. (in %)	-0.015	-0.004	-0.009	-0.009	-0.009	-0.004	0.002	-0.007	0.000
	(8.63)***	(3.35)***	(3.78)***	(3.81)***	(3.82)***	(0.61)	(0.88)	(1.09)	(0.08)
Loans from owners (in %)	-0.016	-0.009	-0.012	-0.012	-0.012	-0.023	0.002	-0.014	-0.003
	(10.17)***	(8.36)***	(5.35)***	(5.34)***	(5.34)***	(4.66)***	(0.78)	(2.38)**	(0.91)
Debt securities (in %)	-0.006	-0.003	-0.005	-0.005	-0.006	0.029	0.007	0.059	-0.001
	(2.77)***	(1.73)*	(1.46)	(1.46)	(1.54)	(2.59)***	(2.14)**	(3.39)***	(0.16)
Years in sample	0.013	0.045	0.012	0.015	0.009	0.048	0.059	0.040	-0.000
	(0.63)	(1.28)	(0.28)	(0.36)	(0.22)	(1.49)	(1.55)	(0.65)	(0.00)
Observations	14826	14826	5574	5574	5574	3707	3706	1549	1332
R-squared	0.19	0.20	0.16	0.16	0.16	0.22	0.08	0.17	0.10
year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
firm fixed effects	no	yes	no	no	no	no	no	no	no
min. number of years in sample	≥ 1	≥ 1	≥ 6	≥ 6	≥ 6	≥ 1	≥ 1	≥ 6	≥ 6
share of total bank debt	-	-	-	-	-	$\geq$ 75th pct	$\leq$ 25th pct	$\geq$ 75th pct	$\leq$ 25% pct

The table shows the results of OLS panel regressions (t-values in brackets). The standard errors are corrected for heteroscedasticity and firm-level clustering. The dependent variable is the interest rate spread. It is calculated as a firm's annual average cost of debt minus the yield on German industrial bonds (in percentage points). *Loan to bank capital* is the amount of loans provided by the lender to the lender's capital. *StrongRel* is a dummy variable which equals 1 if the lender holds at least 80% of a firm's total bank debt. Duration is the number of subsequent years for which a bank has been a firm's main lender. *LongDuration* is a dummy variable which equals 1 if *Duration* is larger than or equal to five years. PD denotes probability of default. *Years in sample* denotes the number of years for which the company has been included the sample (up to the current year). The last two rows of the table indicate whether regressions are based on subsamples. For regressions including information on duration, the sample is restricted to companies which have been included in the sample for at least six years, i.e. we include companies only from the sixth observation onwards. The last row indicates whether and how the sample is restricted with respect to the share of bank debt (i.e. a firm's share of total bank debt to financial debt). ***/**/* indicate statistically significant results at the 1%, 5% and 10% level, respectively. The regressions include a constant.

Table 6: Cost of debt development around switching the main lender (Model B)

	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)
StrongRel	-0.305	-0.202	-0.313	-0.299	-0.352	-0.301
	(4.33)***	(4.27)***	(4.42)***	(4.28)***	(3.76)***	(4.30)***
Switch	-0.035	-0.114				0.080
	(0.54)	(2.66)***				(0.99)
Switch*ML smaller or equal size			-0.004			
			(0.05)			
Switch*ML larger			-0.141			-0.128
			(1.76)*			(1.49)
Switch $*$ [StrongRel$_{t-1} = 1$]				-0.247		-0.336
				(2.01)**		(2.48)**
Switch $*$ [StrongRel$_{t-1} = 0$]				0.045		
				(0.65)		
Switch $*$ [LongDuration$_{t-1} = 0$]					0.060	
					(0.54)	
Switch $*$ [LongDuration$_{t-1} = 1$]					-0.168	
					(1.29)	
Loan to bank capital (in %, log)	0.078	0.057		0.078	0.064	
	(5.94)***	(5.54)***		(5.88)***	(3.49)***	
Total assets (log)	-0.208	-0.446	-0.172	-0.210	-0.210	-0.174
	(7.20)***	(7.72)***	(5.92)***	(7.21)***	(5.54)***	(5.99)***
PD	0.087	0.051	0.099	0.082	0.089	0.098
	(6.30)***	(4.63)***	(7.25)***	(5.94)***	(4.08)***	(7.21)***
Short-term loans (in %)	-0.005	-0.006	-0.006	-0.005	-0.005	-0.006
	(4.20)***	(7.10)***	(5.28)***	(4.10)***	(3.13)***	(5.28)***
Loans from assoc. comp. (in %)	-0.014	-0.004	-0.017	-0.014	-0.010	-0.016
	(7.80)***	(3.19)***	(9.21)***	(7.89)***	(3.99)***	(9.18)***
Loans from owners (in %)	-0.015	-0.007	-0.017	-0.015	-0.012	-0.017
	(9.17)***	(6.85)***	(10.58)***	(9.05)***	(5.34)***	(10.53)***
debt securities (in %)	-0.009	-0.005	-0.008	-0.009	-0.006	-0.008
	(3.58)***	(3.04)***	(3.29)***	(3.63)***	(1.51)	(3.34)***
Years in sample					0.022	
Observations	12499	12499	12222	12239	5517	12222
R-squared	0.15	0.16	0.14	0.15	0.16	0.15
year fixed effects	yes	yes	yes	yes	yes	yes
firm fixed effects	no	yes	no	no	no	no
min. number of years in sample	≥ 1	≥ 1	≥ 1	≥ 1	≥ 6	≥ 1

The table shows the results of OLS panel regressions (t-values in brackets). The standard errors are corrected for heteroscedasticity and firm-level clustering. The dependent variable is the interest rate spread. It is calculated as a firm's annual average cost of debt minus the yield on German industrial bonds (in percentage points). *StrongRel* is a dummy variable which equals 1 if the lender holds a share of at least 80% of a firm's total bank debt. *Switch* is a dummy variable which equals 1 if the firm has changed its main lender in the current period. *Switch* is interacted with characteristics of the previous main lender. *ML larger* (*ML smaller or equal size*) is a dummy variable which is equal to 1 if the current main lender is larger than (smaller than or of equal size to) the previous one. *LongDuration* is a dummy variable which equals 1 if the bank has been the firm's main lender for at least 5 years. *Loan to bank capital* is the amount of loans provided by the main lender to the main lender's capital. PD denotes probability of default. *Years in sample* denotes the number of years for which the company has been included the sample (up to the current year). The last row of the table indicates whether the regression is based on a subsample. For model B5, which includes an interaction term of *Switch* and *LongDuration*, the sample is confined to companies which have been included in the sample for at least six years, i.e. we include companies only from the sixth observation onwards. ***/**/* indicate statistically significant results at the 1%, 5% and 10% level, respectively. The regressions include a constant.

Table 7: Robustness Checks for Model A (table 5)

	(RobA1)	(RobA2)	(RobA3)	(RobA4)	(RobA5)	(RobA6)	(RobA7)	(RobA8)	(RobA9)	(RobA10)	(RobA11)	(RobA12)
restriction	only large firms			cov. ratio $\geq$ 90%			ind. BS & CR			obs after switch		
reference model	A1	A4	A5	A1	A4	A5	A1	A4	A5	A3	A4	A5
loan to bank capital (in %, log)	0.053	0.036	0.033	0.092	0.062	0.059	0.089	0.063	0.062	0.067	0.068	0.067
	(3.00)***	(1.52)	(1.38)	(5.30)***	(2.60)***	(2.47)**	(7.17)***	(3.47)***	(3.41)***	(3.65)***	(3.68)***	(3.59)***
StrongRel	-0.511	-0.480	-0.776	-0.549	-0.555	-0.957				-0.538	-0.534	-0.687
	(5.63)***	(4.02)***	(3.67)***	(6.02)***	(4.53)***	(4.54)***				(5.20)***	(5.20)***	(4.97)***
$\text{StrongRel}_{\text{BSCR}}$							-0.218	-0.242	-0.578			
							(3.53)***	(2.60)***	(2.98)***			
Duration										0.022		
										(0.86)		
LongDuration		0.059			0.111			0.102			0.134	
		(0.52)			(0.96)			(1.14)			(1.15)	
StrongRel*Duration			0.051			0.067						0.056
			(1.75)*			(2.38)**						(1.72)*
$\text{StrongRel}_{\text{BSCR}}$*Duration									0.055			
									(2.06)**			
Total assets	-0.202	-0.144	-0.136	-0.232	-0.226	-0.215	-0.191	-0.171	-0.168	-0.202	-0.202	-0.199
	(4.78)***	(2.74)***	(2.61)***	(6.76)***	(4.93)***	(4.68)***	(7.30)***	(4.68)***	(4.64)***	(5.11)***	(5.12)***	(5.05)***
PD (in %)	0.123	0.151	0.153	0.114	0.116	0.115	0.095	0.086	0.086	0.081	0.081	0.081
	(4.61)***	(3.88)***	(3.92)***	(6.46)***	(4.24)***	(4.19)***	(7.61)***	(3.97)***	(3.97)***	(3.37)***	(3.36)***	(3.36)***
Short-term loans (in %)	-0.005	-0.006	-0.006	-0.005	-0.006	-0.005	-0.004	-0.005	-0.004	-0.004	-0.004	-0.004
	(2.82)***	(2.78)***	(2.74)***	(3.11)***	(2.90)***	(2.84)***	(3.78)***	(2.97)***	(2.89)***	(2.28)**	(2.29)**	(2.26)**
loans from assoc. comp. (in %)	-0.012	-0.006	-0.006	-0.013	-0.010	-0.009	-0.015	-0.010	-0.009	-0.009	-0.009	-0.009
	(5.17)***	(2.12)**	(2.07)**	(6.57)***	(3.74)***	(3.64)***	(8.64)***	(3.92)***	(3.86)***	(3.54)***	(3.55)***	(3.57)***
loans from owners (in %)	-0.013	-0.012	-0.012	-0.014	-0.012	-0.012	-0.016	-0.012	-0.012	-0.011	-0.011	-0.011
	(6.78)***	(4.44)***	(4.43)***	(7.68)***	(4.68)***	(4.61)***	(9.97)***	(5.32)***	(5.27)***	(4.38)***	(4.39)***	(4.39)***
debt securities (in %)	-0.007	-0.000	-0.000	0.001	0.001	0.000	-0.006	-0.005	-0.005	-0.007	-0.007	-0.007
	(2.11)**	(0.04)	(0.06)	(0.30)	(0.17)	(0.10)	(2.47)**	(1.37)	(1.40)	(1.82)*	(1.83)*	(1.87)*
Years in sample	0.043	0.075	0.072	0.016	0.030	0.022	0.026	0.030	0.024	0.010	0.010	0.009
	(1.43)	(1.42)	(1.36)	(0.52)	(0.52)	(0.38)	(1.29)	(0.70)	(0.57)	(0.29)	(0.30)	(0.26)
Observations	7413	3406	3406	8206	3501	3501	14826	5574	5574	4852	4852	4852
R-squared	0.16	0.15	0.15	0.17	0.17	0.17	0.19	0.15	0.15	0.14	0.14	0.14
min. number of years in sample	≥ 1	≥ 6	≥ 6	≥ 1	≥ 6	≥ 6	≥ 1	≥ 6	≥ 6	-	-	-

The table shows robustness checks for different regression models included in Table 5. t-values are shown in brackets. The standard errors are corrected for heteroscedasticity and firm-level clustering. The first row shows which restriction is considered in the robustness check. *Only large firms* indicates that the sample includes only companies above the median size. *Cov. ratio* denotes the coverage ratio, which is defined as the sum of loans across all banks according to the credit register relative to bank debt on the firm's balance sheet. *ind. BS & CR* denotes that the indicator for strong relationship is derived by combining information from the credit register and the firm balance sheet. *obs after switch* shows that the sample includes only observations after the first observed switch of the main lender. The second row contains the reference model of Table 5. *StrongRel* is a dummy variable which equals 1 if the lender holds at least 80% of a firm's total bank debt (according to the credit register). $StrongRel_{BSCR}$ is defined as *StrongRel*, but combines information from the credit register and the balance sheet statistics. For the definition of the remaining variables see Table 5. The last row of the table indicates whether regressions are based on subsamples. For several regression models, the sample is confined to companies which have been included in the sample for at least six years, i.e. we include companies only from the sixth observation onwards. ***/**/* indicate statistically significant results at the 1%, 5% and 10% level, respectively. The regressions include a constant.

Table 8: Robustness Checks for Model B (table 6)

	(robB1)	(robB2)	(robB3)	(robB4)
restriction	only large firms	cov. ratio $\geq$ 90%	ind. BS & CR	obs after switch
reference model	B4	B4	B4	B5
loan to bank capital (in %, log)	0.046	0.082	0.080	0.066
	(2.49)**	(4.56)***	(6.10)***	(3.53)***
StrongRel	-0.451	-0.456		-0.539
	(4.78)***	(4.83)***		(5.20)***
$\text{StrongRel}_{\text{BSCR}}$			-0.134	
			(2.01)**	
Switch $*$ $[\text{StrongRel}_{t-1} = 1]$	-0.386	-0.538		
	(2.15)**	(2.99)***		
Switch $*$ $[\text{StrongRel}_{t-1} = 0]$	0.053	0.102		
	(0.63)	(1.09)		
Switch $*$ $[\text{StrongRel}_{\text{BSCR},t-1} = 1]$			-0.587	
			(3.42)***	
Switch $*$ $[\text{StrongRel}_{\text{BSCR},t-1} = 0]$			0.104	
			(1.58)	
Switch $*$ $[\text{LongDuration}_{t-1} = 0]$				-0.006
				(0.07)
Switch $*$ $[\text{LongDuration}_{t-1} = 1]$				-0.129
				(1.01)
Total assets	-0.185	-0.223	-0.178	-0.198
	(4.31)***	(6.30)***	(6.46)***	(4.98)***
PD (in %)	0.112	0.099	0.081	0.079
	(3.90)***	(5.29)***	(5.84)***	(3.24)***
Short-term loans (in %)	-0.005	-0.004	-0.005	-0.004
	(3.05)***	(2.88)***	(3.90)***	(2.42)**
loans from assoc. comp. (in %)	-0.012	-0.014	-0.014	-0.009
	(4.88)***	(6.58)***	(7.88)***	(3.50)***
loans from owners (in %)	-0.013	-0.015	-0.015	-0.011
	(6.27)***	(7.72)***	(8.89)***	(4.27)***
debt securities (in %)	-0.008	-0.003	-0.008	-0.007
	(2.44)**	(0.80)	(3.44)***	(1.86)*
Observations	6593	7147	12239	4772
R-squared	0.14	0.16	0.15	0.14
year fixed effects	yes	yes	yes	yes

The table shows robustness checks for different regression models included in Table 6. t-values are shown in brackets. The standard errors are corrected for heteroscedasticity and firm-level clustering. The first row shows which restriction is considered in the robustness check. *Only large firms* indicates that the sample includes only companies above the median size. *Cov. ratio* denotes the coverage ratio, which is defined as the sum of loans across all banks according to the credit register relative to bank debt on the firm's balance sheet. *ind. BS & CR* denotes that the indicator for strong relationship is derived by combining information from the credit register and the firm balance sheet. *obs after switch* shows that the sample includes only observations after the first observed switch of the main lender. The second row contains the reference model of Table 6.
StrongRel is a dummy variable which equals 1 if the lender holds at least 80% of a firm's total bank debt. $StrongRel_{BSCR}$ is defined as *StrongRel*, but combines information from the credit register and the balance sheet statistics. *Switch* is a dummy variable which equals 1 if the firm has changed its main lender in the current period. *Switch* is interacted with characteristics of the previous main lender. For the definition of the remaining variables see Table 6. ***/**/* indicate statistically significant results at the 1%, 5% and 10% level, respectively. The regressions include a constant.

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