Relationship lending – empirical evidence for Germany

Christoph Memmel
(Deutsche Bundesbank)

Christian Schmieder
(Deutsche Bundesbank and European Investment Bank)

Ingrid Stein
(Deutsche Bundesbank)

Discussion Paper
Series 2: Banking and Financial Studies
No 14/2007

Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-1
Telex within Germany 41227, telex from abroad 414431

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet http://www.bundesbank.de

ISBN 978-3–86558–355–0 (Printversion)
ISBN 978-3–86558–356–7 (Internetversion)

Abstract

Relationship lending is a common practice in credit financing all over the world, particularly in Germany. On the basis of a comprehensive data set comprising information on firm-bank relationships for more than 16,000 observations, this study analyses the determinants of relationship lending in Germany. We find that small, young and R&D-intensive firms tend to choose relationship lending. Furthermore, we find that firms with a higher creditworthiness are more likely to choose a relationship lender. We find that the importance of relationship lending stayed roughly constant since the mid 90s.

JEL classification: G21; G32

Keywords: Relationship banking; German banking system; SME

Non technical Summary

When applying relationship lending, bank and entrepreneur are engaged in a close relationship. During the last years, there has been the impression that relationship lending loses ground. Quantitative rating systems and new developments in the banking industry, for instance securitization, were believed to repress relationship lending. Considering the traditional prevalence of relationship lending in Germany, a change in the banks' business model may have a large impact on economic growth and employment, especially for the small and medium-sized firms, which fund themselves to a large degree with bank loans.

The aim of the present study is twofold: First, we analyze, which determinants influence the choice of a housebank and, second, we check, whether relationship lending lost ground in Germany. Our main contribution to the literature is our data set: The data set we use in this paper is significantly larger than the ones used in the literature so far. Moreover, the data set is not only composed of a cross-section of firms, but there are time series of each firm, so that we are able to keep track of the lending relationships.

The results of our study can be summarized in three core statements: (i) Especially small, young and R&D intensive firms seek a housebank as their lender. This result is in line with the theory: Especially those firms have problems to convince potential lenders of the quality of their projects. (ii) Firms of high creditworthiness tend to opt for relationship lending. (iii) Contrary to the presumption from above, there are no hints that relationship lending in Germany has lost ground in the last years.

Nicht-technische Zusammenfassung

Beim Hausbankprinzip ("Relationship lending") gehen Bank und Unternehmer eine enge Bindung ein. Während der vergangenen Jahre entstand der Eindruck, dass das Hausbankprinzip an Bedeutung verliert. Quantitative Ratingsysteme und neuere Entwicklungen im Bankgeschäft, wie zum Beispiel Verbriefungen, - so war die Vermutung - würden das Hausbankprinzip zurückdrängen. Vor dem Hintergrund der traditionell großen Verbreitung des Hausbankprinzips in Deutschland könnte eine Veränderung der Geschäftspraxis der Banken weitreichende Folgen für Wachstum und Beschäftigung haben, besonders für den Mittelstand, der sich typischerweise in hohem Umfang über Kredite finanziert.

Ziel der vorliegenden Studie ist zweierlei: Zum einen untersuchen wir, welche Faktoren die Entscheidung für eine Hausbank beeinflussen, und zum anderen überprüfen wir, ob das Hausbankprinzip in Deutschland tatsächlich an Bedeutung verloren hat. Unser Beitrag gegenüber der bisherigen Literatur liegt vor allem in dem Datensatz: Der hier verwendete Datensatz ist deutlich umfangreicher. Außerdem handelt es sich dabei nicht einfach um Daten für einen Querschnitt von Firmen, sondern für jede Firma liegen Zeitreihen vor, so dass wir grundsätzlich auch die zeitliche Entwicklung der Kreditbeziehungen verfolgen können.

Die Ergebnisse unserer Studie lassen sich in drei Kernaussagen zusammenfassen. (1) Besonders kleine, junge und forschungsaktive Unternehmen suchen eine Hausbank als Kreditgeber. Dieses Ergebnis steht im Einklang mit der Theorie, denn gerade diesen Unternehmen fällt es schwer, potentielle Kreditgeber von ihrem Projekt zu überzeugen. (2) Vor allem bonitätsstarke Unternehmen wählen eine Hausbank. (3) Entgegen der obigen Vermutung finden wir keine Hinweise dafür, dass das Hausbankprinzip in Deutschland an Bedeutung verloren hat.

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Relationship lending – Empirical evidence for Germany[1]

1 Introduction

It is common practice in credit financing for close ties to exist between firms and banks, termed *relationship lending*. Relationship lending exists all over the world, including market-oriented banking systems such as the United States.[2] One of the countries where relationship lending is supposed to be especially prevalent is Germany, often cited as the classical example of a bank-based system with strong customer-borrower-relationships (see, eg, Elsas and Krahnen (1998)). The so-called housebanks are supposed to be particularly important for the financing of small and medium-sized companies, which play a crucial role in the German economy.

Given the importance of relationship lending in Germany it is remarkable that there are only a limited number of contributions on this subject. In this study, we focus on the influence of borrowers' characteristics. We examine the importance of two issues. First, it is typically assumed that relationship lending helps to reduce information asymmetries between borrower and lender by the close contact between the two parties. Therefore, companies that are especially exposed to high information problems, such as small, young companies and companies with a high R&D intensity, should choose a relationship lender. The evidence of our study is broadly consistent with these predictions.

The second issue refers to a firm's creditworthiness. The influence of a firm's credit quality on relationship lending is seen contradictorily in the theoretical literature.

[1] Christoph Memmel and Ingrid Stein: Deutsche Bundesbank. Christian Schmieder: Deutsche Bundesbank and European Investment Bank. This paper represents the authors' personal opinions and does not necessarily reflect those of the Deutsche Bundesbank or the European Investment Bank. We thank Wolfgang Bessler, Ralf Elsas, Bronwyn Hall, Martin Hellwig, Wouter van Overfelt, Andreas Pfingsten, Birgit Schmitz, Isabell Schnabel, Mechthild Schrooten and the participants at the GBSA 2006 Workshop, the Kleistvilla Workshop 2006, the Verein fuer Socialpolitik 2006 Annual Congress, the DGF 2006 Annual Meeting, MPI Bonn seminar, the SGF 2007 Annual Meeting, the FMA 2007 European Conference, the 2007 Meeting of the Bundesbank Research Council and the Bankenworkshop 2007 at the University Muenster for fruitful comments.

[2] See, eg, Petersen and Rajan (1994) and Boot (2000).

Depending on the model a firm's credit quality influences the likelihood of relationship lending negatively (Bolton and Scharfstein (1996)), positively (von Thadden (2004)) or the relation is inversely u-shaped (Rajan (1992)). Our study shows that firms of a high credit quality tend to choose a relationship lender and is therefore in line with the predictions of von Thadden (2004). He explains this result by a positive selection process over time where bad firms are more likely to switch from a relationship lender to an arm's-length bank than high quality firms do.

Finally, we also examine whether the importance of relationship lending decreased since the mid 90s. Due to better information processing facilities, more sophisticated rating tools and the growth of securitization market banks are supposed to become more and more to credit factories. However, we cannot observe such a trend for Germany.

We differ from previous empirical papers in several ways: Unlike most studies for Germany (see Elsas (2005), Machauer and Weber (2000) and Neuberger and Räthke (2006)) or other countries (see eg Detragiache et al. (2000)), our analysis is based on a comprehensive database. The data set used for this study comprises a total of around 16,000 observations with an annual frequency for the period from 1993 to 2004. Moreover, in contrast to previous literature our data set is not only a cross-section of observations, but contains also the time dimension. Thus, we are able to study how differences between firms and differences over time influence relationship lending. Finally, our definition of relationship lending differs from the literature which, except to Elsas (2005), refers only to the number of lending relationships as indicators for relationship lending.[3] While this variable is certainly related to the concept of relationship lending, it is too restrictive regarding large companies as such companies typically have several lending relationships. Hence, we focus on the degree of concentration of debt on one bank, but consider also the number of lending relationships.

The paper is organized as follows. Section 2 outlines the hypotheses on the nature

[3] This statement applies to the literature regarding the determinants of relationship lending. Papers which take relationship lending as explanatory variable take a richer set of variables.

of relationship lending in Germany. In Section 3 we provide an overview of the underlying data set. Section 4 addresses descriptive statistics and shows first results. The results of the regressions are presented in Section 5. Finally, section 6 concludes.

2 Hypotheses

We will begin with a short overview on the theoretical literature investigating the importance of borrower characteristics for relationship lending; this represents the starting point for the empirical analysis. We will summarise the predictions in three hypotheses.

In their review of the financial intermediation literature, Bhattacharaya and Thakor (1993) conclude that informational frictions - asymmetric information and proprietary information - "provide the most fundamental explanation for the existence of (financial) intermediaries". This characterisation of banks applies particularly for relationship lenders. Relationship lending implies close ties between borrower and lender; this facilitates the information exchange between the two parties and thereby enables credit rationing to be avoided. Lenders invest in gathering information from their client firms, and borrowers are more inclined to reveal proprietary information.

As information asymmetries are especially large for small, young companies, we expect that relationship lending will be more likely if a company is relatively small and young. In our analysis, we take the logarithm of the company's assets and of the time since the company's formation as a proxy for size and age, respectively. Furthermore, we expect relationship lending to become more likely if the firm is R&D or knowledge-intensive, as proprietary information exists in such companies. As the firm's R&D intensity cannot be directly measured, we alternatively refer to information on the R&D and knowledge intensity of the firms' industry sector. The preceding discussion leads us to hypotheses 1 and 2:

Hypothesis 1: The probability of relationship lending decreases with the borrower's size and age.

Hypothesis 2: The probability of relationship lending increases with the R&D and knowledge intensity of the borrower's industry.

Relationship lending does not only come along with benefits, but also with costs. For example, companies with a relationship lender may face only a soft-budget constraint which makes it difficult for the relationship lender to enforce the credit contract (Bolton and Scharfstein (1996), see also Dewatripont and Maskin (1995)). In the event of a default, it is much easier for the company to renegotiate the debt contract if there is one main creditor than if there were multiple creditors. Thus, companies with a relationship lender have a greater incentive to default strategically, while firms with a large number of creditors tend to be disciplined by their lenders. However, the costs of inefficient renegotiation which exist with multiple creditors prevail also if the firm defaults for liquidity reasons. Thus, there exists a trade off between preventing strategic defaults (best achieved with multiple creditors) and low cost of renegotiation in case of liquidity defaults (best achieved with one creditor). As companies of low credit quality face a substantial risk of a liquidity default, they should especially make sure that they receive high liquidation values and choose one creditor or at least concentrate their borrowing on one bank, the relationship lender.

Partly contradictory results are delivered by the models of Rajan (1992) and von Thadden (2004). The model of Rajan (1992) shows an additional reason why relationship lending may be costly, namely the hold-up problem. Unlike arm's-length lenders, relationship lenders obtain private information about borrowers which enables them to stop inefficient projects, but gives them also an "information monopoly". They could threat not to prolong a loan, thereby enforcing relatively high interest rates and reducing the incentives of the firm's owner. Thus, relationship lending is valuable for stopping inefficient projects whereas arm's length debt is good for providing high incentives. Rajan shows that firms of low credit quality prefer arm's-length debt, whereas firms with medium-quality projects tend to choose a relationship lender. High quality firms are indifferent.

The model of von Thadden (2004) analyzes also the hold-up-problem, but, unlike Rajan (1992), it is assumed that binding long-term contracts are not possible (see

also Sharpe (1990)). At the refinancing stage, the terms of the credit contract are then determined by competition between the inside (relationship) lender and potential outside investors. He shows that there is a positive selection process where bad firms are more likely than high quality firms to switch from the insider lender to an arm's-length bank. Therefore, high-quality firms are more likely to be financed by relationship lenders.

We measure a firm's creditworthiness with its probability of default (PD), which is derived from a separate model.

Hypothesis 3 summarises the above discussion:

Hypothesis 3: The probability of relationship lending depends on the borrower's creditworthiness.

Hypothesis 3a: The probability of relationship lending decreases with the borrower's creditworthiness. [Bolton and Scharfstein (1996)]

Hypothesis 3b: The probability of relationship lending is low for firms of low credit quality, high for medium-quality firms and mediocre for high-quality firms. [Rajan (1992)]

Hypothesis 3c: The probability of relationship lending increases with the borrower's creditworthiness. [von Thadden (2004)]

3 Data

Next, we shall present the data used for our empirical study, namely the databases used to compose the final data set underlying the actual study and the respective data set referred to.

The final database used in this study is composed of three different databases of the Deutsche Bundesbank: i) the German credit register ("MiMiK"), containing single bank-firm credit relationships, ii) balance sheet data of German firms

("Jalys/Ustan") and iii) balance sheet data and audit reports of German banks ("BAKIS"). The data set used for this study thereby provides information as to whether a bank grants credit to a specific firm (through data set i) as well as the characteristics of the corresponding firms (ii) and banks (iii).

(i) *Credit register (MiMiK)*

The credit register contains quarterly data on large exposures of banks to individual borrowers or single borrower units (eg groups). Banking institutions located in Germany are required to submit reports if their exposures to an individual borrower or the sum of exposures to borrowers belonging to one borrower unit exceeds the threshold of EUR 1.5m (formerly DEM 3m) once in the respective quarter.[4] As the banks have to report the quarter-end indebtedness, and due to the borrower unit rule, a significant portion of single exposures in the database are below EUR 1.5m (see Schmieder (2006).) In the German credit register, the concept of indebtedness is broadly defined, i.e. the concept of "credit" comprises a wide range of on-balance and off-balance sheet loans and bonds, but positions of the trading book are not included.[5]

The information contained in the credit register is considerable and makes it a valuable basis for research projects: In the last quarter of 2004, for example, the credit register contained more than 750,000 reported bank-borrower-relationships. Besides credit exposure, the German credit register collects other information about borrowers, namely their name, domicile, country, legal form, assignment to a borrower unit and the industry sector. As for the lender, the name and banking group are recorded.

When using this register for academic purposes, one has to be very careful in order to avoid double-counting exposures contained in the credit register.[6] For the underlying study, sources for double-counting have been systematically investigated and taken into account as outlined below in order to avoid misleading results. First, the credit

[4] See section 14 of the German Banking Act.

[5] In 1996 changes were made to the definition of credit exposures and reporting institutions. In particular, credit derivatives were included in the definition of credit exposures and the concept of "single borrower unit" was extended to include risk units.

[6] The reason is that the German credit register was established for regulatory purposes and not primarily for academic studies. See also Schmieder (2006)

register does not only contain direct loans, but also guarantees, namely cases where banks provide a guarantee for a loan of another bank. In the latter case, the name of the bank which benefits from the guarantee is not available. Given that both a direct loan and a guarantee show a lending relationship omitting guarantees for the current analysis would be misleading. The consequence is as follows: while the inclusion of guarantees may overstate exposures at the disaggregated level of single firm-bank relationships (which will be taken into account), the credit register nets out guarantees at the borrower level.

Second, double-counting may occur because of 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, loans to civil-law associations are omitted from our analysis, and we calculate the borrowers' indebtedness excluding their liabilities to civil-law associations.

Third, the indebtedness of borrower units may be overstated, as it is calculated simply by summing up all loans to borrowers belonging to this unit. Compared with balance sheet data of a proportionate consolidated group, the sum of loans in the credit register may be much higher than in the balance sheet. However, given the very limited number of borrower units in this study (11 of 3231 companies), the effect can be regarded as negligible.

ii) *Corporate balance sheet data*

Jalys/USTAN, the corporate balance sheet database of the Bundesbank, is one of the most comprehensive databases for German non-financial firms. 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 (see below). Balance sheet information is available for roughly 140 items (both from tax or trade balances). Furthermore, the database contains information on the firms' industry sectors, domicile, founding year, number of employees and type of

accounts[7].

The Jalys/USTAN database was established for the rediscount business of the Deutsche Bundesbank. Until 1999, the Bundesbank was required to purchase bills of exchange that were backed by three parties known to be solvent. German firms were obliged to submit their annual accounts to the Bundesbank for examination of their creditworthiness. The drop in the number of accounts since 1998 is connected to the fact that the discount credit facility in the context of bill-based lending was not included by the European Central Bank in its set of monetary policy instruments (see Bundesbank (2001)).

Two aspects are of special interest. First, small SMEs tend to be underrepresented in the data set, particularly for the more recent years. However, one has to keep in mind that, contrary to other data sets, SMEs are included in the first place and that the data are extensive for both medium-sized and large companies. Second, resulting from the collection mechanism a certain quality bias seems to exist. For the 1990s, the bias is relatively limited (see Stoess (2001)). For the period since 2000, the data set is representative for medium-sized and large companies, but, concerning smaller firms (ie smaller SMEs), there is a bias towards high-quality firms (see Ismer et al. (2007)). We will account for this fact in the regressions.

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

This database comprises the annual balance sheets and profit & loss accounts of all German banks and of some types of financial service providers (trade balances). In addition, it contains the yearly quantitative audit reports, which include information about the bank's loan quality and its regulatory capital. The database consists of up to about 250 items of the annual accounts and 300 items of the audit reports. 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 data set*

For the purpose of this study, we used merged data from all three data sources.

[7] The structure of the accounts changed for balance sheets collected after 2002. In general, the structure became more detailed. For some positions, though, a one-to-one translation of the old scheme to the new one is not possible.

Whereas the German credit register and the balance sheet data of German banks (BAKIS) are based on a common identifier for banks and can therefore be easily merged, the match between the credit register and the corporate balance sheet data proved being difficult as there is no common identifier for the firms: The firms were matched based on five criteria: i) their name, ii) location, iii) legal form, iv) their industry and v) an indicator comparing a firm's total indebtedness as stated by the credit register relative to bank loans shown by the balance sheet data. The last two criteria were primarily used as additional criteria in case of uncertainty about the validity of the match.[8] If two firms in the credit register and in Jalys/USTAN differed only to a minor extent regarding the first three criteria, we checked whether the firm changed its name, legal form or domicile. Besides, 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 and a firm's bank loans according to Jalys/USTAN for the match. While this comparison is generally meaningful, two caveats have to be mentioned for the underlying case: First, Jalys/USTAN contains only bank loans included in the balance sheet. The credit register, however, comprises on- and off-balance sheet bank loans, and information about the type of loan is only available from mid-1996. Second, the two data sources refer to different definitions. Whereas Jalys/USTAN applies a legal definition of indebtedness, the credit register follows an economic perspective: a firm's bonds (or bills of exchange) hold by a bank are classified as bonds (or bills of exchange) in the corporate balance sheet statistics, for example, but as bank loans 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 Jalys/USTAN. Besides, the credit register may also understate a firm's bank loans: Written off loans, for example, are not included in the credit register yet are included in Jalys/USTAN. Due to these differences, we used the ratio between the indebtedness according to the credit register and bank

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

loans in Jalys/USTAN only to indicate the correctness of the match.

We matched 3,288 firms for which the credit register and Jalys/USTAN contained overlapping data at least for one year. We eliminated 57 firms (or 277 observations) where the total indebtedness according to the credit register exceeded total assets according to Jalys/USTAN, therefore making data errors very likely.[9] The final match data set used for this study consists of annual data for 3,231 firms of which only 11 companies are borrower units, for the period from 1993 to 2004.

In order to align the data sources with one another, the higher frequency of the quarterly credit register data was reduced in two ways: i) by taking the values of the quarter to which the accounts (Jalys/USTAN) refer to and ii) by calculating four-quarter averages. Whereas the former method is more precise, the latter method may mitigate one of the shortcomings of the credit register, namely that only loans above EUR 1.5m are included. By referring to averages of quarterly values (case ii), smaller loans which exceed the threshold only in one quarter are more likely to be captured. Our final data set contains 15,947 observations when aggregating with method i) and 16,349 observations when aggregating with method ii).

The resulting overall database has three dimensions: a time dimension, a dimension for the lenders and a dimension for the borrowers. In order to be able to use a panel framework, one of the three dimensions of the data set was eliminated: the lender dimension, to be replaced by means of summarising statistics of all lenders of a firm. The respective procedure is explained in Appendix 1.

One might be concerned about the representativeness of our final data set. In principle, the final data set might be biased because of two reasons: i) due to the matching procedure companies may have not selected randomly and ii) due to truncation in the credit register a company's indebtedness may not shown in a reliable way. We will discuss both problems in the following.

[9] Potential errors in the source data were accounted for as follows: If only one or two observations of one matched firm showed a ratio (of the total indebtedness according to the credit register to the total assets according to Jalys/USTAN) above 100%, we eliminated only these observations, as data errors seemed to be random. However, if more than half of the observations of a matched firm showed a ratio above 100%, we excluded all observations of the respective firm as the data errors were apparently systematic in these cases.

Table 3 and 4 contain information regarding problem i) and compare our final data set with the firms in the balance sheet statistics which have not been matched. It gets clear that the typical firm in our final data set is about 3 times larger (measured in terms of sales) than the typical not matched firm. This size bias becomes also evident when the final data set is compared to the total credit register data.[10]. Nonetheless, the median firm in the final sample is still relatively small and generates a revenue of EUR 16m. Besides, the balance sheet statistics is rather problematic regarding small companies (see page 8) as well as the credit register is as the threshold of EUR 1.5m is especially acute for small companies.

Table 3 also shows some information about the debt structure of matched and not matched firms. The match was conditional on the fact that a firm has at least one lending relationship. Thus, our final data set does not contain companies which borrow only from non-banks and rely, for example, only on trade credits. This fact explains why the share of loans to total assets is a little bit higher in the final data set than in the data base of all not matched firms. Table 4 shows the industry structure of the two data sets. There are significant differences concerning some industries. For example, the share of retail trade is in the final sample only half of the value of all not matched firms, probably due to the fact that especially many small companies belong to this industry. However, the industry structure of the data sets are overall similar.

Table 5 contains information about the potential bias in our final data set caused by the threshold of EUR 1.5m in the credit register (problem ii). The table shows two alternative ratios combining values of the indebtedness in the credit register with information from the balance sheet, ie i) the ratio of balance sheet indebtedness in the credit register to bank loans in the firm's balance sheet statistics and ii) the relation of total indebtedness in the credit register to bank loans, total bonds and acceptances. It becomes evident that the credit register is likely to contain the bulk of banks' claims for most companies in our sample. However, there are a number

[10] The median loan in the total credit register data is about EUR 1.5m (only positive loans considered), the median loan in the final sample is EUR 2.7m.

of companies where the debt values in the credit register and in the firms' balance sheet statistics are not comparable and the indebtedness in the credit register is even larger than in the firm's balance sheet statistics as in the latter data set banks' claims may be included in trade credits or other positions.

Overall, our data set seems suitable to examine the determinants of relationship lending. However, one has to keep in mind that our data sample is not representative regarding very small companies and that we restricted our sample to companies which have at least one lending relationship with a bank.

4 Descriptive statistics and first results

4.1 Descriptive statistics

Definition of relationship lending

We refer to the definition of relationship lending posited by Petersen and Rajan (1994). Accordingly, relationship lending exists if a firm has close ties to a financial institution. The empirical literature suggests several possible indicators to measure relationship lending, such as the duration of a bank-borrower relationship, the number of lending relationships or a high share of debt financing by one bank.[11] We take the latter, namely (i) a high portion of debt financing by one bank, as our main indicator.[12] However, we also consider (ii) the number of lending relationships as an alternative measure in order to enhance the robustness of the results.

According to definition (ii), we call a bank a relationship lender if a firm has one single lending relationship with a bank in contrast to another firm which has multiple lending relationships ($RL_{100\%}$). The reasoning for choosing the number of lending relationships as a proxy is that exclusivity of a bank relationship fosters the ties between banks and firms. However, focussing on the number of lending relationships

[11] See eg Petersen and Rajan (1994) and Ongena and Smith (2001).

[12] It turns out that a bank that is the dominant lender in one year tends to be the dominant lender in the following year. Therefore, firms with a dominant lender tend to have long relationships with this lender, ie the first and third measure of relationship lending are correlated.

alone may be too restrictive: While this definition may be appropriate for some firms, particularly smaller ones, larger firms will typically have several lending relationships.[13] In order to account for more general cases, we also define relationship lending as the case in which there exists a bank with a dominant exposure and set the threshold to 80% ($RL_{80\%}$) or 90% ($RL_{90\%}$) of the total bank loans of this firm (case (i)).

A high share of financial debt at one bank, has empirically been shown to be a good proxy for relationship lending. Elsas (2005) empirically examined the quality of several potential indicators for relationship lending, eg number of lending relationships and the duration of the relationship. He asked the banks for each customer in his sample if they classified themselves as relationship lender and compared these self assessments with the different possible indicators for relationship lending. It is shown that a high portion of debt financing by one bank has the highest explanatory power.

In the following, we refer to a dummy variable for definition (i) and the logarithmised number of lending relationships (definition ii). Both measures are only based on information from the credit register, as the definitions of debt are too different in the credit register and the corporate accounts statistics. We may thereby overstate a bank's debt financing (as part of bank loans are not shown in the credit register). To account for this fact, we apply relatively strict measures of relationship lending (minimum share of a firm's bank loans of 80% or even more), so the identified relationship lenders are likely to be those found via more common definitions of relationship lending and "full" information on the credit side.

Descriptive statistics

Table 6 contains descriptive statistics for our main indicator of relation lending, a high concentration of borrowing. Accordingly, 58% (54%) of the firms in the sample raise at least 80% (90%) of their bank loans from one bank (aggregation method i) (values of the balance sheet quarter)). The figures are slightly lower

[13] In our sample, the average number of lending relationships is 2.7, while Degryse et al. (2004) report a mean of around 1.3 lending relationships for Belgium and Sapienza (2002) 9 for Italy.

using aggregation method ii) (averages of quarterly values).

Table 7 gives information on the distribution of the number of lending relationships in the sample. Using aggregation method i) nearly 50% of the companies in the sample have only one lending relationship and roughly 90% of the firms have 5 lending relationships or less. The maximum is 115 lending relationships. With aggregation method ii) the share of firms with only one lending relationship goes down to 40%, reflecting the higher likelihood that a firm has only one lending relationship for one quarter than for four quarters. The shares of having two or more lending relationships increase slightly, so that the 90%- and higher quantiles are similar to the other distribution.

Table 8 shows the pairwise correlations of different house bank indicators. The correlation between the logarithmised number of lending relations, $RL_{80\%}$ and $RL_{90\%}$ (each variable according to both aggregation methods) is at least (-)71% . At the 0.1% level, all variables are significantly correlated. This makes it clear that the indicators contain very similar information.

Table 9 summarises descriptive statistics for our explanatory variables. We use a default risk measure (PD), which is calculated from the balance sheet data and can be interpreted as a probability of default.[14] For the empirical study, we censorized the profitability measure (return on assets) at one percent and 99% to deal with potential data outliers.[15]

4.2 First results

Next, we investigate our hypotheses using some descriptive statistics and simple tests before moving forward to the regressions. We concentrate on one indicator, concentration of debt of at least 80% at one bank. Table 10 shows that there is a strong negative correlation between a firm's size and its concentration of borrowing.

[14] For this purpose, we used a binary logistic regression model based on balance sheet data between 12 and 24 months before default classified as default balance sheets. See Krueger et al. (2005) for further information.

[15] This means that we set those profitability values below (above) the 1%-quantile (99%-quantile) exactly equal to the respective quantile.

The share of companies which borrow at least 80% of their credit from one bank steadily decreases with firm size. The same holds true for the share of the largest lender. This outcome is in line with our expectations (Hypothesis 1) that especially small informationally opaque firms choose a relationship lender.

Table 11 gives the means of firm variables subject to different size classes and conditioned by the relationship lending status. More specifically, firm age, R&D intensity and variables about a firm's quality (for example equity ratio) interfere with size and are therefore analysed conditional on the firm size. Table 11 shows that R&D-intensive firms are more likely to choose a relationship lender. In each size class, companies with a relationship lender have a significantly higher R&D intensity than companies without a relationship lender. The only exception are very large companies where no significant difference exists. This evidence is consistent with Hypothesis 2 according to which R&D-intensive companies are exposed to higher information asymmetries and therefore tend to concentrate their borrowing on one bank. However, the relation between age and choosing a relationship lender is not in line with hypothesis 1. Whereas small companies with a relationship lender are, on average, significantly older than small companies without a relationship lender, the reverse is true for large companies.

Hypotheses 3a, 3b and 3c examine the influence of a firm's quality on relationship lending. Accordingly, the relationship between a firm's credit quality (measured by its PD or equity ratio) and the likelihood of relationship lending can be negative, inversely u-shaped or positively. As table 11 shows, medium-sized and large companies with a relationship lender exhibit significantly higher equity ratios and significant lower PD-values than medium-sized and large companies without a relationship lender, while small companies do not differ significantly with respect to both variables. This evidence indicates that high-quality firms above a certain size threshold tend to choose a relationship lender which is in line with hypothesis 3c and to some extent with hypothesis 3b.

Table 12 contains information how regional competition in the lenders' market (measured by the Hirschman-Herfindahl index, HHI) influences relationship lending. Re-

lationship lending is unlikely if the HHI is very low and regional competition in the lender's market is very high. In the next section, we apply regression techniques to further examine the above hypotheses.

5 Regressions

In the regressions, we focus on the variable "high share of debt financing by one bank (80% level)" as an indicator of relationship lending ($RL_{80\%}$). Additionally, we run regressions with alternative indicators of relationship lending.

As our dependent variable is a dummy variable, we use probability models. A shortcoming of probability models for panel data sets is that a fixed effects regression is only possible for such observations where the dependent variable changed at least once during the sample period. The other observations are excluded from the sample (see Baltagi (2005)). This may lead to a bias as firms that change their relationship lending status may be systematically different than the excluded firms, namely (i) the firms that permanently choose a relationship lender and (ii) firms that have permanently several important lending relationships. Therefore, it is difficult to decide which model - fixed or random effects model - is appropriate, as a standard Hausman test compares the results of two models with different sets of observations. Furthermore, in the case of our regressions, the Hausman test statistics do not show clear results (the difference between the fixed and the random effects model is significant only at the 10% level). We thus use a fixed and a random effects model and discuss the results of both models.

Table 13 summarises the regression results. We consider the lenders' average size as control variable which is highly significant in statistical and economic terms. The negative sign is in line with evidence for Italy according to which especially small banks act as single or relationship lenders (see Detragiache et al. (2000)). Small banks probably have an advantage in processing soft information which is especially valuable for relationship lending (see Stein (2000)).

We also control for the degree of competition as measured by the Hirschmann-Herfindahl-Index (HHI). We find that relationship lending tends to get more likely the lower the HHI and therefore the higher the competition in the lender's market is. The variable is significant only in the random effects specifications. This result is generally consistent with the predictions of the model of Boot and Thakor (2000). The authors show that increasing competition between banks leads to more relationship banking and less transaction banking, as relationship orientation helps to partially insulate the banks from pure price competition. The result contradicts Petersen and Rajan (1995). Besides, we control for the type of balance sheet (tax or trade balance) the information about the firm is taken from. The variable is generally not significant.

Moreover, we included year dummies to examine the time trend in our data set. Generally, the dummies are significant neither in the random nor in the fixed effects model. The coefficients do not show a clear trend and depend heavily on the specification (eg model 3 versus model 5). Therefore, our results do not support the common view that banks have developed to credit factories and relationship lending has become less important.

According to Hypothesis 1 we expect informationally opaque small, young companies to prefer relationship lending. Concentrating their borrowing on one bank may help such firms to reduce information asymmetries and to avoid credit rationing. The results show that age and especially size are statistically and economically important variables for determining the probability of choosing a relationship lender. If size increases by 1%, the probability of relationship lending decreases by 4% in the random effects model. The coefficient in the fixed effects model is roughly the same.

Age decreases the probability of relationship lending as well. Older companies are significantly less likely to choose relationship lending. If age increases by 1%, the probability of relationship lending decreases by about 0.25% (random effects model). Surprisingly, the effect of age is about three and a half times larger in the fixed effects than in the random effects model.

Hypotheses 2 examines whether R&D- and knowledge-intensive firms are more likely

to choose a relationship lender. If relationship lending is an efficient instrument for reducing information asymmetries, R&D- and knowledge-intensive companies should concentrate their borrowing on one relationship lender, as R&D activities are linked with proprietary information and information asymmetries are higher. We measure R&D/knowledge intensity with a dummy variable which relies on long-term industry averages. As this variable is time-constant, we can test Hypothesis 2 only in a panel regression with random effects. The results are in line with our prediction: R&D/knowledge-intensive companies are significantly more likely to choose a relationship lender. The probability increases by 13 percentage points.

Hypotheses 3a, 3b and 3c examine the influence of the firm's creditworthiness. The theoretical literature is ambiguous regarding the effect of a firm's credit quality on the probability of relationship lending. Depending on the theoretical model, a negative, an inversely u-shaped or a positive relation is possible. We measure a firm's credit quality with its PD (probability of default) and include a linear and a squared term to capture non-linear relations. At first glance, table 13 indicates a u-shaped influence of a firm's PD on the probability of relationship lending and thus does not support either of these predictions. The linear and the squared term are both significant. However, when calculating the combined effect over the range of relevant PD values it becomes clear that the influence of a firm's PD is negative for most observations. A firm's creditworthiness affects the probability of relationship lending positively only for very high PD values (values beyond the 98% quantile for fixed and random effects model). Overall, the results are consistent with Hypothesis 3c which is based on the model of von Thadden (2004). Accordingly, there exists a selection process over time where good firms stay at their relationship bank and bad firms choose an arm's-length bank. On average, relationship lenders thus finance firms of higher credit quality than arm's length banks do. The results are also to some extent consistent with hypothesis 3b (model of Rajan (1992)) as the hypothesis states that high-quality firms are indifferent between arm's-length finance and relationship lending. The model derives the decision for relationship lending from a trade-off between an efficient decision about which projects to finance versus providing high

incentives to exert effort.

The results are not in line with the model of Bolton and Scharfstein, which predicts a negative influence of a firm's credit quality on the likelihood of relationship lending (Hypothesis 3a). The authors derive the optimal numbers of creditors from a trade-off between preventing strategic defaults and high renegotiation costs in the case of liquidity defaults. The model also makes the prediction that companies from non-cyclical industries prefer relationship lending. We tested this prediction, too, measuring cyclicality by the long-run sensitivity of each industry's gross value added to changes in the aggregated gross value added.[16] However, we cannot observe a significant effect. Thus, neither variable confirms the model of Bolton and Scharfstein (1996).

One may be concerned that endogeneity problems may influence our results and may lead to reverse causality. For example, age may not only influence the likelihood of choosing a relationship lender, but the existence of a relationship lender may also increase a firm's survival probability and thereby the age distribution in our sample. Endogeneity problems may be relevant with regard to age and size, but are probably minor important or not relevant with regard to a firm's R&D-intensity or a firm's creditworthiness. However, as to age and size, endogeneity issues work into the opposite direction as our hypothesis states. Whereas our hypothesis states that young and small companies should choose a relationship lender, the endogeneity bias would lead to the effect that old and large companies are financed by relationship lenders. Therefore, if there is an endogenity bias, it would reduce the effect of age and size. This may also explain the below results that age is not robustly significant.

Robustness checks

We ran several robustness checks. Firstly we checked whether the influence of firm's size is due to information asymmetries or due to the fact that banks avoid concentration risks. Larger companies need, on average, more capital, which increases the

[16] Data: Statistisches Bundesamt. We run regressions for each industry with the industry's gross value added as the dependent variable and the aggregated gross value added as the explanatory variable in addition to including a constant. The sensitivities then correspond with the regression coefficient.

concentration risk in the bank's portfolio given the bank's size. We therefore ran a new regression excluding all companies from the sample where

$$\frac{\sum loans\ of\ company_i}{liable\ capital\ of\ company\ i's\ smallest\ bank} > 5\%.^{17}$$

In the new regression, the coefficient of size goes down sharply, in the fixed effects model by over 30%, in the random effects model even by nearly 40%. However, the coefficient is still significant at the 1%-level in both models. We also ran a regression where we lowered the threshold further to 2%. Here, the effects are a little bit more pronounced than in the model with a threshold of 5%, but the variables are, once again, significant at the 1%-level.

Secondly, we ran several regressions to check how the problem of truncation in the credit register influences the results. As loans of less than EUR 1.5 million are only partly reported (see Section 3), the credit register shows a biased picture of the debt structure of companies. Firstly, we constructed variables combining 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 1.5m are only partly reported in the credit register and ii) the data sources apply different definitions of debt. As we are only interested in the effects of truncation, we constructed a new indicator for relationship lending in two steps. In the first step, we created an auxiliary variable which classifies a borrower as a customer with a relationship lender if

$$RL_{temp} = 1\ if \frac{largest\ loan\ according\ to\ CR}{\sum bank\ loans\ according\ to\ BS} > 80\%.^{18}$$

$$RL_{temp} = 0\ otherwise$$

[17] The Large Exposures Regulation ("Grosskreditrichtlinie") sets a limit of 10% above which exposures have to be reported to the Bundesbank.

[18] The credit register contains information about the structure of debt (off-balance sheet versus on-balance sheet) only since 1997. Therefore, we used data on total loans until 1996 and data on on-balance sheet loans since 1997.

We use a narrow definition of debt and include only bank loans in the denominator (see discussion in Section 3, especially Table 5). When we compare the new variable with our old indicator $RL_{80\%}$, the two variables are identical in the ideal case. If the new one is 0 and the old one is 1, this is probably due to truncation in the register as for example smaller exposures of other banks are not shown. However, if the new one is 1 and the old one is 0, this combination is probably due to different definitions in the data sources. We thus combined the two indicators:

$$RL_{BSCR} = min[RL_{80\%}, RL_{temp}]$$

Table 14 shows the results using RL_{BSCR} as the dependent variable (model 3 and 4). The results differ quantitatively, but are qualitatively similar. The coefficients of size and R&D intensity are smaller with the new indicator and the effect of age is not significant in the fixed effects model. We also ran regressions where we built our auxiliary variable refering to a broader definition of debt (bank loans, acceptances and bonds) and built the new combined indicator based on this broader definition. The results are similar to the specification with RL_{BSCR}. Except for age, these regressions confirm our above results.

The credit register shows a more reliable picture for those companies where the sum of loans from the credit register is relatively high compared to the debt in the balance sheet. Therefore, we ran a second robustness check regarding truncation by restricting our observations to those companies where the sum of loans in the credit register is least 80% of the corresponding amount in the balance sheet statistics.[19] As Table 14 (model 5 and 6) shows, coefficients and significance levels change only minor. Size, age and credit quality are significant in the random and the fixed effects specification as well as R&D-intensity in the random effects model (which cannot be considered in the fixed effects model).

Furthermore, as especially small companies are exposed to the problem of truncation, we conducted a third robustness check with respect to truncation where we excluded

[19] We used the first coverage ratio of Table 5 as the indicator. As the credit register provides information about balance sheet loans only since 1997, we used a firm's total indebtedness before 1997.

small companies (assets below median) from our sample. The regression also leads to similar results (results not reported).

Finally, we conducted several robustness checks with respect to our dependent variable. We used the (log of) the number of relationships as the dependent variable. The results are similar to those above except that age is not significant anymore, while the significance of size increases. As the two variables are significantly correlated, the coefficient of size may also partly show the effect of age. Moreover, we changed the threshold of our relationship lending indicator. We increased (decreased) the threshold to 90% (70%), ie banks that finance at least 90% (70%) of a firm's loans are now classified as relationship lenders. The results are very similar to the above results. Finally, we calculated our relationship lending indicator based on aggregation method ii, which uses the yearly average values of the credit register instead of the values of the balance sheet quarter. The results are once again very similar.

6 Conclusion

In this study, we empirically analyse factors that determine relationship lending in Germany. Unlike most previous empirical contributions, the data set used in this study is much more comprehensive.

Departing from the theoretical literature, we examine the importance of two issues: Firstly we investigate whether relationship lending reduces information asymmetries and thereby helps credit rationing to be avoided. In line with this argument, we find that small, young and R&D-intensive firms tend to choose a relationship lender. Whereas the effect of size and age is a common result in the literature, the effect of the R&D-intensity is partly in contrast to the international evidence (see eg Detragiache et al. (2000)). Due to underdeveloped equity markets in Germany R&D-intensive firms rely more heavily on bank credits than in other countries. Relationship lending may therefore be a substitute for equity financing.

Secondly, we examine how a firm's credit quality influences the likelihood of relationship lending. From a theoretical point of view, the influence is not clear. We find that firms of high credit quality tend to choose a relationship lender. This is in line with a positive selection process over time where good borrowers stay at their relationship lender and bad borrowers switch to (outside) arm's length banks.

Finally, we also investigate whether relationship lending became less important since the mid 90s. Due to better information processing facilities, more sophisticated rating tools and the growth of securitization market banks are said to be turning more and more into credit factories. However, we cannot observe such a trend for Germany, given our definition of relationship lending.

This data set makes it possible to investigate further important questions concerning relationship lending. Possible research topics are: the duration of lending relationships, the impact of relationship lending on a firm's funding costs, and the behavior of a relationship bank when the borrower is in financial distress.

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Appendix 1: Processing of data (Example)

The following appendix shows an imaginary example of how the raw data is processed. From the credit register we obtain the following information about the indebtedness of the four firms A1, A2, B and C with respect to the banks 1, 2, 3, 4 (See Table 1, please note that the firms A1 and A2 belong to the borrower unit

Table 1: Data from the Credit Register (extract)

Firm	Bank	Year	Indebtedness (th EUR)
A1	1	1999	700
A1	2	1999	1800
A2	1	1999	900
B	1	1999	50000
B	2	1999	1600
B	4	1999	1400
C	3	1999	2000

A). As mentioned above (see 3), not all exposures reported in the credit register are above the threshold of EUR 1.5m. The reason why bank 1 has to report the exposures to the firms A1 and A2 is that the combined exposure, ie the exposure to the borrower unit A, is above the threshold. The exposure of bank 4 to firm B has to be reported because presumably this exposure was above the EUR 1.5m threshold at least once in the preceding quarter (and the requirement to report depends on the maximum exposure during the preceding quarter whereas the exposure to be reported is that of the quarter end).

We condense the data set by i) aggregating the firms to borrower units where adequate (firm in balance sheet statistics is a group) and ii) by replacing the lending information by summary statistics. The data processing in our example results in the data set as displayed in Table 2. Please note that the actual final data set additionally contains the firms' and the banks' balance sheets.

Table 2: Final data set (extract)

Firm	Year	Total indebtedness (th EUR)	Largest bank loan (th EUR)	Number of lending rel.	Share of largest bank loan	Bank ID of relationship lender
A	1999	3400	1800	2	52.9%	N/A
B	1999	53000	50000	3	94.3%	1
C	1999	2000	2000	1	100.0%	3

Appendix 2

Table 3: final sample versus not matched firms of balance sheet statistics

	not matched firms		final sample	
	median	N	median	N
Total Assets (EUR 1000)	2724	748540	10388	16349
Sales (EUR 1000)	5111	748540	16296	16349
Equity ratio (in %)	11.8	748484	14.1	16348
Loans to total assets (in %)	24.7	748484	26.9	16348
Trade credits to total loans (in %)	9.7	748484	7.3	16348

Table 4: industry structure

industry	nace code	share final sample	share not matched
agriculture, fishing and mining	A, B, C	0.9	4.4
food products, beverages and tobacco	DA	4.3	2.9
textiles/textile products and leather/leather products	DB, DC	2.2	2.9
wood and paper; publishing and printing	DD, DE	3.9	4.8
coke, chemicals, rubber/plastic products and other non-metallic mineral products	DF, DG, DH, DI	6.3	5.6
basic metals and fabricated metal products	DJ	6.7	6.3
machinery and equipment; electrical and optical equipment; transport equipment	DK, DL, DM	12.0	9.8
furniture; recycling	DN	2.0	2.0
Electricity, gas and water supply	E	1.6	0.6
construction	F	4.6	6.4
sale, maintenance and repair of motor vehicles; retail sale of automative fuel	G50	7.9	8.9
wholesale trade	G51	26.6	21.4
retail trade and repair of personal/household goods; Hotels and restaurants	G52, G55	4.2	9.3
transport, storage and communication	I	2.4	2.4
financial intermediation	J	0.2	0.2
real estate, renting and business activities	K	13.8	11.3
education, health and other community, social and personal	M, N, O	0.5	0.7

Industry structure for matched and not matched firms, where information was available.

Table 5: Coverage ratios

	Quantiles		
	25%	50%	75%
Balance sheet indebtedness (credit register) to bank loans (Jalys/Ustan)	72.9%	96.8%	104.2%
Total indebtedness (credit register) to bank loans, total bonds and acceptances (Jalys/Ustan)	74.9%	98.7%	116.5%

The first ratio can only be calculated for values from 1997 to 2004.

Table 6: Concentration of borrowing: descriptive statistics

	Aggregation method i): Values of balance sheet quarter		Aggregation method ii): Means of quarterly values	
	$RL_{80\%}$	$RL_{90\%}$	$RL_{80\%}$	$RL_{90\%}$
Share of observations	58.2	54.2	54.1	48.2
N	15947	15947	16349	16349

$RL_{80\%}$ ($RL_{90\%}$) means that a firm concentrates at least 80% (90%) of its borrowing at one bank.

Table 7: Distribution of lending relationships

	Aggregation method i): Values of balance sheet quarter		Aggregation method ii): Means of quarterly values	
Number of banks	in %	cumulative %	in %	cumulative %
1	49.2	49.2	41.0	41.0
2	20.4	69.6	22.2	63.1
3	10.4	80.0	12.1	75.2
4	5.9	85.9	6.6	81.8
5	3.9	89.7	4.6	86.4
6	2.7	92.5	3.6	90.0
7	1.8	94.3	2.1	92.1
8	1.3	95.5	1.8	93.8
9	0.8	96.3	1.1	94.9
10+	3.7	100.0	5.1	100.0

The number of observations is 15947 using aggregation method i) and 16349 with aggregation method ii).

Table 8: Correlation matrix of relationship lending indicators

		Aggregation method i): Values of balance sheet quarter			Aggregation method ii): Means of quarterly values		
		ln NoB	$RL_{90\%}$	$RL_{80\%}$	ln NoB	$RL_{90\%}$	$RL_{80\%}$
Method i)	ln NoB	1					
	$RL_{90\%}$	-0.80	1				
	$RL_{80\%}$	-0.78	0.92	1			
Method ii)	ln NoB	0.94	-0.74	-0.73	1		
	$RL_{90\%}$	-0.70	0.83	0.78	-0.77	1	
	$RL_{80\%}$	-0.71	0.81	0.83	-0.75	0.89	1

ln NoB denotes the logarithmised number of lending relationships. $RL_{90\%}$ and $RL_{80\%}$ mean concentration of bank borrowing of 90% and 80% respectively. All variables are significantly correlated at the 0.1%level.

Table 9: Descriptive statistics of explanatory variables

Variable	Unit	Obs	Mean	Std. Dev.	Quantiles	
					25%	75%
Total assets (firm)	EUR 1000	16349	126907	1541739	4293	34528
Age (firm)	years	14477	44.4	41.8	16.0	63.0
Equity ratio (firm)	%	16348	18.9	17.9	5.0	27.7
Return on assets (firm), %	%	16347	4.7	14.1	0.1	8.6
Corporation (AG or KGaA), %	%	16349	8.9			
Limited liability corporation (GmbH), %	%	16349	49.7			
Cyclicality (firm's industry), %	%	14974	69.1	116.5	-6.0	138.4
R&D intensive (firm's industry)	%	16349	12.7			
Total assets (banks)	EUR m	16230	99399	128615	4349	148462
Regional HHI (bank), %	%	16346	5.2	3.1	3.1	6.3

R&D intensity is a dummy variable which is equal to one if an industry was classified as R&D-intensive in Grupp and Legler (2000). Cyclicality is measured as the long-run sensitivity of each industry's gross value added to changes in the aggregated gross value added.

Table 10: Relationship lending and size classes

	N	$RL_{80\%}$	Share of largest lender
<= EUR 2.5m	1778	94.5	97.6
EUR 2.5m - 5m	2806	88.6	95.1
EUR 5m - 10m	3152	71.4	87.6
EUR 10m - 25m	3263	46.6	75.0
EUR 25m - 100m	2884	32.0	63.9
> EUR 100m	2064	20.3	53.4

Table 11: Firm characteristics and size classes

	Age		High R&D intensity		ROA		Equity ratio		PD	
Size classes	$RL_{80\%}=0$	$RL_{80\%}=1$	$RL_{80\%}=0$	$RL_{80\%}=1$	$RL_{80\%}=0$	$RL_{80\%}=1$	$RL_{80\%}=0$	$RL_{80\%}=1$	$RL_{80\%}=0$	$RL_{80\%}=1$
<= EUR 2.5m	17.9	26.5***	16.3%	23.6%*	1.6	4.5	12.9	13.6	0.7	0.7
EUR 2.5m - 5m	29.8	34.9**	16.3%	24.3%***	3.4	3.4	12.3	11.3	0.6	0.6
EUR 5m - 10m	44.2	41.7	18.2%	21.6%**	2.4	4.4***	12.7	15.5***	0.6	0.5**
EUR 10m - 25m	48.4	43.6***	27.0%	30.0%*	4.0	5.5***	17.1	20.0***	0.5	0.5***
EUR 25m - 100m	53.1	51.7	31.5%	43.2%***	4.7	9.0***	22.9	30.3***	0.5	0.3***
> EUR 100m	63.5	48.8***	59.5%	58.5%	4.4	6.5***	30.1	33.1***	0.4	0.3***
total	51.9	39.2	34.5%	27.9%	4.0	4.9	21.1	17.0	0.5	0.5
N	6178	7945	6671	9276	6670	9275	6671	9275	5752	8377

Means for the different explanatory variables (as mentioned in Table 9), conditioned by the firm's size and the relationship lending status. ***/**/* indicate statistically significant differences in the means at the 1%, 5% and 10% levels, respectively.

Table 12: concentration in the lender's market

HHI	$RL_{80\%}$
very low	70.6
low	56.0
medium	52.2
high	54.7
very high	57.5

Table 13: Panel regression

	Model 1	Model 2
	$RL_{80\%}$	$RL_{80\%}$
log assets (firm)	-1.170	-1.306
	(25.15)***	(8.24)***
age (firm)	-0.187	-0.664
	(2.90)***	(2.43)**
PD (lagged, firm)	-0.657	-0.493
	(5.08)***	(2.78)***
squared PD (lagged, firm)	0.113	0.104
	(3.91)***	(2.49)**
R&D intensive (firm's industry)	0.583	
	(4.39)***	
log assets (bank(s))	-0.381	-0.312
	(13.59)***	(7.47)***
regional concentration (bank's market)	-0.038	-0.020
	(2.60)***	(1.18)
tax balance	0.113	0.174
	(1.14)	(1.47)
year = 1995	-0.053	-0.019
	(0.38)	(0.13)
year = 1996	0.029	0.057
	(0.20)	(0.37)
year = 1997	0.073	0.135
	(0.52)	(0.84)
year = 1998	0.001	0.056
	(0.00)	(0.33)
year = 1999	0.217	0.303
	(1.41)	(1.68)*
year = 2000	0.188	0.264
	(1.21)	(1.40)
year = 2001	0.180	0.319
	(1.12)	(1.61)
year = 2002	0.300	0.565
	(1.81)*	(2.68)***
year = 2003	0.152	0.340
	(0.88)	(1.54)
year = 2004	0.551	0.806
	(2.49)**	(3.00)***
Constant	16.508	
	(31.16)***	
Observations	10426	4302
Number of borrowers	1984	612
Panel method	random	fixed

The table shows the coefficients with the t-values in parentheses. The dependent variable is, in both models, house bank, a dummy variable which is equal to one if the firm concentrates at least 80% of its borrowing on one bank.
The HHI shows the regional concentration. R&D intensity is a dummy variable which equals one if the borrower's industry is R&D- or knowledge-intensive. PD, concentration and cyclicality are measured in percentage points. Firm's and banks' assets are measured in real terms.
***/**/* indicate statistically significant results at the 1%, 5% and 10% levels, respectively.

Table 14: Panel regression

	Model 3	Model 4	Model 5	Model 6
	RL_{BSCR}	RL_{BSCR}	$RL_{80\%}$	$RL_{80\%}$
log assets (firm)	-0.782	-0.809	-1.136	-0.815
	(17.72)***	(5.35)***	(22.02)***	(4.26)***
age (firm)	-0.121	-0.161	-0.217	-0.654
	(1.90)*	(0.60)	(2.95)***	(1.85)*
PD (lagged, firm)	-0.668	-0.551	-0.852	-0.576
	(5.54)***	(3.31)***	(5.57)***	(2.71)***
squared PD (lagged, firm)	0.098	0.096	0.116	0.080
	(4.19)***	(2.89)***	(3.56)***	(1.84)*
R&D intensive (firm's industry)	0.257		0.519	
	(1.96)**		(3.42)***	
log assets (bank(s))	-0.122	-0.124	-0.369	-0.307
	(4.61)***	(2.99)***	(10.61)***	(5.14)***
regional concentration (bank's market)	-0.036	-0.012	-0.049	-0.016
	(2.45)**	(0.68)	(2.70)***	(0.71)
tax balance	0.050	0.082	0.124	0.291
	(0.50)	(0.68)	(1.04)	(1.92)*
year = 1995	0.176	0.198	0.032	0.017
	(1.31)	(1.36)	(0.19)	(0.09)
year = 1996	0.115	0.077	0.073	0.015
	(0.85)	(0.52)	(0.44)	(0.08)
year = 1997	-0.499	-0.615	0.046	0.021
	(3.64)***	(3.96)***	(0.27)	(0.10)
year = 1998	-0.348	-0.386	0.087	0.142
	(2.44)**	(2.34)**	(0.49)	(0.66)
year = 1999	-0.092	-0.080	0.311	0.411
	(0.61)	(0.45)	(1.67)*	(1.76)*
year = 2000	-0.072	-0.034	0.313	0.338
	(0.48)	(0.18)	(1.66)*	(1.40)
year = 2001	-0.119	-0.058	0.362	0.474
	(0.77)	(0.30)	(1.86)*	(1.87)*
year = 2002	0.022	0.165	0.435	0.730
	(0.13)	(0.80)	(2.17)**	(2.68)***
year = 2003	-0.118	-0.007	0.227	0.417
	(0.69)	(0.03)	(1.09)	(1.48)
year = 2004	0.220	0.402	0.815	1.029
	(1.00)	(1.50)	(3.13)***	(3.12)***
Constant	8.356		15.991	
	(17.25)***		(25.99)***	
Observations	10426	4427	7872	2557
Number of borrowers	1984	672	1750	410
Panel method	random	fixed	random	fixed

Model 3 and model 4 are robustness checks with an alternative relationship lending indicator. Model 5 and 6 restrict the sample to those companies where the sum of loans in the credit register is at least 80% of the amount in the balance sheet statistics.
***/**/* indicate statistically significant results at the 1%, 5% and 10% levels, respectively.

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