The Effects of Spatial Distance on Loan Pricing in Relationship Lending

Evidence from Germany

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The spatial range between banks and their borrowers has commonly been considered as ambiguous in literature on borrower-lender-relationships; On the one hand, a higher spatial separation increases informational costs, resulting in ceteris paribus higher interest rates charged by the lending bank. On the other hand, borrowers located closely to their lending banks are exposed to the local market power of the latter and therefore charged higher loan rates. With maintaining a single bank relationship, firms furthermore might occur liquidity risks. In this paper, the spatial distance between German firms and their banks is considered as impact on firms' lending rate. Employing Heckman's two-stage approach, there is strong evidence that distance has a positive impact on firms' lending rates in relationship lending.

Die räumliche Entfernung zwischen einem Kreditnehmer und seiner Bank kann sich einerseits als eine Steigerung der mit Monitoring und Screening verbundenen Kosten äußern. Insbesondere ist dies bei Kreditnehmern relevant, die nur in geringerem Ausmaß über (kodifizierbare) Informationen verfügen, die leicht über weite Strecken transportiert werden können. Andererseits entscheidet die Entfernung zwischen Kreditnehmer und –geber maßgeblich über das Ausmaß lokaler Marktmacht der Bank. Im vorliegenden Beitrag wird die Auswirkung räumlicher Entfernung auf Kapitalkosten bei Anwendung des Relationship Lendings *durch deutsche Unternehmen untersucht. Im Ergebnis des zweistufigen Heckman Verfahrens finden sich deutliche Hinweise auf eine positive Auswirkung räumlicher Entfernung auf die vom Unternehmen zu leistenden Kreditzinsen.*

Relationship Banking, Quantity of Lenders, Distance, Interest Rate Policy, Firm Financing, Firm Location

Finanzierung, Preis- und Konditionenpolitik, Finanzintermediation, Informations- und Kommunikationstechniken, Banken, Rating

1. Introduction

The literature on firm-bank relationships, mainly focusing on credit relations has often considered large distances between debtors and creditors to aggravate the difficulties and costs of transferring non-codifyable information from borrowers to lenders. This type of information might be relevant for estimating data such as the probability of default or the loss given default. Less hard facts provided by the borrower thus should result in increasing monitoring and screening costs which will be borne by the borrower, when being

charged higher interest rates by the lender (s. e.g. *Petersen/Rajan* 2002, 2543f; *Degryse/Ongena* 2005, 234; *Knyazeva/Knyazeva* 2012, 1195; *Cenni et al.* 2015, 251). The increase in interest rates on the other hand is only supposed to happen up to a certain location. At some point in space, other banks, located closer to the borrowing firm, are able to assign a loan to the borrower with lower interest rates due to lower incurring costs.

Furthermore, it is commonly assumed that enterprises' opacity decreases with firm size due to a larger stock of employees, more reporting (obligations) and especially a longer history of the firm resulting in a better availability of firm specific data. Hence, large firms are able to provide hard facts as reliable information to their lenders when applying for credit and thus, in theory, ruling out distance to some high degree.

Empirical Evidence on this topic is mixed. While e.g. *Knyazeva/Knyazeva* (2012) and *Bellucci et al.* (2013) find loan interest rates to increase with borrower-lender-distance, *Degryse/Ongena* (2005) and *Agarwal/Hauswald* (2010) find borrowers located closer to their lenders to be charged on average higher loan rates, due to local market power of the lending bank.

This paper seeks to address whether geographical distances between banks and firms manifest in interest rates on firms' liabilities as lenders allocate their transport and information costs to debtors. The verification of the theoretical argumentation cannot be done without incorporating characteristics of the lending bank. Banks of different types and sizes might use varying lending and communication techniques to cope with larger distances.

As the relevance of distance is assumed to be more pronounced for relationship lending, only exclusive banking relationships are analyzed. With the initial sample consisting of German firms with no or multiple banking relationships as well, Heckman's two stage procedure is used to correct for possible sample selection. While I find strong evidence for the relevance of location in determining whether a firm engages in relationship lending, distance on average has a high positive effect on firms' loan rates in the outcome equation. Therefore, on the one hand, higher costs of monitoring seem to be borne by borrowers. On the other hand, local market power as well has an impact on interest rates, with the number of banks in the vicinity of firms on average decreasing interest rates.

The paper proceeds as follows: In the following section, I'll give a short review on the theoretical argumentation on bank and firm relationship, which will rely on bank and firm size and introduce geographical distance between enterprises and banks. The data used in the analysis will be introduced in section three. Empirical investigations will be performed in section four, using German individual firm level data. Section five concludes.

2. Firm-Bank Relationships and Distance

While some time ago, a well working bank relationship was crucial for external funding, nowadays many, especially large multinational firms, can participate at capital markets without intermediation. In Germany, as a bank-based system of financing, enterprises have relatively long-lasting and often exclusive bank relationships, with bank loans being by far the most important source of external funding (*Handke* 2011, 77f).

The exclusiveness of a bank relation could have different possible outcomes: *Harhoff/Körting* (1998) do not find the number of banking relationships to matter for the interest paid in data on German firms. In constrast, *Stein* (2015) finds interest rates paid by enterprises to increase over time, if the bank owns a large share of the firm's debt, thus exhibit-

ing a hold-up in their relationship. This finding is reasoned with firm growth during the relationship and the need for larger loan amounts. The resulting higher concentration risks of the bank might be prized with higher interest rates. Focusing on distance and market power, it is commonly assumed that borrowers located in the geographical vicinity of the lending bank are priced higher loan rates due to the local market power of the lending bank, whereas loan rates decline as firms' location approaches towards competing banks (*Degryse/Ongena* 2004; *Degryse et al.* 2009; *Belluci et al.* 2013).

The ability of banks to augment loan rates even increases when the firm is relatively opaque and the bank has a long lasting relationship with the firm and thus an informational advantage compared to its competitors. On the one hand, due to resulting lock-in situations, the borrower is stuck with the same lender (*Slotty* 2009, 2f). On the other hand, with the bank exercising some control over the firm, due to its exclusive status and intense relationship, the lender might influence the borrower to act as 'lender-friendly' as possible and reward her with constant access to external funding (*Agarwal/Elston* 2001, 230). Therefore, besides the increasing difficulty of transferring soft information over a larger distance, also the (geographical) structure of the banking market and banks' competition should be considered, as the latter might mitigate the firm's costs associated with transportation and hence the interest rate increasing effect of distance.

Due to their small size and/or young age small and medium sized enterprises (SMEs) do neither own large divisions to communicate or quantify their business plans and results, nor is there a documentation of former firm performance or frequent new information. Thus, due to missing possibility to assess the riskiness of the borrower or high costs of monitoring and screening, it is either impossible or too costly for outside investors to engage in borrowing towards opaque SMEs.

To assess such firms' creditworthiness and future returns, it is crucial to be capable of processing soft information. Such could include the personality of the manager or owner, being a 'key' person of a small enterprise (*Berger et al.* 2014, 266), her 'business vision', her social behavior. Furthermore, soft information could include the mood and the attitude of the workers within the firm as well as relations toward costumers or suppliers.[1] Therefore, to gather and process soft information in order to complete or build the (risk) profile of a firm, high costs arise when relying on relationship banking, enabling the use of personal contacts for credit assessment beyond hard facts.[2]

Borrower lender distance thus has a high relevance to loan transactions in situations, when soft information, that cannot be transported over large distances is essential for assessing a borrower's creditworthiness. Therefore, distance correlates positively with loan costs. On the one hand, the borrower has to visit the lender at least once when applying for a loan (*Agarwal/Hauswald* 2010, 5). On the other hand, a more remote lender incurs distance related costs for monitoring and screening the borrower, e.g. higher travel costs (*Brevoort/Hannan* 2004, 5; *Brevoort/Wolken* 2009, 29f; *Cenni et al.* 2015, 251). Furthermore, monitoring activities including personal interaction are directly related with the possibility of processing soft information which is therefore dependent on frequent mutual encounters.

1 A detailed overview over informational aspects that can be considered as soft can be found in *Ahnert et al.* (2005).

2 S. *Berger/Black* (2011) for a discussion of hard vs. soft lending techniques.

Several studies find soft information to improve the predictions of banks' risk models on default, when used additionally to hard facts.[3]

Nevertheless, the use of soft information can be misleading, too, and hence a sole focus on hard facts could reduce the chance of granting loans that are riskier than expected (*Emmons et al.* 2004).[4]

Banks' organizational layers also matter when processing soft information through those layers with resulting filter effects. Therefore, one must differentiate between the place where the borrower contacts the lender (e.g. branch office of a bank) and the place where decisions on the loan approval and/or conditions are made (e.g. head office of a bank). *Alessandrini et al.* (2009) term the former *operational distance* and the latter *functional distance*. According to the above argumentation, transport costs for soft information rise with a higher operational distance, whereas functional distance between branch office loan officers and the decision-making manager in the head office can result in agency costs (*Jiménez et al.* 2009).

Considering this, the fewer hierarchical layers of savings and cooperative banks relative to commercial banks might leave the former with some comparative advantage in terms of using soft information (*Prantl et al.* 2008, 12). Furthermore, their denser net of branch offices, spread over a small geographical area might allow them more opportunities to let soft information improve their credit assessment, as the transfer of those data would occur over a short distance.

Hence, such small lenders are especially beneficial for small firms, which depend on soft information to a high degree. Additionally, those small lenders often can rely on knowledge of the local market area (*Stiroh* 2004). Furthermore, with higher monitoring costs charged by higher loan rates, and the necessary intense monitoring, small firms do not have access to more distant financial centers and are therefore dependent on local operating lenders (*Alessandrini/Zazzaro* 1999, 75).

Berger/Black (2011) find that lending to small firms including the use of collateral or scorings seems to replace also the importance of soft information, whereas it is still relevant for larger enterprises. Furthermore, established firms might be forced to offer collateral to a lower extend, as they had time to build up reputation (*Harhoff/Körting* 1998, 1336). Scorings and additional securities[5] of the borrower thus can be seen as a way to overcome the informational disparity between large banks and small opaque firms (*Berger/Udell* 2006).

Brevoort/Wolken (2009) find distance between firm and bank to be on average closer when the bank provides asset or financial management services rather than loans and that loans were rather operated in person when there was no/less valuable asset the lender

3 S. *Altman/Sabato* (2007) and *Deyoung et al.* (2008) argue that the reduction to quantifiable information (scoring) might lead to riskier lending). E.g., *Ahnert et al.* (2005) propose that soft information related to large firms can be used to detect (financial) problems before a crisis would be notified in quantitative ratios. For instance, soft information could have an increased value between two dates of publication of new quantified facts.

4 Note, however, that a mere use of soft facts in lending is not possible from a regulatory point of view (s. KWG § 18 (1) and CRR, Art. 179 (1a)).

5 *Berger/Black* (2011, 727) argue that lending under the use of collaterals has a higher efficiency than lending e.g. solely on a basis of quantitative financial information, as banks, whose loan agreement includes a declaration of a fixed asset as collateral, have a higher probability of receiving some kind of repayment in case of the borrower's bankruptcy.

could rely on in case of default. Their analysis of the National Surveys of Small Business Finances of 1993/1998/2003 has a similar result: of all services offered by financial institutions, banks and firms have by far the highest median distances when it comes to 'leases'. This supports the finding of the aforementioned decrease of importance of distance in the presence of scorings or collateral.

For those reasons, the effect of firm size on the loan rate in the context of borrower-lender-distance is hard to determine, as its impact on the loan rate not only seems to depend on distance, but as well on the loan pricing policy and lending technique employed by the lending bank.

3. Data

The data used was obtained from Bureau van Dijk's enterprise database *Amadeus*, Bisnode's *Hoppenstedt Firmendatenbank für Hochschulen*, the *INKAR* database of the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) and coordinates of zip code areas are obtained from the *OpenGeoDB*-project. The addresses, streets and postal-codes (ZIP-Code) of the banks' head offices and branches are provided by *Gelbe Seiten*, a German provider of telephone directories.

As *Amadeus* only provides the names of the affiliated banks but neither balance sheet data nor their (postal) address, those data have to be looked up in the *Hoppenstedt Firmendatenbank für Hochschulen* providing information on employees and turnover for banks.

Amadeus contains financial and accounting information on European enterprises as well as the names of the banks the enterprise is affiliated with in 2014 as well as their locations. As information on the nature of the relationship is not provided, i.e. it is not known whether the enterprise is a borrower or depositor of the bank.[6]

To cope with the problem of unknown type of banking relationship and to restrict the investigation to relationship lending, only data of German enterprises having an exclusive bank-relationship is used. First, using only data on German financially indebted enterprises with complete data for 2013 and 2014 reduces the initial sample size of about 90,000 firms to about 8,200 observations. Selecting financially indebted firms with exclusive banking relationships, where data on banks could be matched with the data of the Hoppenstedt database yielded 2,185 single bank-firm-relationships.

Matching the ZIP-Codes with the decimal degrees obtained from the OpenGeoDB-project, borrower–lender-distances were calculated. Hence, borrower-lender-distance is measured as actual distance between the bank's branch, the firm is affiliated to, and firm's headquarter-location. Assuming banks' headquarters to be the relevant point for calculating borrower-lender-distance does not seem reasonable, as results would probably be biased by nation-wide operating banks, yielding a large variety of distances.

The distances were calculated as euclidean distances in kilometers using decimal degrees (*Distance*). Note, that the total number of banks' addresses does equal neither the number of firms nor the number of banks that are affiliated to an enterprise but is 22,932. Therefore, the quantities of the locations in Figure 1 differ.

6 E.g. *Shikimi* (2005), using similar data, assumes the loan interest rates to be equal among banks and each firm to have established a lending relationship with the banks named, which possibly assigns lending relationships to deposit or other relationships.

The resulting dataset is unique, as most analyses of bank-firm relationships using German data do not have information on firm-level bank relations or locations. Furthermore, research until now has not considered the use of data describing firms' locations in order to assess their probabilities to conduct relationship banking. Thus, until now, an important aspect possibly contributing to banking relationships and loan pricing has been neglected so far.

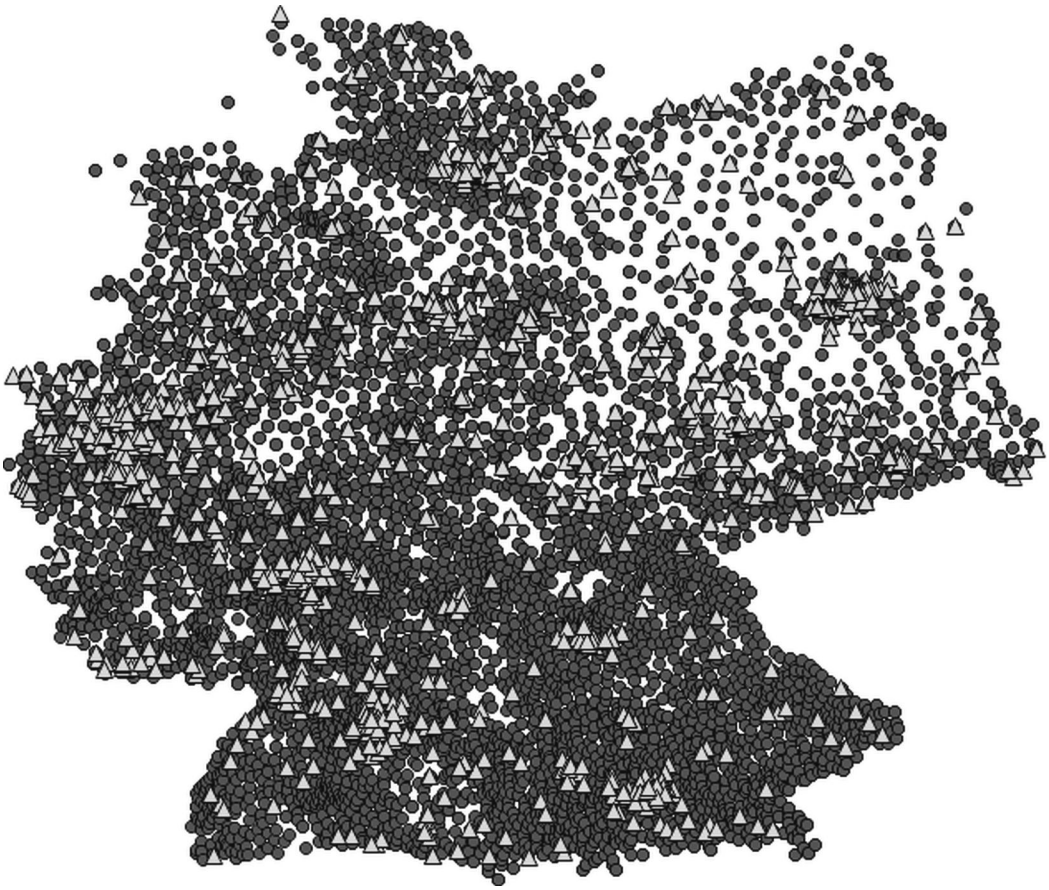

Figure 1: Geographical representation of firms (light triangles) and bank branches (dark dots)

4. Empirical Analysis

4.1 Variables and descriptive statistics

Before turning to the econometric analyses, I give a description of the employed variables as well as summary statistics in *Table 1*.

Amadeus provides data on total interest payments on loans and data on firms' long and short-term financial debt. To estimate the effects of geographical distance on the costs firms are charged by banks for loans, firms' total interest payments on loans are set into relation with the sum of short and long-term loans to calculate an average interest rate

paid in 2014 over all loans a firm owes to its bank (s. also *Shikimi* 2005). To avoid the impact of few extreme outliers, the resulting variable *Interest rate* was winsorized at the 95% level. The resulting vector contains firms with minimum interest rates of close to zero and a maximum of 14.35%, whereas the mean interest rate is about 7.5% in the full sample as well as in the subsample containing only firms engaged in relationship lending.

Instead of using the actual distance measured in kilometers, the natural logarithm of 1+ borrower-lender-distance is used to grasp operational distance. The logarithmic trend is employed, as one unit of additional distance should matter more when the distance has not reached a high level (s. eg. *Felici/Pagnini* 2008, 508).

The number of bank branches within a circumference of 25 km from the firms' location could indicate higher banking competition in the surrounding of the firm. Lower interest rates due to competition induced higher efficiency of banks could be inferred from this variable (s. *Chen et al.* 2001, 14; *Conrad et al.* 2014, 559).

Logarithmized total assets (in thsd. €) not only controls for more available hard information on the firm (*Berger et al.* 2005, 243; *Illueca et al.* 2014, 1228), thus including its ability of engaging in transaction banking, but also indicates its need of external financing sources. Large firms on average have more locations and a higher need for varying services and higher loan amounts. The sample has a high variation with total assets ranging between about 0,25 mio. € up to 351,247 mio. €, with the maximum of total assets being considerably smaller in the subsample of exclusive bank relationship firms.

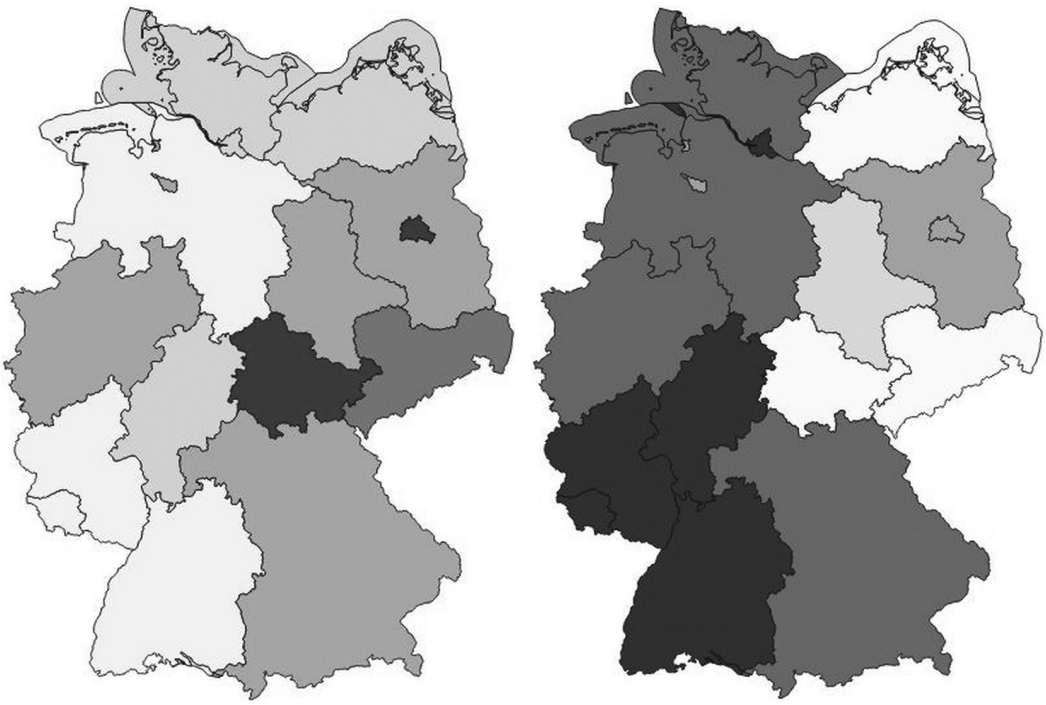

Figure 2: Unweighted average borrower-lender-distance (left) and interest rates (right), grouped by federal states. Lighter areas indicate lower values. Shape data provided by the German Federal Agency for Cartography and Geodesy

Instead of the size of the bank (in total assets) as proxy for lending technology, the employees of the bank are set in relation to the bank's turnover (in bio. €) to control for personnel intensity of the bank (*personell*). As soft information has to be processed personally, banks relying on relationship lending need c.p. more personnel as they do for more intense monitoring, too.

The share of tangible fixed assets relative to total assets in 2013 describes firms' ability to assign collateral to loans. A higher share of tangibles in total assets thus should increase firms' ability to conduct transaction based banking on the one hand, but also decrease firms' overall interest rates due to lower risk premia. For similar reasons, the solvency ratio (in %) of the preceding year is included to describe firms' endowment with equity.

The provisions relative to total assets in 2013 might explain loan rates in the investigated period, as banks might consult last year's results to estimate the future development of the firm.

Turnover per employee describes firms' personnel efficiency.

Firm age is logarithmized, as the advantages of firm age w.r.t. lower information asymmetry between borrower and lender decline with increasing age of the firm (*Jackson/Thomas* 1995, 342). Firm age on the one hand is regarded as a proxy variable for the duration of the firm bank relationship (s. *Berger et al.* 2014; *Berger et al.* 2015). On the other hand, it can be employed to control for hold-up costs, as elder firms are unlikely to maintain only one banking relationship except when there is either no firm growth and/or hold-up costs. Net commuters (*NComm*) should to grasp the centrality of firms' locations,[7] with the difference between incoming and outgoing workers related to all employees at a location and multiplied by 100.

The relation of long-term loans to all loans is used as a proxy for the maturity of debt. Therefore, it could indicate either firms' likelihood to form close banking relationships or the impact of financial debts' term structure on interests paid. As especially (German) small firms depend on long-term loans, there could be different effects of a higher share of long-term debt on behalf of the bank (*Prantl et al. 2008*, 4f; *Agarwal/Hauswald* 2010, 2) . There could be a higher ability of gathering firm specific information on the one hand and higher risk of the loan on the other hand.

Finally, financial liabilities (i.e. the sum of long and short term financial debt) in relation to all liabilities could assess firms' dependency on external bank based finance, similar to the measure used in (*Ongena et al.* 2012, 835). Note, that the variable is not set in relation to firms' equity or total assets, to avoid gauging firms' indebtedness twice, as it is already grasped by solvency ratio.

As can be seen from *Figure 2*, borrower-lender-distance in the sample is on average higher in the federal states of (north)east Germany, which can possibly be explained by lower bank branch density in those areas (s. Figure 1). Thus, the coincidence of lower loan rates and higher borrower-lender-distances, as suggested by *Figure 2*, might stem from those differences and varying regional economic performance. This graphical insight might not point to a negative relationship between distance and loan rate per se, but rather to some relationship due to local economic conditions impacting both variables. Therefore, dummy variables for German regions will be included in the subsequent analysis, where an impact on the coefficient of Banks_{25} is expected.

7 NComm is defined by the BBSR as $\frac{\text{incoming} - \text{outgoing}}{\text{all local employees}} \times 100$.

	Min	Mean	Max	SD	n
Average interest rate	0.0000	0.0734	0.1435	0.0449	8,202
Average interest rate (RB only)	0.0000	0.0766	0.1435	0.0459	2,185
log (1+Distance)	0.0000	2.6350	8.7880	1.8592	2,185
$\frac{\text{Long term loans}}{\text{All loans}}$	0.0000	0.7007	1.0000	0.3443	8,202
$\frac{\text{Financial liabilities}}{\text{Total Liabilities}}$	0.0000	0.3863	0.9968	0.2766	8,202
NCOmm	-392.8000	2.3500	76.9000	46.5916	8,202
Banks_{25}	0.00	266	829	189.9704	8,202
$\frac{\text{Turnover (in thsd. €)}}{\text{Employees}}$	1.39	721.85	69,142.42	2602.4540	8,202
$\frac{\text{Tangible fixed Assets}}{\text{1+Fixed Assets}}$	0.0000	0.7692	1.0000	0.2901	8,202
$\frac{\text{Provisions}_{2013}}{\text{Total Assets}_{2013}}$	0.0000	0.1199	0.9649	0.1186	8,202
log (Total Assets)	5.5840	10.7470	19.6770	1.5436	8,202
$\text{Solvency Ratio}_{2013}$	-15.8200	37.1100	98.2200	22.5755	8,202
log (Age)	0.6931	2.9526	29.9336	1.3990	2,185
Personnel	0.0000	0.0116	0.0901	0.0078	2,185

Table 1: Summary Statistics of sample and subsample

As can be gauged by Table 1, there is a high degree of heterogeneity among firms. K-Means cluster analyses most frequently revealed clusters of outliers and additionally did not yield valuable insights regarding bank-firm-distance or interest rate payments.[8]

4.2 Econometric Analysis

At a first stage, one must control for the potential sample selection biases which might arise when only firms with exclusive banking relationships are regarded. E.g., *Petersen/Rajan* (2002, 2540) and *Berger et al.* (2005, 254) find empirical evidence that spatial distance between borrowing firms and their lenders increases when enterprises do not have deposits at their lending bank, possibly because of the resulting less frequent transactions between bank and borrower. Thus, due to arising endogeneity concerns, a Heckman two-stage procedure is employed, where the first stage is a probit estimation on whether firms engage in relationship banking. As the application of relationship banking cannot be observed directly, I follow *Berger/Black* (2011) and use the exclusiveness of the banking relationship as proxy. This furthermore suits the problem of unknown banking relation type mentioned above. The following OLS estimation tries to capture the determinants of the

8 According to several criteria, the optimal number of clusters in most cases, varying firm level variables, was three, with the cluster sizes pointing to outlier clusters and a separation between large firms and SMEs.

average interest rate on firm's financial debt in relationship banking, where special attention is paid to the effects of the included distance variable.

As the variables employed in selection and outcome equation differ, error terms were checked separately for correlations with the right hand side variables and no correlation could be detected. Logarithmized total assets and firms' dependency on bank-based finance were used in the selection equation as exclusionary variables, as they might rather affect the choice on relationship versus transaction banking directly than on interest rates. Large firms might rely on more banking relations in order to satisfy their need for external funding (*Cosci/Meliciani* 2002; *Neuberger et al.* 2008, 103). Furthermore, it is commonly assumed that small firms strongly depend on soft information and thus have a higher incentive to form a close relationship with their lender (*Jiménez et al.* 2009, 237). As small firms are expected to have on average more concentrated borrowing (s. *Harhoff/Körting* 1998, 1331), a significant negative impact of the variable on the probability of exclusive banking relationships is expected.

As can be seen from Table 2, the coefficient of the Inverse Mill's Ratio is significant in both estimations, indicating the presence of sample selectivity bias.

Before turning to other coefficients, the results on borrower-lender-distance in the outcome equation are discussed. In both estimations, the coefficients prove to be positive, of similar magnitude and highly significant. If borrower-lender-distance increases by one percentage, firms have to pay on average c.p. 0.22 bp (0.2 bp) higher interest rates. The result thus is in line with the findings of *Knyazeva/Knyazeva* (2012) and *Bellucci et al.* (2013) , indicating that German firms engaged in relationship lending have to bear higher costs of screening and monitoring. Thus, there is no evidence for banks' use of local market power as found by *Agarwal/Hauswald* (2010), using US-data.

A confirming result can be found in the outcome equation of estimation (2), where the significant negative coefficient on bank's personnel intensity indicates lower interest rates if information can be processed more from person to person. Yet, as this coefficient is not significant in estimation (1) and, due to missing additional information, those results must be interpreted with care.

The number of bank branches in a 25 km circumference increases firms' probability of engaging in relationship banking, which contradicts expectations at a first glance.[9] One would suppose that matching probabilities between firms and banks increase with more banking branches in the vicinity of the firm. The result might in part stem from the location of firms and banks: With stronger banking competition, financial institutions could be forced to provide quantitative and qualitative above average services to firms and lower credit constraints. Hence, there might be a lower necessity to engage in multiple banking relationships.

Additionally, as distance in lending relationships matters, lower distances of firms located in urban environments (s. *Petersen/Rajan* 2002) might have an advantage in relationship lending, including the transfer of qualitative or non-codifyable information. As banks have higher incentives to build up long lasting relationships with their borrowers in competitive markets, the result could indeed indicate a higher prevalence of relationship lending in urban environments.

9 Following *Degryse et al.* (2009), distance of competing banks is not interacted with their size as the latter does have little explanatory power on the lending technique used by the bank.

This is also indicated by the coefficient of the dummy variable for firms located in large cities *(COM1)*, which is even larger in magnitude than its rural counterpart *(COM5)*, indicating a c.p. smaller probability for firms located in small rural communities to engage in relationship lending compared to urban enterprises. The high likelihood of rural firms to keep close ties with their lending bank as exclusive banking relationship might stem from lower availability of different banking services in such locations or different characteristics of firms in rural areas, such as smaller sizes, higher opacity or higher volatility. Furthermore, banks in rural environments could have advantages in operating in a 'familiar' environment and have better connections to their borrowers as well as to the local economy (*DeYoung et al.* 2012). In unreported additional regressions, dummy variables for the community types between *COM1* and *COM5* were included in the probit estimation with varying specifications of the equation. All of them proved to be significant and negative. Thus, there seems to be some quadratic impact of the community type on a firm's probability to engage in relationship lending.

Similar to *COM1*, locations with higher net commuters, indicating higher centrality within interaction with other locations, have a higher probability to dedicate themselves to one bank. Overall, the results of the locational variables in the selection equation are highly statistically and economically significant, thus pointing to the relevance of considering enterprises' environment when investigating its choice of external funding.

The negative coefficient of $Banks_{25}$ in the outcome equation might reflect lower interest rates due to higher banking competition within an area (s. e.g. *Degryse/Ongena* 2004, 577) and a resulting higher cost efficiency in assigning loans. An increase of one banking branch in the firm's vicinity lowers firms' interest rate on average c.p. by 0.0119% (0.0034%). As the number of bank branches in a 25km circumference of the firm is up to 829, a distinct impact of banking competition on loan rates must be considered. This in part is in line with the findings of *Degryse et al.* (2009) and *Bellucci et al.* (2013) that banks demand higher loan rates when firms are located in their proximity and competing banks are relatively distant from the firm. The result at a first glance contradicts the visual evidence of Figure 2, but must be interpreted under the consideration of absolute firm location.

The regional dummy variables indicate firms' locations in southwest Germany (Baden-Württemberg, Rhineland-Palatinate, Hesse, and Saarland), in one of the states of the former GDR (including Berlin) and northwest of Germany (North Rhine-Westphalia, Lower Saxony, Bremen, Hamburg, and Schleswig-Holstein).[10] The mode of separating the federal states as stated above is motivated by the pattern shown in Figure 2, yielding an 0.6% higher average rate in southwestern Germany and 0.9% lower average interest rate in eastern Germany, relative to Bavaria (i.e. southeastern Germany). The effects of firms' absolute location w.r.t. region seem to be offset by including the variable on banking competition. Excluding either the former or the regional dummy variables, results in insignificant coefficients for the dummy variables or a weaker impact of banking competition. Therefore, the graphical evidence and econometric results can be reconciled.

In line with theoretical expectations, firm size has a negative impact on the probability of engaging in relationship banking with an average marginal effect of -1.12% in estima-

10 To test for the application of spatial error models, Moran's-I-Tests with varying k-nearest-neighbor matrices were conducted, which clearly failed to reject the null of no spatial correlation. Spatial autoregressive or spatial expansion models furthermore were not considered, as the sample selection might have led to geographical biases.

tion (1) (-1.69 % in estimation (2)). This is in line with theoretical expectations and empirical findings of other studies (s. *Ongena/Smith* 2000; *Farinha/Santos* 2002; *Neuberger et al.* 2006; *Neuberger et al.* 2008).

The share of firms' financial debt was included in the selection equation. A higher dependency of firms on financial debt could decrease the probability of single bank lending, due to a higher potential for credit crunches and transfer of financial problems of the bank to the firm (*Detragiache et al.* 2000). As banks with a high share of loans are prone to such problems, the negative coefficient in both estimations is in line with theoretical predictions.

The term structure of financial debt has an expected positive impact on the probability of relationship lending, whereas a negative impact on interest rates is observed, contradicting a normal term structure of interest rates. The result might arise because of closer ties in exclusive banking relationships, or as long-term debt usually is used to finance assets that can be used as collateral in case of default. Furthermore, banks can reduce average costs of screening when financing multiple or long-term projects of (opaque) firms (*Cenni et al.* 2015, 251), thus on average decreasing interest rates for long term borrowers.

The share of firms' tangible fixed assets has, as expected, a negative impact on the probability of relationship lending which is similar to the results in *Knyazeva/Knyazeva* (2012, 1200). Firms having a higher share of realizable assets that can be employed as securities are rather able to engage in transaction based banking. Furthermore, firms with a higher share of tangible assets could rather be in need of credit (*Cenni et al.* 2015). With the coefficients in the outcome equations contradicting, the effect on interest rates is not clear. With exclusive banking relationships, subordination problems in case of default are not reflected in the coefficient, as liquid collateral might be of a higher relevance in exclusive banking relationships, with deposits and securities of firms stored by the lender.

While the effect of firms' provisions of the preceding year is not stable in the selection equation and hardly or not significant, its effect on interest rates is positive as expected.

A higher solvency ratio decreases firms' probability to engage in relationship lending, possibly because firms with higher endowment of equity are able to conduct transaction based banking. Although one would expect firms with higher solvency to be charged on average lower interest rates, higher solvency ratios in the preceding year increase interest rates on average in both outcome equations.

Firm age has a positive impact on average interest rates paid. This contradicts a higher transparency due to longer firm history and higher probability to survive. Contrarily, with the sample in the outcome equation consisting out of firms with single bank relationships, the coefficient might rather reflect hold-up costs arising for elder firms, which remain with only one banking relationship.

To control for bank-type specific loan rate policies, dummy variables were included for savings, cooperative and state-level central banks. The dummy variables indicate that savings and cooperative banks charge on average lower loan rates than commercial banks. The results on the dummy variables must be handled with care; as commercial and savings bank branches certainly are more ubiquitous than commercial bank branches, lower distances must be expected for lenders belonging to one of the former bank types. Therefore, lower loan rates also might not only stem from the bank type itself, but also from included higher borrower-lender-proximity.

	(1)		(2)	
	Selection	**Outcome**	**Selection**	**Outcome**
Intercept	-0.4495***	0.43403***	0.4129*	0.14222***
COM1			0.2366***	
COM5			0.1673**	
NComm			0.001096***	
$Banks_{25}$	0.000651***	-0.000119***	0.000277***	-0.000034***
$\frac{\text{Financial liabilities}}{\text{Total Liabilities}}$	-0.1369**		-0.2715***	
log (1+Distance)		0.002197***		0.001954***
$\frac{\text{Turnover}}{\text{Employees}}$	0.000003	-0.000001***		
$\frac{\text{Long term loans}}{\text{All loans}}$	0.3626***	-0.080852***	0.2622***	-0.025274***
$\frac{\text{Tangible fixed Assets}}{\text{1+Fixed Assets}}$	-0.1755***	0.009499**	-0.1065*	-0.0097023***
$\frac{\text{Provisions}_{2013}}{\text{Total Assets}_{2013}}$	0.2393*	0.061146***	0.147	0.1026***
log (Total Assets)	-0.0344***		-0.05264***	
$\text{Solvency Ratio}_{2013}$	-0.00238***	0.000486***	-0.003679***	0.0003234***
Personnel		0.13195		-0.34656**
log (Age)		0.001729***		0.001167**
Savings Bank				-0.010881***
Cooperative Bank				-0.014213***
Central Bank				0.003298
Southwest				0.005971**
East				-0.009193***
Northwest				-0.000545
Inverse Mill's Ratio		-0.25352***		-0.069562***
Industry dummies	-	-	18	18
n (total)	8,202	8,202	8,202	8,202
censored obs.	6,017	6,017	6,017	6,017
adj. R^2		0.2882		0.2799

*Table 2: Estimation results of Heckman-2-stage models, standard errors in parentheses. Due to heteroscedasticity problems in outcome estimations, robust standard errors were used. Levels of significance are indicated by *** (99%), ** (95%) and * (90%).*

5. Conclusions

With many firms keeping close ties with their banks, relationship banking has a high relevance for external funding of German firms. Analyses investigating its impact on lending come to different results, depending on the employed method of research as well as on the investigated international firm location (e.g. *Bolton/Scharfstein* 1996; *Farinha/Santos* 2002; *Neuberger et al.* 2008; *Guiso/Minetti* 2010; *Ongena et al.* 2012).

As technical progress modifies methods of communication and collecting information, the proclaimed 'death of distance' in lending seems to be more immanent (e.g. *Petersen/ Rajan* 2002, 2537). Furthermore, the use of credit scoring models weakened the importance of soft information and average distances were able to grow (*Berger et al.* 2015). Yet, as there is non-codifyable information or information that cannot be transferred or quantified, spatial proximity to asses a borrower's economic situation could further play a major role in lending (*Agarwal/Hauswald* 2010). Therefore, as SMEs make up a large portion of German firms, the impact of distance in relationship lending still has a high economic relevance.

Using a dataset, that allows, to the best of my knowledge, for the first time to measure spatial distances between firms and bank branches for German firms, there is evidence that higher costs of screening and monitoring due to higher distance have to be borne by borrowers. Thus, banks do not seem to have or at least exert local market power, i.e. pricing loans of nearby borrowers differently. Higher banking competition has a negative impact on interest rates, possibly indicating higher efficiency in competitive banking markets. Further research should focus on the question whether the distance related costs arise due to higher transportation costs of surveillance of opaque firms or because of risk premia for distant firms.

Another result are the effects of firm location on its probability to engage in relationship lending. There is strong evidence for quadratic relationship between location types and the likelihood to commit oneself to a single bank. With bank branch density varying widely, this in turn might result in c.p. higher loan costs due to firms' location. Thus, banks' interest pricing policies w.r.t. distance and competition might affect the overall spatial location of economic activity in Germany. Especially the importance of small local lenders for SMEs, as discussed in section two, and the disappearance of the former in rural areas might reinforce spatial economic growth patterns such as the agglomeration of production.

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