Firms and Their Main Banks

Effects of Main Bank Characteristics on Firms' Bank Choice, R&D Investment, and Survival

Inauguraldissertation
zur Erlangung des akademischen Grades eines
Doktors der Wirtschaftswissenschaften
der Universität Mannheim

vorgelegt von
Daniel Höwer

Tag der mündlichen Prüfung: 17. Juni 2013
Sprecher Abteilung Volkswirtschaftslehre: Prof. Dr. Martin Peitz
Referent: Prof. Konrad Stahl (Ph.D.), Universität Mannheim
Koreferent: Prof. Yossi Spiegel (Ph.D.), Tel Aviv University, Israel

Acknowledgements

My interest in economics and the role of banks as financial intermediaries began with the age of 16 as a trainee in a *Sparkasse*, not knowing that I would ever write a related dissertation thesis. Now that this work is complete, nothing remains but to thank all the people supported the writing of my thesis. Firstly, I am indebted to my supervisors, Prof. Konrad Stahl (Ph.D.) and Prof. Yossi Spiegel (Ph.D.), for their time discussing my work, their guiding questions, and their valuable suggestions for the improvement of my papers. I am grateful to a project Prof. Konrad Stahl started more than twenty years ago. He established a cooperation with Creditreform and created the Mannheim Enterprise Panel (MUP), a firm-level data base that is maintained by the Centre for European Economic Research (ZEW) and the underlying data set for my empirical analysis. I gained tremendously from the fruitful discussion with Prof. Yossi Spiegel during my two research stays at Tel Aviv University. I very much appreciated the hospitality, research atmosphere and the warm welcome at his faculty.

This dissertation was written when I was a research fellow at the Centre for European Economic Research. I thank Georg Licht for let my ideas how to use the MUP develop. I appreciated a nice and pleasant working atmosphere at the ZEW, especially due to Kathrin, Katrin and Johannes who shared the office with me and discussed econometric issues or solved every day problems. I thank Bettina Müller and Kathrin Müller for critical "referring" of my first drafts. I would like to thank Bettina Peters and Dirk Czarnitzki, both contributed to the methodological standard of my analysis by patiently discussing model specifications or convergence problems. Further thanks go to my co-authors Tobias Schmidt, Wolfgang Sofka, Martin Brown, Hans Degryse, and Fabiana Maria Penas for fruitful teamwork. They taught me how to analyse data more efficiently. My thanks go also to the team conducting the KfW/ZEW Start-up Panel for the constructive discussions and valuable comments preparing banking related questions for the questionnaire.

Finally, I owe special thanks to Katja, my family, and all other friends, who had to bear with me during my absent-mindedness and time constraints.

Daniel Höwer

Contents

List of Papers

The thesis comprises extended versions of the following papers:

1. "From Soft and Hard-Nosed Bankers Bank Lending Strategies and the Survival of Financially Distressed Firms", ZEW Discussion Paper No. 09-059, Mannheim.

2. "An Information Economics Perspective on Main Bank Relationships and Firm R&D", ZEW Discussion Paper No. 11-055, Mannheim and Deutsche Bundesbank Discussion Paper Series 1: Economic Studies, No. 19/2011, Frankfrut/Main, joint with Tobias Schmidt and Wolfgang Sofka.

3. "Corporate Main Bank Decision",ZEW Discussion Paper No. 13-018, Mannheim.

List of Figures

List of Tables

List of Abbreviations

AG	incorporated company
b	bank
BBR	Federal office for building and regional planning
BP	ZEW Bank Panel
CEO	Chief Executive Officer
CIS	Community Innovation Survey
d	district (*Landkreis* or *kreisfreie Stadt*)
DSGV	German Savings Bank and Giro Association
Emp	No. of employees
GDP	Gross Domestic Product
GDR	German Democratic Republic
GmbH	limited liability company
GmbH & Co. KG	limited partnership with a limited liability company as general partner
HHI	Herfindahl-Hirschman index
i	firm
ind	industry
IV	Instrumental Variable
KfW	Promotional and Development Bank at the federal level
KG	limited partnership
km	kilometer
ln	natural logarithm
MIP	Mannheim Innovation Panel
MoP	Mode of Payment
MUP	Mannheim Enterprise Panel
NACE	General Industrial Classification of Economic Activities in the European Communities
OECD	Organisation for Economic Co-operation and Development
SE	Societas Europea
S.D.	Standard Deviation
SME	small- and medium-sized enterprises
SpG	state law governing *Sparkassen*
SuP	KfW/ZEW Start-up Panel
R&D	Research and Development
ROC	Receiver Operator Characteristics

VC	venture capital
ZEW	Centre for European Economic Research

Chapter 1

General Introduction

Bank financing is the most important source of external financing for small- and medium-sized enterprises (SME). Banks financed 29% of the total volume invested by German SMEs in 2011. In contrast, only 11% of investment funding was provided by promotional loans or other subsidies and another 6% provided by other funds, such as mezzanine capital or private equity (54% of total investment volume was provided by own/internal funds (Schwartz, 2012)). In addition, any German firm has a main bank relationship in order to participate in the financial transfer system. Firm bank relationship can vary from pure financial transactions to very "close monitoring and implicit long-term contractual agreements" (Berlin and Mester, 1998) often refered to as relationship oriented banking. Firms can benefit for several reasons from relationship oriented banking, e.g. through improved access to funds or relaxed collateral requirements (Petersen and Rajan, 1994; Elsas and Krahnen, 2002). But firms have to bear higher transaction costs providing information in relationship oriented banking. Therefore, not all firms might ask for relationship oriented banking.

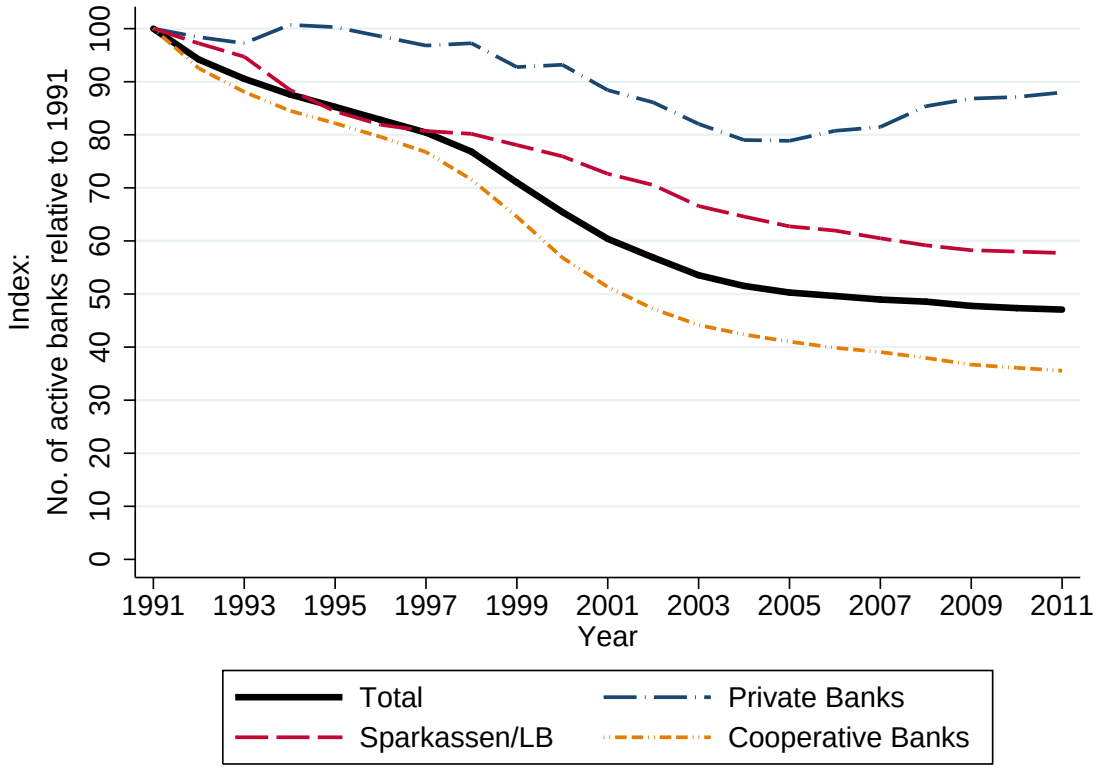
The banking market can be very heterogenous and banks are characterized by different degrees of relationship oriented banking. Banks need to invest in specialization in order to add value to the firm, such as a relationship oriented bank (Boot and Thakor, 2000). Those that invest more in specialization are better positioned to aggregate the outcomes of the information production of other firms in the industry or region in their client portfolio, i.e. information externalities (Stiglitz, 2002). The degree of their investment in specialization might depend on their governance structure or chosen business model. Resulting differences in the banks' portfolio composition or differences in the banks' governance have mainly been disregarded in the literature. The more recent literature has started to acknowledge that banks are not identical. Most of these studies argue that the structure of the hierarchy of banks differs which is approximated in empirical studies by bank size (e.g. Berger and Black, 2011). The structure of the German banking market for example shows that banks differ in many more aspects, such as the governance, the industry, or the spatial specialization. These differences can have potential effects on the firm-main bank relationships.

The German banking market is highly spatially diversified with more than 2,000 banks, all active as universal banks (offering all kinds of banking services). Probably the most important factor is that German banks differ in their governance structure and can be

classified into three groups: *Sparkassen*, cooperative banks, and private banks. Both *Sparkassen* and cooperative banks emerged as a response to the social tensions in the late nineteenth century accompanying the industrial revolution. *Sparkassen* mostly started as a part of the financial administration of the municipalities and were only allowed to take deposits to ensure wealth building for the poor. At the beginning of the last century *Sparkassen* were reorganised as independent institutions under the supervision of the municipalities. A *Sparkasse* can offer all kinds of banking services but its spatial area of business is restricted according to the so–called "regional principle". *Landesbanken* are the central banks of *Sparkassen* and also have business clients themselves. *Landesbanken* are jointly owned by the regional *Sparkassen* associations and federal states (*Bundesländer*).

At the same time, cooperative banks based on the ideas of Hermann Schulze-Delitzsch and Friedrich Wilhelm Raiffeisen were founded. Cooperative banks in the commercial sector are called *Volksbanken* and in the agricultural sector *Raiffeisenbanken*. The philosophy of the cooperatives banks was to put their members in the position of being able to help themselves. The cooperative banks have taken deposits from and granted loans only to members in the early beginning. Since the 1970's cooperative banks also provide all kinds of banking services to non-members (Born, 1976). In contrast to other European countries, such as Italy, *Sparkassen* and cooperative banks have not been privatised. Although *Sparkassen* and cooperative banks compete with private banks, they still have a mandate or a mission statement to support the regional economy.

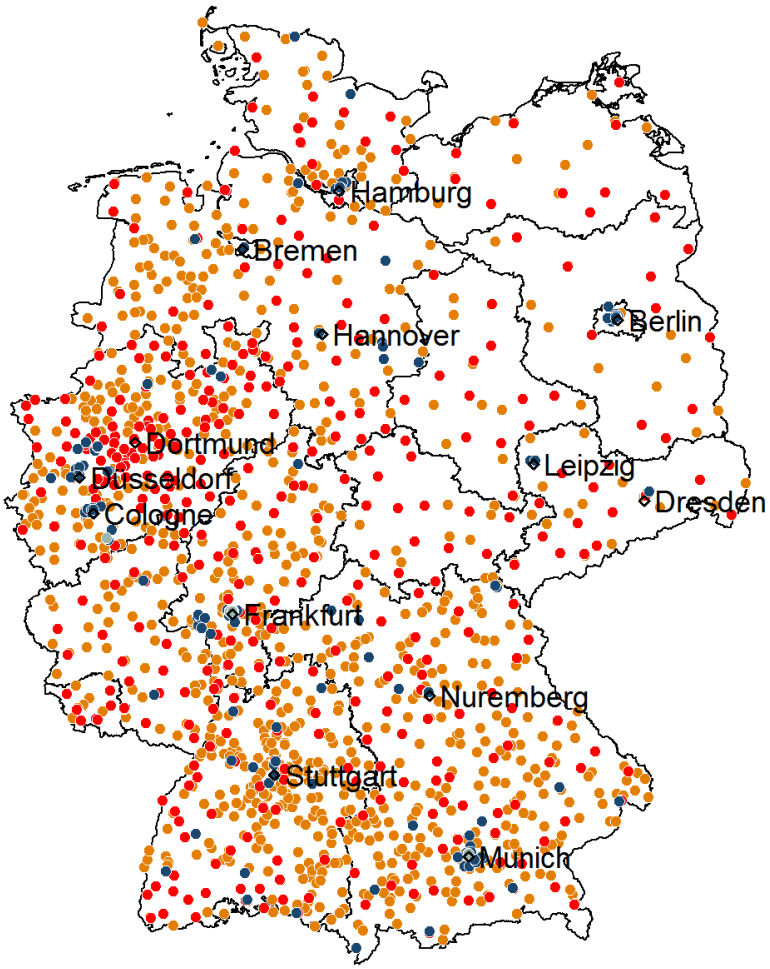
Figure 1.1: Bank mergers in Germany by bank type (1991-2011)



Source: Deutsche Bundesbank 2012, author's own calculation

In the last two decades the German banking market consolidated vastly. The time series index in figure 1.1 shows the number of banks in the years 1991 to 2011 relative to the base year 1991. All the mergers took place within each of their own banking sectors. The total number of banks was reduced by over a half (black line). Most mergers took place within the sector of cooperative banks (orange line), followed by mergers of *Sparkassen* (red line). In terms of the size of the merged bank, the largest merger occurred in the private banking sector (*Commerzbank* with *Dresdner Bank* in 2008/2009; blue line). The temporary increases of the number of private banks can be explained by market entries of foreign banks.

Figure 1.2: Location of bank headquarters in Germany (2011)



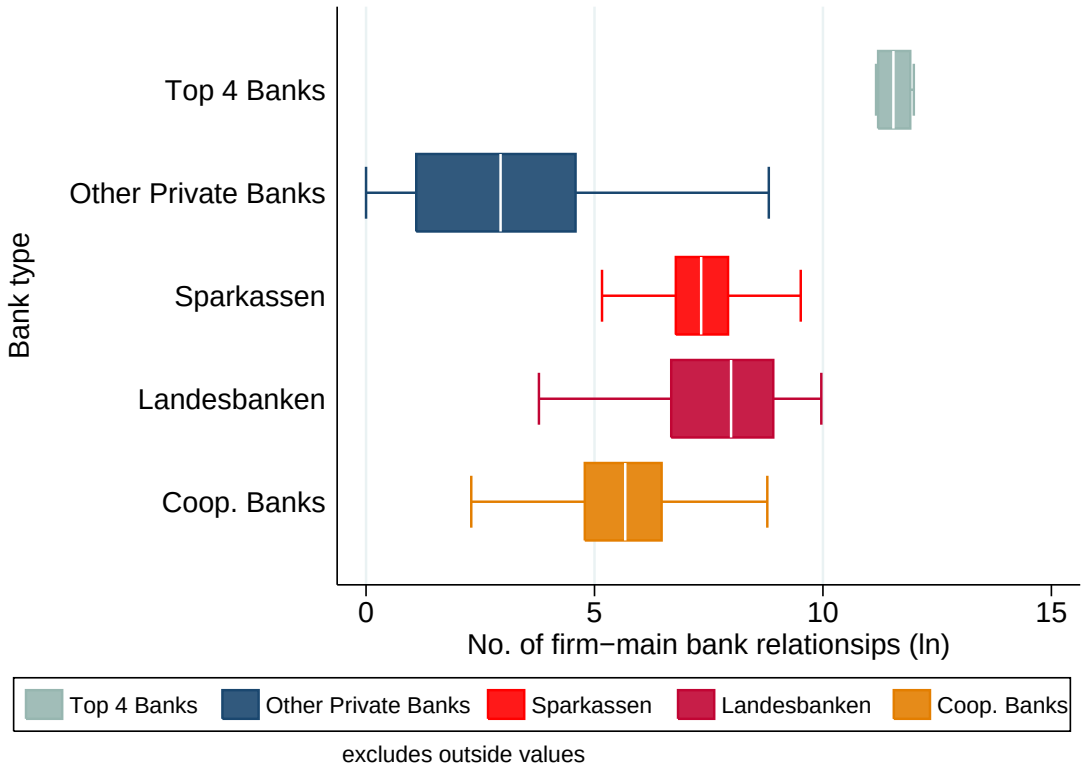
• Top 4 Banks • Other Private Banks • Sparkassen and Landesbanken • Cooperative Banks ♢ major cities
Source: ZEW Bank Panel, 2013; Geodata: google maps.

Although, a large number of banks merged, the German banking market remains highly fragmented regionally. Figure 1.2 shows the locations of bank headquarters in Germany in 2011 by bank type. Private banks, indicated in blue, are located in major cities. The headquarters of the Top 4 banks are located in Frankfurt (*Deutsche Bank* and *Commerzbank*), Bonn (*Postbank*), and Munich (*HypoVereinsbank Unicredit*). Headquarters of

Sparkassen and cooperative banks are located all over Germany, even in rural areas. In southern Germany the density of cooperative banks is high. The low bank density in Eastern Germany can be explained by the political situation in the former German Democratic Republic (GDR) and transformation after reunification. In the 1950's *Sparkassen* were officially independent but were organised centrally by the GDR's ministry of financial affairs. In the 1970's the number of *Sparkassen* was reduced and cooperative banks were forced to transfer accounts to local *Sparkassen*. After the German reunification in 1990 many *Sparkassen* and cooperative banks in Eastern Germany were inefficient and merged to larger units.

In the *Sparkassen* and cooperative banking sector, banks' spatial business areas generally do not overlap. Bank size is therefore restricted to the local (firm) population. The regional distribution and the number of banks of each bank type result in different distributions of bank size. In figure 1.3, I present the distribution of bank size in terms of the number of firm-main bank relationships (ln). The Top 4 banks have by far the highest number of bank relationships (between 70,000 and 160,000 firm-main bank relationships). On average, *Landesbanken* had 6000 firm-main bank relationships. *Sparkassen* (mean 2400) are larger than cooperative banks (mean 500), whereas both bank types have outliers in both directions. Private banks that do not belong to the Top 4 banks are relatively small (mean 200). These are mostly banks specialised in private wealth management which run the service of firms as a secondary business or foreign banks.

Figure 1.3: Bank size distribution by bank type (2011)

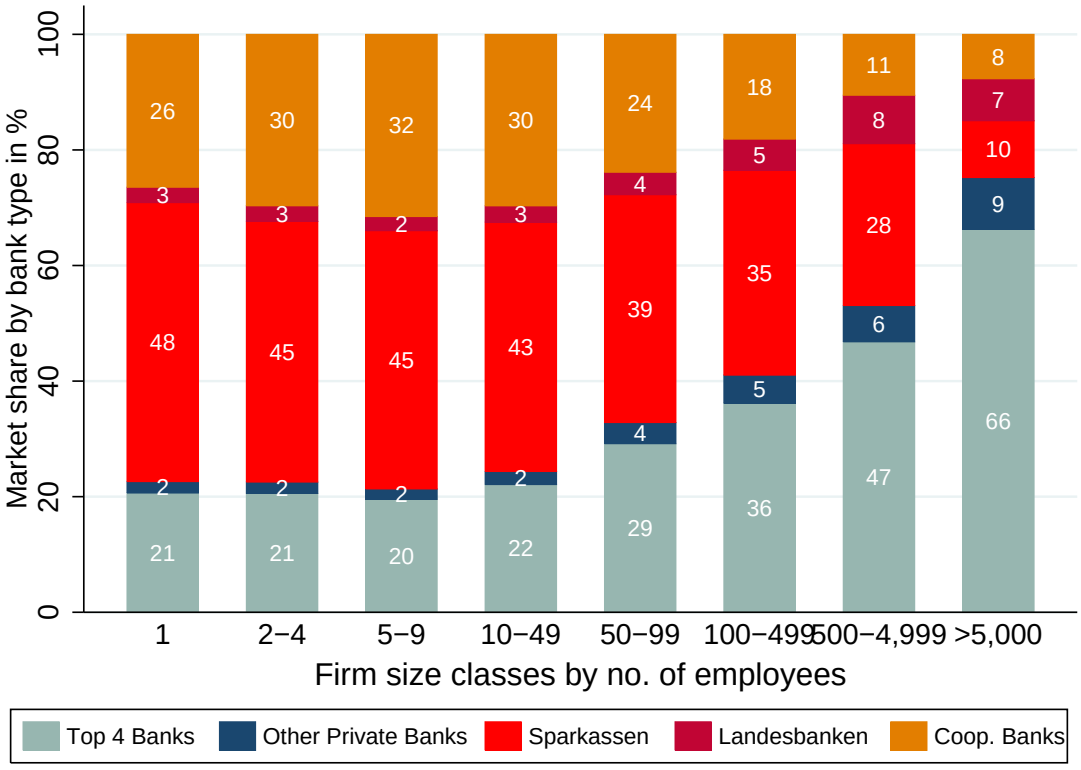


Source: ZEW Bank Panel 2013, author's own calculation.

Spatial distribution of a bank's business area also influences the bank's portfolio structure. The industry composition of the portfolio of banks with restricted business areas is more likely to reflect the industry composition of the local economy. Although these banks can give specific industries higher or lower weights in their portfolio. The industry specialization is restricted to the pool of firms within their business area. Banks specialized in certain industries but without business area restrictions might be less capable of gathering local knowledge.

Banks of different types also seem to attract certain types of firms. In figure 1.4, I present the market share in terms of firm-main bank relationships by bank type and firm size. The market shares in the groups of small firms with less than 50 employees (column 1 to 4) are relatively stable. *Sparkassen* have the largest market share varying between 43% and 48%, followed by cooperative banks (26% - 30%). The market share of large banks varies between 20% and 22%. As firm size increases the market shares of non-private banks decrease. In the largest firm size class, private banks have a market share of more than two third of all main-bank relationships.

Figure 1.4: Market shares in main-bank relationships by bank type and firm size (2011)



Source: ZEW Bank Panel and MUP (ZEW) 2013, author's own calculation.

The described differences of bank characteristics potentially affect their business client's access to and conditions of bank financing. Banks that are more experienced e.g. in a clients industry might be more capable of processing firm information and monitoring projects. Clients of those banks might have easier access to funds. Specialized banks can also be expected to be more capable of evaluating projects that are in distress and make more efficient liquidations. Bank's specialization is influenced by its governance. Banks

with a mandate to support distressed but viable firms would need to invest more in specialization. Firms might consider that specialization comes with additional transaction costs and self select a bank type according their preferences.

Taking all these heterogeneity of banks into account in this thesis, I provide a detailed analysis of firm-main bank relations and the role of bank and bank portfolio characteristics within the context of relationship banking. The thesis is a collection of three empirical papers on firm-main bank relationships. One of the main objects of investigation throughout all chapters is the effect of the characteristics of the main bank on the firms. A special interest lies in the governance regime of the bank, i.e. whether it is a private or a non-private bank. Chapter 2 contains an empirical investigation on the role of banks when firms are financially distressed. In chapter 3, I investigate the effect of banks' industry expertise and diversification on firm's Research and Development (R&D) intensity. In chapter 4, I explore the firm's selection of its main-bank relationship.

The reason why these differences have mostly been disregarded in the literature is mainly due to data limitations which do not allow studying both, i.e. firms and their main-bank relations in detail. Studies analyzing the German banking market either use information from banking supervisor authorities or publicly available balance sheet information. Information maintained by banking supervisory authorities contains bank balance sheet information, sums lent to industry classes, and information about interventions in bank management by the bank supervisory authorities. These data do not contain information on the firm-main bank link. In other cases this information is highly selective (e.g. *Millionenevidenzzentrale* by the *Deutsche Bundesbank* contains only information on firms asked for loans of more than 3 million Euros). Publicly available balance sheet information, e.g. provided by BankScope, does not cover the complete banking sector. Especially small *Sparkassen* and cooperative banks are missing. Although these banks are small, their aggregate has a significant market share of SME finance in Germany (see Figure 1.4).

The data set used in this thesis overcomes the gap between detailed information on both sides, on the side of firms and on the side of banks. The MUP covers nearly all firms active in Germany. The MUP is maintained by the Centre for European Economic Research (ZEW) but the data is collected by Creditreform, Germany's largest rating agency. Next to firm characteristics, such as firm age, industry coding, and ownership, the data also contains information on a firm's bank relationships, whereat the main-bank relationship is identified. I constructed a panel of all banks including branches that can be directly linked to the firm-main bank relationships in the MUP. Based on that link, I aggregated information that helps to describe the banks' portfolio, e.g. with respect to industry specialization or the regional banking market. The resulting ZEW bank panel consists of all universal banks active in Germany with detailed information on the portfolio characteristics of each bank for the years 2000–2011.

I supplemented firm level data provided in the MUP with detailed information collected in two surveys, the Mannheim Innovation Panel (MIP) and the KFW/ZEW Start-up Panel. The MIP is a panel data set of mainly mature firms that allow studying innovation activities of firms. The KfW/ZEW Start-up Panel is a computer assisted telephone interview of newly established firms. It contains information from the start of business

regarding entrepreneurial characteristics, firm's investment, innovation activities, and financing. Firms are tracked for several years. Firms in both data sets are stratified from the MUP and can directly be linked to firm observations in the MUP. The generated datasets allow to provide answers to the following research questions: Does survival of financially distressed firms depend on their main bank relationship? Do main banks that are specialized in the firm's industry eases a firms' access to funds financing R&D projects? Does a firms main bank choice depend on firm risk or the entrepreneurs demand for liquidity insurance?

In summary, the three analyses yield the following results,

- Firms with a main bank relationship to a private bank have a higher probability of becoming financially distressed.

- The type of the firm's bank relationships does not affect the probability of default of financially distressed firms.

- Financially distressed firms' probability of market exit increases with the size of the bank that serves as the firm's main bank relationship.

- Financially distressed firms' probability of market exit increases with the number of bank relationships.

- Firms have a higher probability of becoming financially distressed, if their main bank suffers from a high ratio of market exit within its portfolio. But, financially distressed firm's probability of market exit reduces with the share of market exits in the bank's portfolio.

- A bank's industry market share positively affects R&D intensity of high-tech firms. But an increasing industry portfolio share reduces the R&D intensity of high-tech firms.

- R&D intensity of high-tech firms decreases as the size of its main bank increases.

- High-tech firms have a lower R&D intensity if their main bank is a non-private than a private bank.

- Newly established firms for which banks support in financial distress is of utmost importance are more likely to choose non-private bank. But, there is no indication that bank choice is affected by the firm's probability of default at the start of the business.

- Newly established firms that ask for bank finance in their initial year are more likely to choose a non-private bank.

- Newly established firms for which favorable market conditions are of utmost importance are more likely to choose a private bank.

- Banks with a high market share in the firm's district and those that are specialized in the firm's industry are more likely to be chosen.

These results of the analysis lead to very important insights into the functioning of the relationship between various types of banks and their business clients. First, a bank's capability of offering relationship oriented banking depends on its own characteristics that goes beyond its hierarchal structure. Firms with a relationship to a *Sparkasse* or cooperative bank are less likely to become financially distressed. A potential explanation is that non-private banks are more willing to absorb financial shocks from their customers and firms are in the position to pay their bills in time. There is no robust evidence that the the institutional background of the main bank also influences the firm's survival probability. I find "perversive incentives" similar to Peek and Rosengren (2005) that banks with difficulties in their loan portfolio are more likely to keep distressed firms alive. However, I also show that firms with a relationship with such a bank are more likely getting financially distressed in the first place. The results also confirm, that banks need to invest in specialization in order to add value to their clients (Boot and Thakor, 2000). The finding, that firms R&D investment is positively related with the bank's industry experience can be interpreted that those banks are more capable of evaluating new, uncertain projects. However, banks also need to diversify their portfolio in order to compensate idiosyncratic industry shocks and firms R&D intensity reduces with an increase of the industry share in the bank's portfolio.

Second, not all firms ask for relationship oriented banking. Depending on preferences or business model, a firm demands a different degree of relationship oriented banking. The results suggest that the firms can distinguish the bank's business model by its type. Public mandate or mission statements of non-private banks might make entrepreneurs belief that these banks are more likely to help in an episode of financial distress. Private banks instead, might be considered as much tougher in renegotiations. Furthermore, firms are more likely to select banks with a high regional market share and industry specialization. Firms therefore might take into consideration that those banks have a better knowledge of the regional market and the firm's industry and are more capable of evaluating the project.

Chapter 2

The Role of Banks When Firms are Financially Distressed

2.1 Introduction

Firm–bank relationships are special in reducing information asymmetries between borrowers and lenders. Banks gain proprietary information when screening and monitoring borrowers (Fama, 1985). Compared to holders of publicly traded debt, banks have more incentives to use their own resources in order to evaluate the viability of firms (Diamond, 1984; Chemmanur and Fulghieri, 1994). As a consequence, banks make more efficient decisions on liquidation versus renegotiation of firms (Chemmanur and Fulghieri, 1994). In addition, banks have access to private information observing the behavior of firm management and can influence the firm's decisions (Fama, 1985). This allows banks to "*lean against the wind*" and keep with their customers when they are most in need (Petersen and Rajan, 1995). But banks differ with respect to the composition of their business client portfolio and institutional background, which influences their ability and strategy to deal with financially distressed firms.

In this study, I analyze the influence of the main bank characteristics on the survival rate of financially distressed firms. In particular, I focus on the following questions: Does the firm survival probability increase with its main bank's ability to process soft information? How do difficulties within the bank's portfolio affect the survival of financially distressed firms? Do firms with multiple bank relationships have coordination difficulties and exit the market with a higher probability? How does local banking market competition affect a bank's ability to support financially distressed firms?

There is a growing literature on banking and financing of small and medium sized enterprises. While most studies are concerned with the access to finance, lending technologies, and terms and conditions, only a few studies have focused on financial distress and bank relationships. Dahiya et al. (2003) analyzed the effect of a firm's failure on the value of the bank. Studies on the recovery rates of distressed firms have tried to measure the effect of firm or entrepreneurial characteristics on loss given default (e.g. Grunert and Weber, 2009). The studies most related to this one focus on banks' role in reducing the costs of financial distress in Japan during the 1990s (e.g. Peek and Rosengren, 2005; Fukuda et al., 2009; Shimizu, 2012). Compared to those studies, my data set allows analyzing the effects

for all firm sizes under "normal" economic conditions.

For the empirical analysis, I use data on German firm–bank relationships to address these questions. The data set represents a 10% random sample of German firms and covers semiannual firm observations of the years 2000 to 2005. The data is collected by Creditreform, the largest German credit bureau. The data set contains firm characteristics such as the firm's industry, location, date of incorporation, main and further bank relationships. It was supplemented with information from the ZEW Bank Panel concerning bank type, bank portfolio, and local banking market characteristics.

My main findings are that firms with a main relationship with a smaller bank are more likely to survive. Those banks tend to be more capable of processing soft information. This type of information can be important for efficient liquidations of financially distressed firms. Firms with multiple bank relationships have a lower probability of surviving. Increasing local banking market competition also reduces the firm's probability of surviving. I find "perversive incentives" similar to Peek and Rosengren (2005) that banks with difficulties in their loan portfolio are more likely to keep distressed firms alive. However, I also show that firms with a relationship with such a bank are more likely to become financially distressed in the first place. A bank's institutional background does affect the firm's distress probability. Firms with a relationship with a *Sparkasse* or cooperative bank are less likely to become financially distressed. There is no robust evidence that the the institutional background of the bank also influences the firm's survival probability.

The paper is structured as follows. In Section 2.2, I introduce the hypotheses regarding the relationship between firm–bank relationships and the survival of financially distressed firms. In Section 2.3, I describe the German banking market and discuss potential influences due to institutional differences of German banks. In Section 2.4, I present the data set and the empirical model. In Section 2.5, I present the results of the probit model of the market exit of financially distressed firms. In Section 2.6, I employ a heckprob model in order to control for potential selection biases. In Section 2.7, I discuss the results and present further robustness checks. I conclude in Section 2.8.

2.2 Hypotheses

I build on several strands of the literature to derive hypotheses on the effect of a bank's ability to process soft information, bank loan defaults, multiple bank relationships and local banking market concentration on a financially distressed firm's probability of market exit.

Soft information processing Banks can use different types of information when it comes to financing or to renegotiating contracts (Berger et al., 2001; Main, 2006; Jimenez et al., 2009). Stein (2002) distinguishes between hard and soft information. Hard information can be verified, such as financial data or ratings. In contrast, degrees of trust or character assessment can be described as soft information. It is produced by an agent, e.g. a bank clerk, and cannot be directly verified by others. This type of information becomes especially valuable once a firm is financially distressed and needs to restructure its debt. Stein (2002) argues that banks are not alike in their ability to process soft information.

More complex or hierarchically organized banks are less able to process soft information.

In the case of financially distressed firms soft information can have two effects. Either bad hard information is supported and the firm gets liquidated, as it would without considering soft information, or soft information attenuates the bank's decision. The liquidation rate of financially distressed firms should therefore decrease with the main bank's ability to process soft information.

Hypothesis 1 *Financially distressed firms' probability of survival increases with its main bank's ability to process soft information.*

Bank loan default rate The capacity of a bank to absorb financial shocks from a firm in its portfolio by providing additional financing is restricted once the bank itself suffers substantial losses. One should therefore expect that the probability of market exits of financially distressed firms increases with the bank's rate of loan defaults. In contrast, Peek and Rosengren (2005) find that distressed Japanese banks keep financing weak firms. They argue that troubled banks have an incentive to avoid the realization of additional losses on their own balance sheet by allocating funds to borrowers in financial distress. By avoiding or delaying the firm's bankruptcy the bank is not required to report such non-performing loans. Peek and Rosengren (2005) observed this phenomenon in Japan during a period of economic crisis. I test whether this holds under "normal" economic conditions for banks in a bank-based system.

Hypothesis 2 *Financially distressed firms financed by banks which suffer losses have a lower probability of closing than financially distressed firms financed by banks that do not suffer from losses.*

Multiple bank relationships Close relationships between a firm and its bank provide incentives for information production and monitoring, and allow for intertemporal transfers (e.g. Petersen and Rajan, 1995; Boot and Thakor, 2000). Sharpe (1990) and Rajan (1992) argue that with repeated lending, a single bank relationship may not be optimal. Superior information enables a single bank to extract monopoly rents. If this hold-up problem is too severe, firms can reduce banks' bargaining power using multiple bank relationships. But for firms in financial distress, multiple bank relationships can be problematic for two reasons. First, there is a free-rider problem in monitoring that leads to inefficiencies in renegotiation (Diamond and Dybvig, 1983). Rajan (1992) argues that an increase in the number of bank relationships decreases the probability that a single bank is pivotal in renegotiation and increases the cost of renegotiation. Second, there is a risk of coordination failure, which increases with the number of lenders (Thakor, 1996). Coordination is even more difficult if creditors are less concentrated (Bris and Welch, 2005). Brunner and Krahnen (2008) find that for distressed firms in Germany, the probability of coordination problems increases with the number of bank relationships, and decreases in the concentration of bank debt. They also find that the length of a workout plan increases and the likelihood of turnaround decreases with the number of banks coordinating.

Hypothesis 3 *Financially distressed firms with multiple lenders have a higher probability of closing than financially distressed firms with only one lender.*

Local banking market competition Banks need to invest in expertise in order to act as a relationship lender and add value to borrowers (Boot and Thakor, 2000). An important kind of added value for firms in financial distress is that banks with expertise make more efficient liquidations (Chemmanur and Fulghieri, 1994). Those banks are better able to evaluate firm liquidation vs. going–concern value. This allows identifying viable firms, rather than liquidating any distressed firm. Supporting those distressed but viable firms is an implicit intertemporal contract. A monopolistic bank can charge low payments during the period of financial distress and extract future surpluses. In a competitive environment, banks cannot expect to participate in future firm's profits. Once recovered, firms switch if the bank charges a rate above the competitive level (Petersen and Rajan, 1995). Boot and Thakor (2000) argue that increased interbank competition hurts banks' profits more from transaction than relationship lending. Relationship orientation can therefore partially insure banks against pure price competition. But banks have less incentives to invest in expertise as the degree of banking market competition increases. Boot and Thakor (2000) further argue that relationship lending is more important in competitive markets, as it provides less added value to borrowers. Banks in markets with a high degree of competition would make less efficient liquidations and financially distressed firms' survival probability would be lower.

Hypothesis 4 *The probability of the market exit of a financially distressed firm increases with the degree of competition in the local banking market.*

2.3 The German Banking Market

I test the hypotheses presented above with a data set on financially distressed German firms. Bank ownership structure, and therefore governance, can provide banks with different risk taking incentives. Creditors and depositors demand higher interest rates as compensation for an increased risk level. Creditors and depositors of protected banks have lower incentives to monitor and punish banks' risk taking behavior (Flannery, 1998). Merton (1977) argues that bail out guarantees therefore limit this disciplinary effect of markets, and banks have incentives to increase risk. But owners have a charter value that reflects future income or influence. Owners with a high charter value tend to limit bank risk taking in order not to lose their influence in the bank (Keeley, 1990). Those differences in governance can have direct and indirect effects on banks' dealing with financially distressed firms. Theoretical considerations do not suggest the direction of the overall effect (Cordella and Yeyati, 2003; Hakenes and Schnabel, 2010). Because banking systems and bank governance differ across countries, I describe the German banking system and the potential effects of the bank type on the survival of financially distressed firms.

The German banking system is often described as a "three pillar system", consisting of private, *Sparkassen/Landesbanken*, and cooperative banks, all of them active as universal banks (Krahnen and Schmidt, 2004; Engerer and Schrooten, 2004). Table 2.1 presents the number of banks active in the years 2000–2005 by bank type. Table 2.10 in the Appendix provides an overview of bank types and how banks are assigned to either groups.

The ***Sparkassen* sector** consists of *Sparkassen* and *Landesbanken*. *Sparkassen* are

Table 2.1: German banking market by bank type, 2000–2005

Bank Type	Year of observation					
	2000	2001	2002	2003	2004	2005
Non-private banks	**575**	**550**	**534**	**504**	**489**	**475**
Sparkassen	562	537	520	491	477	463
Landesbanken	13	13	14	13	12	12
Cooperative banks	**1,796**	**1,621**	**1,491**	**1,395**	**1,338**	**1,296**
Private banks	**498**	**478**	**463**	**438**	**420**	**415**
Large banks	4	4	4	4	5	5
other commercial banks	494	474	459	434	415	410
Total	**2,869**	**2,649**	**2,488**	**2,337**	**2,247**	**2,186**

Note: The following banks are classified as large banks: *Deutsche Bank*, *Dresdner Bank*, *Commerzbank*, *Postbank*, *HypoVereinsbank* (since 2004 after international mergers); Building societies, real estate specialized banks, and public banks with special purposes (e.g. Central Bank, development banks, etc.) do not have main bank relations with businesses and are excluded from the analysis throughout the paper.
Sources: Deutsche Bundesbank (2012)

owned by the district or municipality, while *Landesbanken* are jointly owned by a federal state and that state's *Sparkassen* association.[1] Throughout the years of observation, *Sparkassen* and *Landesbanken* banks had a bail out guarantee.[2] It is argued that these guarantees weakened bank market discipline and increased banks' risk taking (Fischer et al., 2011). Local authorities hold the majority of the board of supervisors and the boards' chair is usually linked with the position of the district administrator (e.g., a city mayor). Local politicians would lose their influence on the bank's lending strategy when it is in need of a merger due to high risk taking. The political influence is regulated by the *Sparkassen* act and should ensure that *Sparkassen* achieve their mandate to provide finance and financial services to the people, companies, and authorities within the business area (e.g., article 6 SpG (2005), Engerer and Schrooten (2004)). In their mission statement, *Sparkassen* promises to support firms "in critical periods [...] as long as economically justifiable" (DSGV, 2008).

Table 2.2: Market shares within the German banking market by bank type (2000–2005)

Bank type	Total Assets (1)	Business Lending (2)	Main bank relation			
			all (3)	small firms (4)	medium firms (5)	large firms (6)
Non-private banks	**0.47**	**0.49**	**0.49**	**0.50**	**0.44**	**0.29**
Sparkassen	0.20	0.27	0.46	0.47	0.41	0.23
Landesbanken	0.27	0.22	0.03	0.03	0.03	0.06
Cooperative banks	**0.16**	**0.17**	**0.27**	**0.27**	**0.27**	**0.06**
Private banks	**0.37**	**0.33**	**0.23**	**0.23**	**0.46**	**0.64**
Large banks	0.22	0.19	0.15	0.14	0.20	0.47
other commercial banks	0.15	0.14	0.09	0.09	0.09	0.16

Note: Market shares are estimated based on the total sum of bank total assets (column 1), credit volume of to domestic enterprises and self-employed persons (column 2) and main bank relations (columns 3-6) related to firm size. Firm size is classified as follows: <100 employees as small firms; >100 & <1,0000 employees as medium firms; ≥ 1,000 & ≤50,000 employees as large firms.
Source: Deutsche Bundesbank, 2011 (Columns (1)-(2)); ZEW Bank Panel and MUP (ZEW) 2011 (Columns (3)-(6)); author's own calculations.

[1] Some *Landesbanken* are jointly owned by two or more federal states. HSH Nordbank (Hamburg) is the only *Landesbank* with a minority stake of a private investor (since 2006).

[2] The so-called *Gewährträgerhaftung* and *Anstaltslast* provided an unlimited cover for the owners in case of the bank's distress, that led to lower refinancing costs compared to private banks. For competitive reasons, both were abolished within the transition period from 19.07.2001 to 18.07.2005, while banks' risk from financial contracts are covered until 2015.

In 2005 the *Sparkassen* had total assets averaging 2.2 billion Euros. Table 2.2 shows that *Sparkassen* had the second largest market share in terms of total assets (column 1) and the largest in terms of credit volume to domestic enterprises and self-employed persons (column 2). Nearly half of all firms have their main bank relationship with a *Sparkasse* (column 3). *Landesbanken* have the largest market share in terms of total assets. However, only few and especially large firms have their main relationship with a *Landesbank*.

Cooperative banks are owned by individuals holding cooperative shares. Market discipline is also reduced for cooperative banks, since shareholders are usually required to make additional though restricted payments in case of insolvency. The aim of cooperative banks is "*promote the acquisition and the business of members*" (Engerer, 2006). So members of a corporate society, who are at the same time customers, have a high stake in the bank and their charter value should reduce risk taking. The lending strategy of cooperative banks is quite similar to that of *Sparkassen* and Hakenes and Schnabel (2010) state that under most circumstances, cooperative banks can perform the same functions as the *Sparkassen*. In 2005, they had on average 451 million Euros in total assets. Their market share of business lending was 17 %, and their share of the number of main bank relationships to enterprises, 27%.

Large banks and other commercial banks are in general **private banks**. Mostly, these banks operate in the legal form of a public stock company or a limited liability company. Owners' liability is limited by their shares. There are no restrictions on private banks' lending policies (Engerer, 2006) except overall banking regulation. In the period 2000–2005, private banks had on average a market share in business lending of 33%. The market share of the five largest banks accounts for 19%. Larger firms are more likely to have their main bank relationship with a private bank (see Table 2 for details).

The differences in mandates or mission statements between private banks on the one side and cooperative and *Sparkassen* sector banks on the other, should lead to a lower survival probability of financially distressed firms that have a relationship with a private bank. Banks with higher risk levels should have on average a higher probability of firm distress within their portfolio. In addition, governance can effect competition in loan markets. Stiglitz and Weiss (1981) argue that borrowers have risk-shifting incentives as the interest burden increases. As documented by Sapienza (2004), protected banks can pass on their lower refinancing costs to customers and offer lower interest rates for loans. Firms financed by private banks that have relatively high interest rates should be more prone to moral hazard and shift to riskier projects. Matthey (2010) argues that private banks compete with non-private banks in debt repayment rather than simply on interest streams. Private banks can offer transaction-based lending that rules out renegotiation in financial distress in order to attract low-risk firms. The liquidation threat needs to be credible in order to prevent high-risk firms from free riding. Private banks should therefore be less likely to absorb the exogenous shocks from their clients and clients should have a higher probability to default.

2.4 Data and Methodology

2.4.1 Description of the Data Set

The core data comes from the MUP, maintained by the Centre for European Economic Research (ZEW). The MUP is a firm-level dataset based on data collected by *Creditreform*, the largest credit rating agency in Germany. Since 1999, ZEW receives a copy of *Creditreform*'s whole firm-level data warehouse twice a year. These data are cleaned and brought into a panel structure. The MUP covers almost all of the roughly 3.1 million firms located in Germany. It contains information on the firm's industry code, location, legal form, size, owners, and owners' characteristics. In addition, it provides information on the creditworthiness, the main bank relationship, and up to five further bank relationships of each firm.

For data processing reasons, I use only a 10% random sample of the total population of economically active firms in all sectors except agriculture, the public sector, and holding companies. The sample contains semiannual observations for the years 2000 to 2005. The time period has been chosen for the following reasons. First, financial distress is defined as a negative change in firm's payment status between two observations. The MUP started in 1999. The first panel observation is required for identification of financial distress. Second, in 2005, unlimited state guarantees for *Sparkassen* sector banks were abolished and important legislative changes concerning standards for the banks' decision making processes in lending became effective.[3] Gropp et al. (2010) and Fischer et al. (2011) show that *Sparkassen* sector banks increased their risk taking after this removal of state guarantees. Third, it is necessary to observe financially distressed firms some time after they became financially distressed in order to determine whether or not they close. In this analysis, this period is defined to be two years. The restriction of episodes of financial distress to the period prior to 2005 rules out any effect of the economic crisis which started in 2008. The sample consists of 3,039,854 firm-year observations based on 319,423 firms.

Each firm in the sample is linked to the ZEW Bank Panel. The Bank Panel covers all banks active in business lending within the sample period in Germany. It includes bank characteristics, such as the banking group, bank size, market shares in business lending, default of portfolio firms, as well as characteristics of the local banking market.

2.4.2 Distress and Market Exit

My interest is in exploring the effects of the main bank's characteristics and the local banking market conditions on the survival of financially distressed firms. To examine the

[3] EU legislation abolished state guarantees for *Sparkassen* sector banks in 2005. The Basle II accord came into effect at the end of that period (*Bundesamt für Finanzaufsicht* letters 34/2002 (minimum standards for business credit), 18/2005 (minimum standards for risk management), and European Union guidelines 2006/48 and 2006/49.)

different hypotheses above, I estimate the following probit regression:

$$\begin{aligned} Default|Distress = \beta_0 \quad & +\beta_1 \times \text{Soft Information} \\ & +\beta_2 \times \text{Bank Portfolio Default Rate} \\ & +\beta_3 \times \text{Multiple Bank Relationships} \\ & +\beta_4 \times \text{Local Banking Market Competition} \\ & +\beta_5 \times \text{Controls} + \varepsilon \end{aligned} \tag{2.1}$$

A natural choice in survival analysis would be a hazard rate model. Such a model would require the identification of financial distress and market exit on a daily or at least monthly basis. However, the interest is not in the estimation of the time elapsed between financial distress and market exit.

Identification of financial distress I employ trade credit rating information identifying episodes of financial distress. Petersen and Rajan (1994) used the level of trade credit rating in order to identify financially constrained firms. Since I am interested in events of financial distress, I deviate from the identification used by Petersen and Rajan (1994). Two conditions must hold: First, a firm's credit rating needs to decline from the previous period. Second, the new credit rating must be poor.

Table 2.3 presents a description of the payment status categories of the MUP. The payment status of a firm worsens if a firm moves to a category with a higher number. Changes from unknown to known payment status are ignored because it cannot be inferred whether or not the payment status worsens. There is a sufficiently large number of firms which recovered. In total, 66,069 cases of payment status decline are identified. A firm is defined as becoming financially distressed if it moves to category 4 (poor), 5 (bad), or 6 (junk) from any other category. In total, 47,626 episodes of distress are observed.

Table 2.3: Classification of payment status in the MUP

Code	Payment Status	Description	Decline in payment status	Distress
0	unknown	No information provided		
1	excellent	Cash discount; does not use trade credit		
2	sound	Within term of payment, makes use of trade credit	Yes	
3	fair	Minor problems; occasionally payments are made later than term of payment	Yes	
4	poor	Exceeds the agreed payment term up to 30 days / payment reminders	Yes	Yes
5	bad	Exceeds the agreed payment term up to 3 months or longer / several payment reminders	Yes	Yes
6	junk	Severe payment problems / Insolvency procedures	Yes	Yes

Note: This table presents the classification of the firms status of payment by Creditreform. Decline in payment status is defined as a worsening of payment status code compared to the previous period. Observations with class 0 in the previous period are neglected. Distress is defined if a decline in payment status end up in code four to six.
Source: MUP (ZEW) 2011

Identification of firm closure The MUP contains two sets of information allowing the identification of a firm closure. First, information on insolvency procedures, because insolvency regulation is binding for limited liability firms. The vast majority of insolvent firms were liquidated. Only in rare cases was insolvency procedure used to restructure the

firm. Unless the firm was restructured, I consider the date of opening the procedure as the date of market exit. Second, information on firms which voluntarily closed without insolvency procedure. During its inquiries, Creditreform collects information on those market exits including the approximate date of market exit.

Unfortunately, I can not observe whether a bank applies an audit to distinguish between viable and non-viable firms, or if a renegotiation has taken place. However, I can distinguish between firms that survive and those that exit the market. From this finding, I can infer that surviving firms successfully renegotiate debt contracts.

I consider market exit within a two-year period after facing financial distress as being related to the fact of having been financially distressed. I estimate the probability that financially distressed firms closed in period t and the following four periods n, where each period n takes six months.

2.4.3 Main Explanatory Variables

The main explanatory variables are provided in the MUP. The definitions and descriptives statistics of the main explanatory variables are provided in Table 2.5. The bank type is assigned according to the bank groups described above. Table 2.4 shows the univariate results of bank type on a decline in payment status, financial distress and exit rate. Of the firms which have a private bank as a main bank 2.4% experience an episode of payment decline and 1.8% an episode of financial distress. Of firms with a *Sparkasse* or cooperative bank as their main bank, the shares of payment decline and financial distress are significantly lower. The share of financial distressed firms that closed was 61.0% for firms with a private bank as their main bank relationship. The share of financially distressed firms that closed was lower for firms with a *Sparkasse* (56.6%) or cooperative bank (55.6%) as their main bank relationship.

Table 2.4: Bank type, distress, and market exit

		Private banks (1)	Sparkassen (2)	Cooperative banks (3)	Total (4)
Decline in payment status	Number	18,792	29,396	17,881	66,069
	%	2.42	2.17	2.28	2.27
	Test private vs.		***	***	
Distress	Number	13,660	21,392	12,574	47,626
	%	1.76	1.58	1.6	1.63
	Test private vs.		***	***	
Market Exit (if distressed)	Number	8,337	12,110	6,994	27,441
	%	61.03	56.61	55.62	57.62
	Test private vs.		***	***	

Note: The rows denoted with "Number" present the count of cases within the sample. The rows denoted with "%" give the percentage of firms with the particular bank type as main bank relation to which the respective variable applies. The rows "Test private vs." present test statistics of mean differences between private banks and either Sparkassen or cooperative banks. *,**, and *** denote significance level on the 10, 5, and 1% levels of significance.
Source: MUP (ZEW) 2011, author's own calculations.

Hypothesis 1 states that there is a negative relation between a firm's market exit and its main bank's ability to process soft information. I test whether $\beta_1 > 0$ in Equation 4.1. Williamson (1973) argues that size is a proxy for organizational complexity and that larger organizations are generally more hierarchically structured. Soft information

describes a banks' knowledge of the firm or entrepreneur that can not be codified, such as trustworthiness, and is difficult to diffuse through the bank's hierarchy. In the empirical banking literature, bank size is often used as a proxy of a bank's ability to process soft information (e.g. Stein, 2002; Berger and Black, 2011). Bank size is usually measured by the bank's total assets. In the publicly available data bases for bank balance sheet information, such as Bankscope, the total assets are missing for a large share of the banks. This would reduce the sample size significantly. Therefore, I measure *"bank size"* as the total labor force of the firms for which the bank serves as the main bank. The Spearman rank correlation between the total assets reported in Bankscope and bank size provided in the ZEW Bank panel varies between 0.72 and 0.80 for the years 2000–2005 and are significant at the one percent level.

The nearly full coverage of the stock of firms by the MUP allows generating information about the portfolio characteristics of each bank. Related to hypothesis 2, I test for $\beta_1 > 0$ in Equation 4.1. *Bank loan default rate* considers the potential losses a bank faced in a particular year. This measures the share of firms closing in a given year in proportion to the number of portfolio firms (bank size; both weighted by the number of employees of their portfolio firms).

Hypothesis 3 asserts that firms with multiple bank relationships are more likely to exit the market, and I test for $\beta_2 > 0$ in Equation 4.1. The MUP contains information of a firm's main bank and up to five further bank relationships. The median of the variable *Number of Bank Relations* is one while the mean is 1.28. These figures are considerably lower than found by other studies concerning Germany. Elsas and Krahnen (1998) report a median of five relationships to banks and Ongena and Smith (2001) find that the number of relationships is eight on average, while the median is five. The reason for this difference is that average firm size in the data at hand is significantly lower than for the other studies, while the number of banks is positively correlated with firm size. Firms with multiple bank relations also have better ratings (10 point mean difference; rating varies between 100 and 600 points). The MUP does not contain information on each bank's financing share, which would be useful for controlling for multiple but asymmetric relationships. The effect is therefore rather underestimated.

The nearly full coverage of the MUP is also used to measure the degree of local market competition in order to test hypothesis 4, whether $\beta_4 > 0$ in Equation 4.1. I consider the local banking market to correspond with the administrative districts (*Landkreise* and *kreisfreie Städte*). A bank is assigned to a district if at least one of its branches is located in this district. In the literature on competition in banking markets, variables describing the market structure are commonly used (Degryse and Ongena, 2008). *Bank intensity* is calculated as the ratio of banks active in business lending in a district per capita. This variable captures the possible alternative bank relationships a firm can have. The Herfindahl-Hirschman index (HHI) is calculated as the sum of squared market shares in the main firm–bank relationships in a district. However, bank intensity and the HHI do not necessarily describe competition. Local market concentration is often negatively related with market size, and market share could just reflect a bank's efficiency (Degryse and Ongena, 2008). Firms' switching between banks can be considered as an alternative measure identifying that banks compete against each other and attract new customers. In

regions with low competition on the banking market firms are locked in a bank relationship and banks can extract rents. In regions with a high level competition in the banking market, firms can more easily switch. In such regions, banks can only extract rents to a lower extent and are less able to invest in specialization (Boot and Thakor, 2000). I use the ratio of firms that switch their main bank relationship to the total number of firms in the district. Recall that in the period of interest, a significant number of banks merged. Bank merger causes a discontinuity in relationships and firms are more likely to switch their bank relationship (Degryse et al., 2011). In order to rule out such merger effects, I consider only firms whose house bank was not involved in a merger. On average 0.8% of all firms in a district change their main bank within a six-month period. The maximum of bank switches was 7%.

Table 2.5: Descriptive statistics – Main explanatory variables of financially distressed firms

Variables	Explanation	Mean	Min	Max
Sparkasse	1 if a public bank is the main financing partner	0.45	0	1
Cooperative Banks	1 if a cooperative bank is the main financing partner	0.26	0	1
Bank size	$= \sum_{b=1}^{Bank} Firm_{i,b} \times Emp_i$	44,836	49	476,952
Bank loan default rate (emp wght)	$= \frac{\sum_{b=1}^{Bank} Firm_{i,b} \times Emp_i \mid firmclosure=1}{Banksize_b}$	2.01	0.01	42.93
local bank competition (intensity)	Number of banks active in the firm's district per capita	0.01	0.00	0.02
local bank competition (HHI)	$= \sum_{d=1}^{District} (\frac{Firm_{i,b}}{Firm_{i,d}})_b^2$	0.23	0.07	0.63
local bank competition (switch)	$= \frac{\sum_{d=1}^{District} Firm_{i,d} \mid \text{switch main bank}=1}{\sum_{d=1}^{District} Firm_{i,d}}$	0.01	0	0.07
No. of Bank relationships	Number of bank relationships	1.22	0	6

Note: This table presents descriptive statistics of the main explanatory variables used in the probit regression of market exit of financially distressed firms. In this table, I use the following indices and abbreviations: i for firm; b for bank; d for district; Emp for the number of employees.
Source: MUP (ZEW) 2011, author's own calculations.

2.4.4 Control Variables

In line with other studies on firm survival, I include several variables grouped as internal or external factors factors. The definitions and descriptive statistics of the control variables are provided in the Table 2.11 in the Appendix. 38% of financially distressed firms faced two or more episodes of financial distress covered by the variable *History of Distress*. Almost one-third of all firms are *Limited liability* companies. *Real Estate* is an indicator variable that residential, commercial, or mixed property is owned by either the firm or the entrepreneurs. This property can either be used as collateral or liquidated in order to repay debt. For almost one-third of all firms, real estate could be used. *Debt collection* is unity if Creditreform was asked to collect debt from the firm in the particular period. The outcome of debt collection can be further distinguished as still open, repaid completely, partly, or unpaid.

The vast majority of firms is run by a single person. Only 8% are managed by a team, while for 17%, no information on management team is available. 10% of all firms are run by entrepreneurs with a certificate of *Master Craftsman* and 9% with a university

degree as their highest educational level.[4] The average firm size is 12 employees and the average firm age is 17 years in the full sample. In contrast, financially distressed firms are smaller (seven employees) and younger (an average age of 7.4 years). 25% of the sample firms are younger than eight years but 60% of financially distressed firms are younger than eight years. The variables *change in local number of market exits* and *East Germany* cover regional differences of business environments. I further control for industry and year effects.

2.5 Results of the Probit Regression

In this section I present the results of a probit regression of the cross-sectional sample of financially distressed firms on their market exit. The model is estimated after the period of financial distress and up to four of the successive periods, in order to take into account any delay in the borrower's or lender's decision making process, as well as any delay in observing the firm's market exit. Robust clustered standard errors are used, due to existence of firms with multiple episodes of financial distress during the sample period.

Table 2.6 presents the marginal effects of the main explanatory variables.[5] Columns (1)–(2) present the base specification, including the bank type; columns (3)–(4) include further variables for the local banking market competition and multiplicity of bank relationships, and columns (5)–(6) include the bank size and the bank portfolio default rate. All specifications include the full set of control variables.

Characteristics of the main bank and local banking market The results of the main explanatory variables from estimating Equation 4.1 support the hypotheses. I find that the probability of a financially distressed firm's exiting the market increases with the size of its main bank. The marginal effect of *bank size* is not significant immediately after the event of a firm's financial distress, but is positively significant from the third period on. Larger banks usually are more hierarchically structured and are less able to process soft information. Bank size and hierarchy influence the guidelines about the handling of financially distressed firms. For example, it has been specified whether a firm is still supervised by its account manager or has been passed on to a specialized department. This finding suggests that larger banks have stricter guidelines. Soft information, such as trustworthiness, cannot be codified, and only with difficulties is it passed on to the new account manager. The new department is less likely to process soft information, but more likely to liquidate such a firm.

The findings for the *Bank portfolio default rate* support hypothesis 2. An increasing loan default rate in business lending has a negative effect on subsequent market exit. The effect on market exit remains stable over all estimated periods. This supports the findings on the perverse incentives of troubled banks to minimize additional losses on the balance sheet by Peek and Rosengren (2005).

The results also support hypothesis 3 and suggest that financially distressed firms

[4] A master certificate represents a higher degree of business qualification awarded either by the chamber of industry and commerce or the chamber of crafts.

[5] Table 2.13 in the Appendix provides regression results of the full list of variables.

Table 2.6: Main results – Market exit given financial distress (marginal effects after probit)

	Base		Loan Default		Full	
	Exit in t+1 (1)	Exit in t+4 (2)	Exit in t+1 (3)	Exit in t+4 (4)	Exit in t+1 (5)	Exit in t+4 (6)
Sparkasse			0.029*	0.008	0.028	0.021
			(0.02)	(0.02)	(0.02)	(0.02)
Cooperative Bank			0.002	-0.018	-0.002	0.013
			(0.02)	(0.02)	(0.02)	(0.02)
Bank size (ln)					-0.002	0.016**
					(0.01)	(0.01)
Bank portfolio default rate			-0.012**	-0.016***	-0.013**	-0.013**
			(0.01)	(0.01)	(0.01)	(0.01)
Local bank market	5.972***	3.661**	5.706***	3.705**	5.741***	3.476**
competition (switch)	(1.44)	(1.47)	(1.58)	(1.62)	(1.58)	(1.62)
No. of bank relationships	0.032***	0.036***	0.054***	0.044***	0.054***	0.045***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

Note: This table presents the marginal effects of selected variables after probit regression of financially distressed firms. Marginal effects are presented for the period directly (t+1; half year) and 4 periods (t+4; 2 years) after the episode of financial distress. Standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels of significance.
Source: MUP (ZEW), 2012, author's own calculations.

located in more competitive local banking markets have a higher probability of market exit. The economic effect is also large for both events. This finding suggest that banks within a competitive environment are less able to generate revenues from good customers to compensate for any potential losses due to distressed firms. Even more importantly, the bank cannot build on an inter-temporal contract because it faces the threat that distressed firms' are more likely to switch once recovered. There might be a potential concern that switching rate is more a measure of regional economic performance than bank competition. This would be the case if switching behavior depend on firm risk. Further analyses does not indicate such a relationship. The rating of firms that will switch within the next two years is slightly better than those firms that stay with their main bank relationship (4 points mean difference in rating; rating scales varies between 100 and 600 points). The rating of firms that did switch within the previous two years is lower (25 points mean difference) than of firms that stayed. Next to the small differences in mean rating one has to take into account that the average switching rate at the district level is approximately 1%. For robustness checks I included the the change in insolvencies on the state level, as well as regional GDP growth and the change in the local number of market exits (both on the district level). Both variables are insignificant and do not have severe effects on local switching rate.

Similar effects can be found at the firm level. Firms with multiple bank relationships have a better rating, general. Those firms should be better able to arise financing from there lenders. However, an increasing number of bank relationships of financially distressed firms increases the probability of market exit. There are two related explanations. First, firms with multiple bank relationships can generally switch more easily and the main bank is less willing to offer an inter-temporal contract. Second, an increasing number of stakeholder increases the difficulties in coordinating the various bank lenders. This finding is in line with previous studies on debt renegotiation and restructuring (Franks

and Sussman, 2005; Brunner and Krahnen, 2008).

The effects of the bank type on the market exit of financially distressed firms is not robust. There is a positive effect on leaving the market from firms with a main bank relationship with a *Sparkasse* in the first period after financial distress. However, this effect is significant only at the 10 % level and vanishes in later periods. There are no significant effects of the bank type cooperative bank on market exit.

Results of control variables There are further interesting results about the control variables. There is a negative effect of *real estate*, owned by the firm or the entrepreneurs, on market exit. Firms or entrepreneurs that are able to offer *real estate* property for securitization have a lower probability of exiting the market. Firms possessing the legal form of a limited liability company are more likely to become financially distressed but also have a higher probability of subsequential market exit. This is in line with Harhoff et al. (1998), who found that high-risk firms are more likely to choose limited liability as the legal form.

Creditreform also offers debt collection for trade credit partners. Firms from which *Creditreform* was asked to collect debt have a lower probability of market exit. Further analysis showed that this result is driven by firms that were able to repay the debt completely or at least in part. Firms for which debt collection is still going on have some chance of repaying their debt. Those firms still have a lower probability of market exit, although the economic effect is lower compared to full or part repayment. Only firms for which *Creditreform* was unable to collect debt have a higher probability of market exit.

Firm age is found to have a non-linear negative effect on market exit. This finding is consistent with the literature on firm survival (Audretsch and Mahmood, 1995). With increasing firm age, the probability of surviving financial crises increases substantially. In contrast to other studies (Audretsch and Mahmood, 1995), I find a positive effect of firm size on market exit probability. Only for very large firms do I find the market exit probability decreasing.

There are two interesting results regarding firm exit in connection with regional aspects. First, even 10 to 15 years after the reunification, firms located in East Germany are more likely to exit the market. This reflects still existing regional differences in product and banking markets in spite of the time passed since German reunification. Second, financially distressed firms in regions with an increasing rate of market exits have a negative effect on the probability of firm market exit.

2.6 Heckprob Model on Financial Distress and Market Exit

The results presented above require that a change in payment status is observed. One could argue that the observation of a change in payment status is related to the main explanatory variables or to the data generating process. To control for potential biases, I estimate the probability of a firm's financial distress in a first step, and its probability of market exit in a second step. I employ the empirical model of a heckprob that is closely related to Van de Ven and Van Praag (1981) in order to control for a potential error term correlation of both steps.

Model identification requires an exclusion restriction, a variable that affects the selection equation but does not affect the main equation. Those variables should be correlated with the change in the firm's mode of payment status or affects the probability that such an event is observed. However, those variables should not be correlated with a firm's subsequent market exit (Cameron and Trivedi, 2009).

2.6.1 Exclusion Restrictions

I use three variables as exclusion restrictions that cover different aspects of the data generating process. These variables should affect the likelihood that a decline in payment status is observed by *Creditreform*. Once *Creditreform* has downgraded a firm's payment status, the firm is most likely to be under current observation. Therefore, there is neither a reason to believe that the same variables have an influence on the observation of market exit nor on the market exit itself. Table 2.7 presents the descriptive statistics and definitions of the exclusion variables and the main variables for the selection equation.

Table 2.7: Descriptive statistics of main explanatory variables – Selection equation

Variables	Explanation	All firms Mean	Min	Max
Exclusion restrictions				
Quality Index	Index of investigation quality of Creditrefom branches per period. Index varies between 0 (lowest quality) and 1 (highest quality). Index reflects the range of the predicted common factor after factor analysis of the following five components: 1. Share of firms with missing date of foundation; 2. Share of missing date of business registration for limited liabilities; 3. Missing information on the number of employees; 4. Share of active firms investigated; 5. Mean time elapsed between date of foundation and first observation.	0.51	0	1
Investigation	1 if firm was investigated by Creditreform staff in the particular period.	0.22	0	1
same Hausbank (Creditreform and firm)	1 if the firm and local Creditreform branch have the same main bank relationship; zero otherwise.	0.23	0	1
Banking variables				
Sparkasse	1 if a public bank is the main financing partner	0.47	0	1
Cooperative Banks	1 if a cooperative bank is the main financing partner	0.26	0	1
Bank size	$= \sum_{b=1}^{Bank} Firm_{i,b} \times Emp_i$	46,327	13.00	476,952
Bank loan default rate (emp wght)	$= \frac{\sum_{b=1}^{Bank} Firm_{i,b} \times Emp_i \mid firmclosure=1}{Banksize_b}$	1.90	0.01	46.15
local bank competition (intensity)	Number of banks active in the firms district per capita	0.01	0.00	0.04
local bank competition (HHI)	$= \sum_{d=1}^{District} (\frac{Firm_{i,b}}{Firm_{i,d}})_b^2$	0.23	0.07	0.63
local bank competition (switch)	$= \frac{\sum_{d=1}^{District} Firm_{i,d} \mid switchmainbank=1}{\sum_{d=1}^{District} Firm_{i,d}}$	0.01	0	0.07
No. of Bank relationships	Number of bank relationships	1.21	0	6

Note: This table presents descriptive statistics of the main explanatory variables used in the heckprob regression model. In this table, I use the following indices and abbreviations: i for firm; b for bank; d for district; Emp for the number of employees.
Source: MUP (ZEW), 2012, author's own calculations.

The probability that an episode of financial distress is observed should increase with the quality of the investigation. I make use of the organizational structure of *Creditreform*. *Creditreform*'s central business activities, subsidiaries, and joint ventures are all legally united under the *Creditreform AG* which is owned by a society (*Verband der Vereine*

Creditreform e.V.). But firm information is collected by 130 independent, regional, separate companies that are members of this society. Even if investigation procedures adhere to certain standards, the sources and quality may differ between *Creditreform* branches (Almus et al., 2000). A branch with relatively *"poor quality"* is more likely to make an error of the second type, not observing a deterioration of payment behavior of a financially distressed firm.

I construct a *Creditreform branch quality index*. This variable is based on five measures of different quality aspects, each calculated at the level of the local *Creditreform* offices per period. First, the share of firms with missing date of foundation. Second, the share of firms in the legal form of a limited liabilities missing the date of its first registration. Third, the share of firms with missing information on the number of employees. Those three pieces of information can usually be collected at little cost. In addition, firm age and size are mostly reported as important variables predicting market exit (see for example studies by Audretsch (1991) and Franks and Sussman (2005)). Fourth, the share of active firms investigated in the particular period within the branch portfolio. The quality of the data pool is assumed to increase with the share of up to date firm information. Fifth, the mean time elapsed between the firm's foundation and the first observation.[6] Branches with high quality and good business networks are more likely to shorten the time in identifying new businesses in their region.[7]

I employ a factor analysis to predict the common factor of the described quality indicators for each period (OECD, 2008). The eigenvalues of the first factor varies between 1.67 and 1.94 and the scoring coefficients have the expected signs. The index is a transformation of the relative distances between the predicted factors and range between 0 and 1. An index value of one indicates the branch with the best quality in a given period. *Creditreform* updates firm information either automatically, based on external information, such as business register information, or investigation by own staff. It is more likely that an episode of financial distress is observed if the particular firm was investigated in this period. The dummy variable *Investigation* takes on the value one if *Creditreform* staff did some investigations concerning the firm in the particular period, and zero otherwise.

In 23% of the firm-period observations, the firm and the local *Creditreform* branch have a relationship with the same bank. I do not suppose that the banks violate bank secrecy. However, *Creditreform* might use bank references for their own credit assessment. Local branches could negotiate better terms and conditions for bank references if they have a relationship with the particular bank themselves. Requesting references in such cases more often would positively affect the identification of financial distress.

2.6.2 Results of the Heckprob Estimation of Distress and Market Exit

Table 2.8 presents the marginal effects of the exclusion restriction and the main explanatory variables of the heckprob model.[8] I present three specifications. Columns (1)–(3)

[6] I use only firms that are observed for the first time with a known date of foundation.

[7] For confidentiality reasons, I do not report statistics of the individual variables describing *Creditreform* branch quality.

[8] Table 2.13 in the Appendix provides regression results of the full list of variables for firm distress and table 2.14 for firm exit.

present the base specification, including banks' rent seeking potential; columns (4)–(6) present the bank types; and columns (7)–(9) present the variables concerning bank portfolio characteristics. All specifications include exclusion restriction and the full set of control variables. As in the probit regression model, I estimated the market exit after the period of financial distress and through up to four succeeding periods. Robust clustered standard errors are used, due to the existence of firms with multiple episodes of financial distress during the sample period.

A Comparison of Tables 2.6 and 2.8 shows that the results of the main explanatory variables remain stable after controlling for potential selection bias. The results from the first step provide some interesting findings on their own. In addition, these lead to a better understanding and interpretation of the findings on market exit.

Exclusion restrictions I find strong and significant results for the the *Creditreform* quality index and investigation. The quality index is found to be both statistically and economically significant. *Creditreform* branches with relatively higher quality are more capable of detecting episodes of firms' financial distress. A firm that was investigated by the *Creditreform* staff in a particular wave has a higher probability that financial distress is observed than does a firm without such an investigation. The variable that indicates whether the same bank has a main relationship with the *Creditreform* branch and with the firm is significant only in the base specification. The effect vanishes as soon as I control for the type of the firm's main bank relationship. The correlation coefficient $\hat{\rho}$ (see Table 2.14 in the Appendix) for the market exit regression is found to be significantly different from zero at the 1% level. Estimates obtained from a normal probit model are likely to be inefficient.

Heckprob–Main explanatory variables The effects of *Bank Size* on market exit remain stable after controlling for potential selection bias. I find no evidence that firms with a main relationship to a large bank face a higher probability of financial distress.

The results of the heckprob show a significant and negative effect of *Bank Loan Default rate* on market exit, as in the previous probit regression. The results of the first heckprob step show a significant and positive effect of *Bank Loan Default rate* on financial distress. These findings support the interpretation of perverse incentives of troubled banks by Peek and Rosengren (2005) only in part. Troubled or distressed banks are not willing or able to absorb the financial shocks of their portfolio firms. Compared to sound banks, relatively more clients of a troubled banks become financially distressed. A troubled bank then has incentives to minimize additional defaults in their portfolio.

Local Banking market competition has positive effects on both financial distress and market exit. The economic effect is also large for both events. Banks in competitive markets where firms often switch their main bank relationship are less likely to absorb financial shocks from their clients. In addition, renegotiation is more difficult and the firms are more likely to exit the market. The reasoning behind this bank behavior is that in competitive markets, good clients can easily switch. A bank that supports a financially distressed firm cannot be sure to collect from the future profits of the firms that recover.

Table 2.8: Main results – Heckprob on financial distress and market exit (marginal effects)

Specification:	Base			Bank Type			Bank Characteristics		
Dependent Variable:	Distress	Exit in t+1	Exit in t+4	Distress	Exit in t+1	Exit in t+4	Distress	Exit in t+1	Exit in t+4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Quality Index	0.003***			0.003***			0.003***		
	(0.00)			(0.00)			(0.00)		
Investigation	0.010***			0.009***			0.009***		
	(0.00)			(0.00)			(0.00)		
Same Hausbank	0.001***			0.000			0.000		
(Creditreform and firm)	(0.00)			(0.00)			(0.00)		
Sparkasse				-0.001***	0.010*	0.005	-0.001***	0.010*	0.008
				(0.00)	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)
Cooperative Bank				-0.002***	0.001	0.019	-0.003***	0.	0.005
				(0.00)	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)
Bank size (ln)							0.000	0.002	0.005**
							(0.00)	(0.00)	(0.00)
Bank portfolio default rate							0.001***	-0.005***	-0.005***
							(0.00)	(0.00)	(0.00)
Local bank competition	0.162***	2.289***	1.411**	0.175***	2.269***	1.348*	0.177***	2.306***	1420**
	(0.02)	(0.54)	(0.55)	(0.02)	(0.59)	(0.59)	(0.02)	(0.60)	(0.60)
No. of bank relationships	0.001***	0.011***	0.013***	0.000***	0.019***	0.016***	0.000***	0.018***	0.015***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: This table presents the marginal effects of selected variables after the Heckprob model. Columns (1), (4) and (7) present the marginal effects of the first step probit on firms financial distress. Columns (2)-(3), (5)-(6), and (8)-(9) provide the marginal effects on market exit within one period (t+1; half year) and within 4 periods (t+4; 2 years) after the eposide of financial distress. Standard errors are presented in parentheses below. *,**, and *** denote significance level on the 10, 5, and 1% levels of significance.
Source: MUP (ZEW), 2012, author's own calculations.

A larger number of bank relationships has a significantly positive correlation with a higher probability of financial distress. However, this effect is economically irrelevant. The effect on market exit between the heckprob regression and the probit regression does not vary significantly.

2.7 Discussion and Further Robustness Checks

In this section I discuss the influences of the type of the bank and the age of the firm on the presented results.

Discussion of the bank type As discussed in Section 2.3, banks differ in their institutional background. These differences affect their liquidation policy as well as their portfolio risk. In the first stage of the heckprob regression I control for several potential influences. I find that firms with a *Sparkasse* or cooperative bank as their main bank have a lower probability of becoming financially distressed. One explanation of this observation is the *Sparkassen* and cooperative bank's mission statement to support distressed but viable firms. Let's assume that a firm's chance of receiving a financial shock is uncorrelated with its main bank type. Non-private banks would be more likely to provide additional finance for a firm hit by a financial shock. Such a firm would not need to delay payments and is therefore not observed as financially distressed.

The institutional background of a bank also has a potential influences on its risk taking. Merton (1977) argues that creditors and deposit holders of protected banks do not have incentives to relate the level of demanded interest rates to the banks risk level. Banks that lack such a disciplining market behavior have incentives to increase their portfolio risk (Flannery, 1998). During the sample period, *Sparkassen* sector banks were protected by guarantees provided by the local authorities. Keeley (1990) argues that bank risk-taking is influenced by its charter value. The charter value (current value and future earnings) is owner specific. If the bank goes bankrupt or must be sold, owners would not only lose the current but the future value as well as their political influence on the bank's business policy. Due to this threat, protected banks tend to decrease risk taking.

The presented results could be biased by bank type if there are severe differences in the portfolio risk between bank types. In general, a financially sound firm is more capable of absorbing financial shock on its own, shifting internal funds. If a bank portfolio consists of a larger share of sound firms, the probability should be lower that an episode of financial distress of a portfolio firm is observed. The empirical findings on differences in the portfolio risk are mixed. (Gropp et al., 2011) find evidence that the charter value effect dominates the market discipline effect. Fischer et al. (2011) observed that risk taking increased for *Landesbanken* after the abolishment of explicit public guarantees. Analysis from the MUP (Figures 2.1 and 2.2 in the Appendix) show that the credit portfolio of *Sparkassen* sector banks and cooperative banks is first and second order stochastic dominant over private banks' credit portfolio in terms of risk. Cooperative banks have the highest share of firms with good risks. But tests on differences between bank types of the cumulative distribution and kernel density are not significant. In contrast, (Iannotta et al., 2007) found that for a sample of European banks, public sector banks have poorer loan quality and higher

insolvency procedure risk and Koetter et al. (2007) documented a high share of distress bank mergers that are related to *Sparkassen* sector banks and cooperative banks. In the regressions presented in this paper, I control for differences in portfolio risk structure using the variable *Loan default rate*.

Boot and Thakor (2000) argue that relationship oriented banks invest in specialization. The added value from specialization is that these banks make more efficient liquidations (Chemmanur and Fulghieri, 1994). Furthermore, I am interested in whether surviving firms from relationship oriented banks recover better from financial distress than do those from transaction oriented banks. Therefore, I employ a test of differences in performance measured by sales. I use a difference in difference approach. First, I calculate the difference of sales between distressed but surviving firms with a private versus a non-private bank for the baseline (immediately after an episode of financial distress) and a follow-up period. Second, I calculate the difference between the baseline and follow-up period. For the baseline period, I use sales observations of the first and second year after financial distress. The follow-up period consists of the sales figures from between four to seven years after the financial distress. I employ a difference in difference approach controlling for firm age, industry, and years of the sales figures after financial distress. Sales figures are updated infrequently in the MUP, resulting in a significant reduction in the number of observations.

Table 2.9: Performance of surviving firms after financial distress by bank type

Outcome Variable and Statistics	Base line (1st and 2nd year after distress) Public and Coop. Banks (1)	Private Banks (2)	Diff (1)-(2) (3)	Follow-up (4th-7th year after distress) Public and Coop. Banks (4)	Private Banks (5)	Diff (4)-(5) (6)	DIFF-In-DIFF (3)-(6) (7)
All available observations (No. of obs. 18,198)							
Sales†	468.676	1933.68	1465.004	459.491	1220.543	761.051	-703.952
Std. Error	233.494	300.463	269.813	473.815	499.777	215.094	344.212
t	2.01	473.55	5.43	468.66	1923.09	1461.73	-2.05
$P>t$	0.045	0	0.000***	0.332	0.015	0.000***	0.041**
Single observation for follow-up period (No. of obs. 12,734)							
Sales†	463.427	1940.956	1477.529	514.404	1107.27	592.867	-884.662
Std. Error	268.03	345.529	313.568	278.932	377.777	351.112	469.497
t	1.73	467.7	4.71	463.61	1989.59	1475.01	-1.88
$P>t$	0.084	0	0.000***	0.065	0.003	0.091*	0.060*
Only firms with both, baseline and follow-up observations (No. of obs. 8,200)							
Sales†	776.452	1903.492	1127.039	827.487	1555.703	728.216	-398.823
Std. Error	184.28	242.642	219.247	182.485	237.66	210.746	303.208
t	4.21	781.1	5.14	776.73	1952.85	1125.15	-1.32
$P>t$	0	0	0.000***	0	0	0.001***	0.188

Note: This table presents results of the difference in difference estimation of changes in sales of survived firms after an episode of financial distress. Differences in Differences were estimated controlling for firm age, industry and number of years after financial distress. Level of significance: *** p<0.01; ** p<0.05; * p<0.1
† Sales in kEUR
Source: MUP (ZEW), 2012, author's own calculations.

In Table 2.9 I present three difference in difference estimations. The upper panel presents the results, pooling all available observations. It shows that the mean of sales for non-private banks is in general lower than that of private banks. This is in line with the previous results, that private banks tend to server larger clients. It also shows that firms with private banks performed poorly compared to those with a *Sparkasse* or cooperative bank as their main bank. The mean sales of firms with a *Sparkasse* or cooperative bank reduced by 2% while for firms with private banks, it reduced by 37%. The results hold if

I shrink the observations to the maximum distance in years between the financial distress and reported the sales figures. I further limit the panel to firms for which sales figures are observed in both the baseline and the follow-up period. *Creditreform* updates sales figures for the larger firms more frequently. Smaller firms are more likely to have a main relationship with a non-private bank. The reported mean of sales increases, while figures for private banks are mainly unaffected. As in the middle panel, mean sales increase for firms with non-private banks (+ 6.6%) and decrease for firms with private banks (- 18.3%). The reported Diff-in-Diff is not significant.

Discussion of local banking market competition As discussed in the data section, there is a broad literature on bank competition, applying various kind of measures. As a robustness check, I use three different specifications of the local banking market competition. The Table 2.16 in the Appendix shows the regression results using the HHI, the bank intensity, and the ratio of main bank switches as a proxy for local banking market competition. Hypothesis 4 stated that firms have a higher probability of financial distress when there is higher competition in the local banking market. To support the hypothesis one should find a negative sign on the HHI, a positive on bank intensity and on switching rate. For the HHI and bank intensity I find the reverse. These variables are also not significant as to the probability of the market exit of a distressed firm. However, these variables might be related to market structure and yet not reflect a bank's rent-seeking potential.

Discussion of firm age, main bank switching, and legal form The findings of other firm survival studies suggest that young firms have a high probability of exiting the market (Headd, 2000; Bates, 2005). For German firms, Egeln et al. (2010) found a peak of market exit rate at the age of three to four years. As a robustness check, I re-estimated the model when excluding young firms up to the age of seven years. The results on the effects of the remaining sample of mature firms are presented in the Table 2.15 in the Appendix. The results remain overall stable. Compared to the full model, I no longer find a positive effect of bank size on market exit. In addition, the effect of competition in the local banking market vanishes for mature firms in the regression up to two years after financial distress.

Because the MUP started as a panel in 1999 the duration of firm-main bank relationships are unknown. Instead, a recent switch of the firm-main bank relationship is observed. Firms that will switch their main bank relationship within the next tow years have a slightly better rating than firms that will stay, whereupon the rating of recently switched firms is poorer (see Section 2.5). Recently switched firms might have a less strong relationship and are therefore more likely becoming financially distressed. An indicator variable identifying firms that switched within the previous two years is insignificant and main results remain stable. In a further specification, I excluded switching firms and again the main results remain stable.

The available data as well as the corresponding empirical model have some limitations that need to be considered for the interpretation of the results. The coefficients of *Business Register* are found to be positive and highly significant in all periods and marginal its

effects are considerable high. These findings are consistent with those presented by Harhoff et al. (1998). However, as time goes by after an episode of financial distress, this effect decreases, indicating that it takes longer to observe the voluntary market exit of firms not publicly registered. Therefore, a sample selection problem might still exist.

Insolvency procedures are to be made public by the courts and information is incorporated in the *Creditreform* data base in a timely manner. But there is no centralized, publicly available body of information on voluntary market exits, and identification is based on *Creditreform's* investigation efforts. Therefore, insolvency procedures could be over-represented compared to voluntary market exits. An appropriate assumption would be that firms which were not investigated or whose information was not updated for a long time have closed. However, this would not solve the problem. Accordingly, the observations of deteriorating mode of payment are rare for these firms. Only limited liability firms need to file insolvency procedures. In the regressions, the firm's legal form controls for the type of market exit.

In addition to firms exiting the market after financial distress, the panel also contains observations on firms that fail without a deteriorating mode of payment. Three cases can be considered. First, the deteriorating state is simply not observed. The selection equation incorporated in the model should mitigate this possible selection bias. Second, a firm's status already refers to the worst case. For this reason, further deterioration is not possible. The third case is related to the institutions of German bankruptcy legislation for indebted firms. Those firms need to file for bankruptcy, while bankruptcy is for balance sheet rather than for solvency reasons. Logically, a deteriorating status of the mode of payment is not observed.

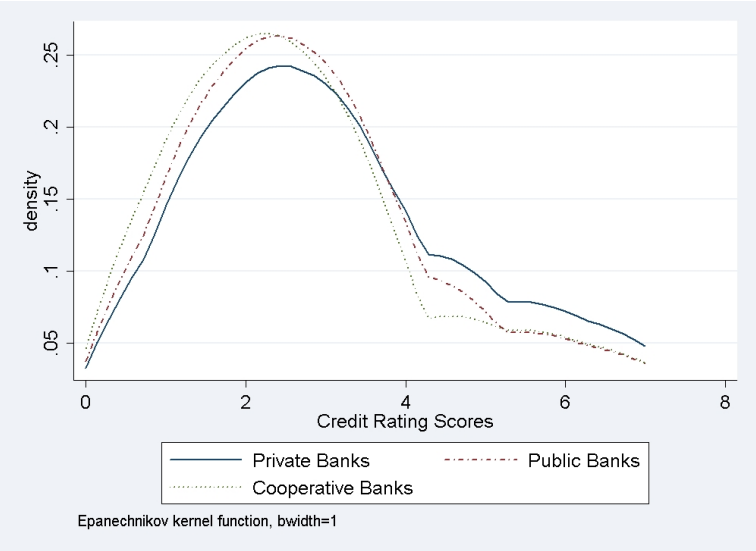
2.8 Conclusion

Banks can "lean against the wind" and keep financing troubled but viable firms. But banks are not alike in their lending strategy, organizational structure, or rent seeking potential, all of which are relevant to their ability to do so. I analyze the effects of bank governance, bank size, loan default rate, a firm's having multiple bank relations, and the local banking market competition on a firm's probability of becoming financially distressed and subsequently exiting the market. I use a large sample of firms active in Germany in the period 2000–2005.

The main findings are that larger banks are less able to process soft information once firms are in financial distress. Those firms show a higher probability of leaving the market. A firm's probability of becoming financially distressed is higher if its main bank has a high loan default rate. But those banks try to reduce additional losses on their balance sheet and firms have a lower probability of exiting the market. Banks are less likely to act as a relationship lender if they are active in a local banking market with a high degree of competition.

2.9 Appendix

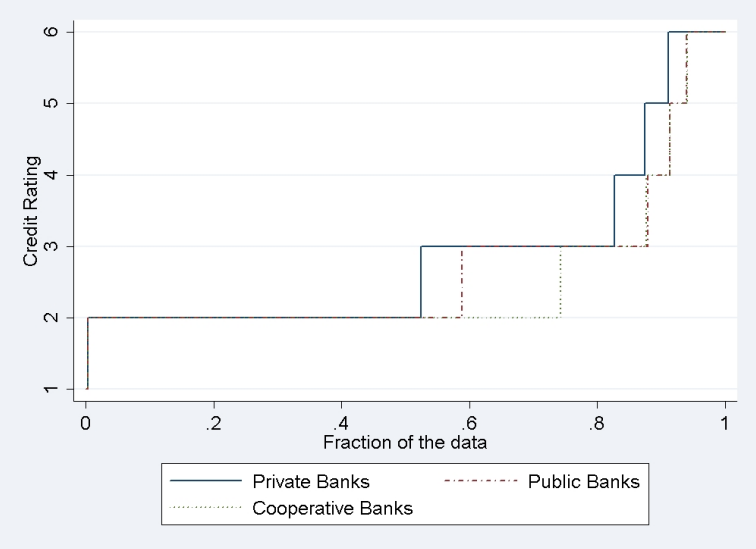
Figure 2.1: Kerneldensity of bank type's credit risk (2005)



Note: Credit rating score 1 indicates low and 6 high risk. Calculation is based on the number of firms financed by each bank type where a credit risk score was assigned by Creditreform in August 2005.

Source: MUP (ZEW) 2011, Author's own calculation.

Figure 2.2: Risk portfolio related by bank type (2005) – Cumulative distribution



Note: Credit rating score 1 indicates low and 6 high risk. Calculation is based on the number of firms financed by each bank type where a credit risk score was assigned by Creditreform in August 2005.

Source: MUP (ZEW) 2011, Author's own calculation.

Table 2.10: Description of bank types within the German banking market

Bank type	Bank or Banking Group	Description
Private Banks	Large banks: *Deutsche Bank AG*, *Commerzbank AG*, *Dresdner Bank AG*[1], *HypoVereinsbank*[2], *Postbank*[3]	Publicly listed companies.
	other commercial and real estate banks, branches of foreign banks	In general, legal form of limited liability; some are publicly listed companies; including branches of foreign banks.
Public banks	*Sparkasse*	Owned by area municipalities.
	Landesbanken[4]	Clearing houses for *Sparkassen*; Banks are jointly owned by *Sparkassen* and the *Länder*.
Cooperative banks	Cooperative banks	Owned by members of the cooperative society.
	Central bank for cooperative banks[5]	Clearing houses for cooperative banks. Banks jointly owned by cooperative banks.
excluded public banks	*Deutsche Bundesbank*	Central bank.
	Development / special purposes banks[6]	Public development banks are governmentally owned and operate either on *Länder* or federal level.

[1] *Dresdner Bank AG* merged with *Commerzbank AG* in 2008.
[2] *HypoVereinsbank* merged with *UniCredit* in 2005.
[3] *Deutsche Postbank AG* merged with *Deutsche Bank AG* in the period 2008-2010.
[4] Following institutions are classified as *Landesbanken*: *HSH Nordbank* (before 2003: *Hamburgische Landebank*, *Landesbank Schleswig-Holstein*), *Norddeutsche Landesbank Girozentrale*, in 2008), *Landesbank Rheinland-Pfalz Girozentrale* (LRP; merged with LBBW in 2008), *Landesbank Saar* (SaarLB; since2002 (NORD/LB), *Bremer Landesbank*, *Landesbank Berlin* (LBB), *Westdeutsche Landesbank* (WestLB), *Landesbank Hessen-Thüringen Girozentrale* (Helaba), *Landeskreditkasse Kassel*, *Landesbank Sachsen* (merged with mainly owned by BayernLB), *Landesbank Baden-Wrttemberg / Baden-Wrttembergische Bank* (LBBW), *Bayerische Landesbank* (BayernLB), *Deutsche Kreditbank*, *DekaBank*, *Deutsche Wertpapier Service Bank AG*, *NLB FinanzIT*, LBS.
[5] Following institutions are classified as central banks for cooperative banks: *DZ Bank AG*, WGZ Bank AG(*Westdeutsche Genossenschaftliche Zentralbank*), *Deutsche Apotheker und Ärztebank eG*.
[6] Following institutions are classified as public development banks: *Landestreuhandbank Rheinland-Pfalz*, *LfA Förderbank Bayern*, *L-Bank*, *Investitionsbank Berlin*, *Investitionsbank des Landes Brandenburg*, *Bremer Aufbau-Bank GmbH*, *Hamburgische Wohnungsbaukreditanstalt*, *LTH-Bank für Infrastruktur*, *Investitionsbank Hessen*, *Landesföderinstitut Mecklenburg-Vorpommern*, *Niedersachsen-Bank* (N-Bank), *Investitions- und Strukturbank Rheinland-Pfalz* (ISB) GmbH, *Sächsische Aufbaubank*, *Investitionsbank Sachsen-Anhalt*, *Investitionsbank Schleswig-Holstei*n, *Thüringer Aufbaubank*, *Kreditanstalt fr Wiederaufbau* (KfW), *Deutsche Ausgleichsbank* (DtA, merged with KfW in 2003).

Table 2.11: Descriptive statistics of control variables

		All firms				Firms in financial distress			
Variables	Explanation	Mean	SD	Min	Max	Mean	SD	Min	Max
History of Distress	Number of previous episodes of distress	0.03	0.19	0	4	0.38	0.63	0	4
Limited liability	1 if the company has the legal form of a limited liability (GmbH, GmbH & Co. KG) or stock company (AG, SE).	0.29	0.45	0	1	0.30	0.46	0	1
Real Estate	1 if either residential, industrial or mixed property is owned	0.31	0.46	0	1	0.22	0.41	0	1
Debt Collection (all)	1 if CREDITREFORM is commissioned to collect debt from the particular firm	0.08	0.28	0	1	0.54	0.50	0	1
Debt collection open	1 if debt collection is not yet finished	0.05	0.22	0	1	0.26	0.44	0	1
Debt collection paid	1 if debitor completely payed back the debt CREDITREFORM was asked to collect.	0.02	0.13	0	1	0.12	0.33	0	1
Debt collection partly paid	1 if debitor payed back a part of the debt CREDITREFORM was asked to collect.	0.00	0.06	0	1	0.02	0.14	0	1
Debt collection unpaid	1 if the debtor was unable to pay back the debt CREDITREFORM was asked to collect.	0.01	0.11	0	1	0.13	0.33	0	1
Management Team	Number of entrepreneurs or Number of management board members.	0.08	0.28	0	1	0.05	0.22	0	1
Management Team M	1 if the number of entrepreneurs or number of management board members is unknown.	0.17	0.37	0	1	0.09	0.28	0	1
Master Craftsman	1 if the highest educational degree of all the members of the management team is a master certificate received from the chamber of industries and commerce or the chamber of crafts.	0.10	0.30	0	1	0.08	0.28	0	1
Academic	1 if the highest educational degree within the management team is a University degree (either a German diploma, degree of doctor, or professorship).	0.09	0.28	0	1	0.07	0.26	0	1
Firm size	Number of employees	11.64	284.09	1	50,000	7.39	59.49	1	9,249
Firm age	Firm age in years	16.90	34.06	0	1004	13.05	29.12	0	995
Firm age cat. 1	1 if firm age is between 0 an 2 years	0.05		0	1	0.29	0.45	0	1
Firm age cat. 2	1 if firm age is between 3 and 7 years	0.20	0.40	0	1	0.30	0.46	0	1
Firm age cat. 3	1 if firm age is between 8 and 12 years	0.27	0.45	0	1	0.15	0.36	0	1
Firm age cat. 4	1 if firm age is between 13 and 19 years	0.17	0.38	0	1	0.11	0.32	0	1
Firm age cat. 5	1 if firm age is between 20 and 49	0.19	0.39	0	1	0.05	0.21	0	1
Firm age cat. 6	1 if firm age is 50 years or older	0.09	0.29	0	1	0.01	0.12	0	1
Firm age unkown	1 if date of foundation is unknown	0.03	0.18	0	1	0.08		0	1
change in market exit	Percentage change in the number of market exits on the district level.	1.10	0.52	0.12	12.19	1.10	0.51	0.12	12.19
East Germany	1 if firm is located in East Germany	0.22	0.41	0	1	0.29	0.46	0	1
Cutting edge technology	1 if Cutting Edge Technology	0.01	0.07	0	1	0.00	0.06	0	1
High technology	1 if High Technology	0.01	0.11	0	1	0.01	0.10	0	1
Low-tech manufacturing	1 if Manufacturing	0.08	0.28	0	1	0.08	0.27	0	1
High-tech services	1 if Technology-intensive Services	0.06	0.23	0	1	0.04	0.20	0	1
Knowledge intensive services	1 if Consultancy	0.05	0.22	0	1	0.04	0.19	0	1
Corporate oriented services	1 if Industry/corporate-related Services	0.04	0.20	0	1	0.04	0.20	0	1

Table 2.11: Descriptive statistics of control variables

		All firms				Firms in financial distress			
Variables	Explanation	Mean	SD	Min	Max	Mean	SD	Min	Max
Consumer oriented services	1 if Consumer Services	0.21	0.41	0	1	0.21	0.40	0	1
Energy and Mining	1 if Energy and Mining	0.00	0.05	0	1	0.00	0.03	0	1
Construction	1 if Construction	0.15	0.36	0	1	0.20	0.40	0	1
Trade	1 if Trade	0.30	0.46	0	1	0.28	0.45	0	1
Transportation	1 if Transportation and postal services	0.05	0.22	0	1	0.07	0.26	0	1
Financial services	1 if Financial services	0.03	0.17	0	1	0.03	0.16	0	1
Industry unknown	1 if Industry code unknown	0.01	0.07	0	1	0.00	0.06	0	1
Year 2000	1 if year is 2000	0.12	0.33	0	1	0.11	0.31	0	1
Year 2001	1 if year is 2001	0.15	0.36	0	1	0.14	0.34	0	1
Year 2002	1 if year is 2002	0.17	0.38	0	1	0.17	0.39	0	1
Year 2003	1 if year is 2003	0.19	0.39	0	1	0.18	0.39	0	1
Year 2004	1 if year is 2004	0.20	0.40	0	1	0.21	0.41	0	1
Year 2005	1 if year is 2005	0.16	0.40	0	1	0.19	0.39	0	1
No. of observation		2,477,819				45,256			

Note: This table presents descriptive statistics of the explanatory variables used in the probit and heckprob regression.
Source: MUP (ZEW) 2011, author's own calculations.

Table 2.12: Results of probit regression – Marginal effects (full set of variables)

	Base		Loan Default		Full	
	Exit in t+1	Exit in t+4	Exit in t+1	Exit in t+4	Exit in t+1	Exit in t+4
Sparkasse			0.029*	0.008	0.028	0.021
			(0.02)	(0.02)	(0.02)	(0.02)
Cooperative Bank			0.002	-0.018	-0.002	0.013
			(0.02)	(0.02)	(0.02)	(0.02)
Bank size (ln)					-0.002	0.016**
					(0.01)	(0.01)
Bank portfolio default rate			-0.012**	-0.016***	-0.013**	-0.013**
			(0.01)	(0.01)	(0.01)	(0.01)
Local bank market	5.972***	3.661**	5.706***	3.705**	5.741***	3.476**
competition (switch)	(1.44)	(1.47)	(1.58)	(1.62)	(1.58)	(1.62)
No of bank relations	0.032***	0.036***	0.054***	0.044***	0.054***	0.045***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Real estate	-0.158***	-0.139***	-0.162***	-0.150***	-0.162***	-0.146***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Management team	0.029	-0.052	0.017	-0.059	0.017	-0.059
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Management team MV	0.053**	0.0	0.041*	-0.009	0.042*	-0.01
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Master Craftsman	-0.048**	-0.087***	-0.053**	-0.086***	-0.053**	-0.086***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
University degree	-0.028	-0.037	-0.021	-0.034	-0.021	-0.034
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Limited liability	0.476***	0.532***	0.471***	0.515***	0.471***	0.515***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Debt collection	-0.220***	-0.122***	-0.239***	-0.132***	-0.239***	-0.132***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
History of MoP decline	-0.023**	0.009	-0.025**	0.006	-0.025**	0.007
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Firms size (emp, ln)	0.01	0.073***	0.016	0.075***	0.016	0.076***
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
Firm size^2	0.064***	0.041***	0.061***	0.040***	0.061***	0.040***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Firm size^3	-0.009***	-0.006***	-0.008***	-0.006***	-0.008***	-0.006***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Firm age 3 - 7	-0.029	-0.082***	-0.024	-0.077***	-0.023	-0.077***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Firm age 8 - 12	-0.098***	-0.227***	-0.075***	-0.213***	-0.075***	-0.214***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Firm age 13 - 19	-0.145***	-0.292***	-0.120***	-0.278***	-0.120***	-0.279***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Firm age 20 - 49	-0.154***	-0.330***	-0.138***	-0.324***	-0.137***	-0.326***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Firm age > 49	-0.105**	-0.308***	-0.108**	-0.311***	-0.107**	-0.312***
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)
Firm age unknown	-0.064	0.018	-0.013	0.06	-0.012	0.057
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)
Δ local market exits	-0.016	-0.014	-0.022*	-0.027**	-0.022*	-0.027**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
East Germany	0.127***	0.118***	0.143***	0.131***	0.143***	0.131***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Cutting edge technology	0.105	-0.168	0.082	-0.193*	0.082	-0.192*
	(0.10)	(0.10)	(0.10)	(0.11)	(0.10)	(0.11)
High technology	-0.062	-0.094	-0.104	-0.141*	-0.104	-0.142*
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Low-tech manufacturing	-0.061**	-0.054*	-0.071***	-0.055*	-0.071***	-0.054*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High-tech services	0.007	-0.037	0.004	-0.043	0.004	-0.043
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Knowledge intensive services	-0.082**	-0.078**	-0.084**	-0.085**	-0.084**	-0.088**
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Corporate oriented services	-0.025	-0.003	-0.031	0.0	-0.031	-0.001
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Consumer oriented services	-0.016	-0.019	-0.036*	-0.039**	-0.036*	-0.040**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Construction	-0.070***	-0.057***	-0.064***	-0.051**	-0.064***	-0.051**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Transportation and	0.025	0.057**	0.022	0.049*	0.022	0.048*
postal services	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Financial services	-0.110***	-0.086**	-0.155***	-0.112**	-0.155***	-0.111**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Industry missing	-0.242***	-0.240***	-0.191*	-0.204*	-0.190*	-0.208*
	(0.08)	(0.08)	(0.11)	(0.11)	(0.11)	(0.11)
Year 2000	-0.295***	-0.271***	-0.268***	-0.257***	-0.268***	-0.254***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Year 2001	-0.163***	-0.124***	-0.154***	-0.117***	-0.154***	-0.115***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)

Table 2.12: Results of probit regression–Marginal effects (full set of variables)

	Base		Loan Default		Full	
	Exit in t+1	Exit in t+4	Exit in t+1	Exit in t+4	Exit in t+1	Exit in t+4
Year 2003	0.021	0.016	0.009	0.003	0.009	0.001
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Year 2004	0.024	0.019	0.01	0.01	0.01	0.006
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Year 2005	0.098***	0.073***	0.095***	0.063***	0.096***	0.057***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Constant	-0.245***	0.190***	-0.258***	0.235***	-0.232***	0.062
	(0.03)	(0.03)	(0.04)	(0.04)	(0.08)	(0.08)
Observations	54283	54283	45256	45256	45256	45256
LR Chi2	3343	3010	2934	2596	2934	2599
log likelihood	-34896.52	-34946.6	-29102.49	-28961.09	-29102.4	-28957.38

Source: MUP (ZEW) 2011, author's own calculations.

Table 2.13: Estimation results Heckprob – Financial distress (full sample)

Model:	Basis		Bank type		Bank characteristics	
Statistics:	Coefficient	Marginal	Coefficient	Marginal	Coefficient	Marginal
Dependent variable: Financial Distress	(1)	(2)	(3)	(4)	(5)	(6)
Quality Index	0.073***	0.003***	0.073***	0.003***	0.071***	0.003***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Investigation	0.252***	0.010***	0.238***	0.009***	0.244***	0.009***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Same Hausbank (Creditreform and firm)	0.015***	0.001***	0.006	0	0.005	0
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Sparkasse			-0.027***	-0.001***	-0.035***	-0.001***
			(0.01)	(0.00)	(0.01)	(0.00)
Cooperative Bank			-0.059***	-0.002***	-0.070***	-0.003***
			(0.01)	(0.00)	(0.01)	(0.00)
Bank size (ln)					-0.001	0
					(0.00)	(0.00)
Bank Loan Loss Provision (emp wght)					0.013***	0.001***
					(0.00)	(0.00)
Local bank competition (switch)	4.237***	0.162***	4.540***	0.175***	4.581***	0.177***
	(0.44)	(0.02)	(0.49)	(0.02)	(0.49)	(0.02)
No of bank relations	0.021***	0.001***	0.012***	0.000***	0.012***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Firms size (emp, ln)	-0.024***	-0.001***	-0.038***	-0.001***	-0.036***	-0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Firm age	-0.002***	-0.000***	-0.002***	-0.000***	-0.002***	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Firm age unknown	-0.199***	-0.008***	-0.203***	-0.008***	-0.201***	-0.008***
	(0.01)	(0.00)	(0.02)	(0.00)	(0.02)	(0.00)
Limited liability	0.019***	0.001***	0.028***	0.001***	0.028***	0.001***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Int: Sparkasse x firm size			0.015***		0.013***	
			(0.00)		(0.00)	
Int: cooperative bank x firm size			0.032***		0.030***	
			(0.00)		(0.01)	
Int: Sparkasse x Investigation			0.017		0.018	
			(0.01)		(0.01)	
Int: Cooperative bank x Investigation			0.004		-0.002	
			(0.01)		(0.01)	
Debt collection	1.150***	0.044***	1.176***	0.045***	1.174***	0.045***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
East Germany	0.081***	0.003***	0.075***	0.003***	0.069***	0.003***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Delta local market exits	0.001	0	0	0	0.001	0
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Cutting edge technology	-0.079***	-0.003***	-0.076**	-0.003**	-0.072**	-0.003**
	(0.03)	(0.00)	(0.03)	(0.00)	(0.03)	(0.00)
High technology	-0.034*	-0.001*	-0.022	-0.001	-0.022	-0.001
	(0.02)	(0.00)	(0.02)	(0.00)	(0.02)	(0.00)
Low-tech manufacturing	0.019**	0.001**	0.028***	0.001***	0.029***	0.001***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
High-tech services	-0.017*	-0.001*	-0.01	0	-0.013	-0.001
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Knowledge intensive services	-0.001	0	-0.002	0	-0.003	0
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Corporate oriented services	0.063***	0.002***	0.063***	0.002***	0.064***	0.002***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Consumer oriented services	0.059***	0.002***	0.063***	0.002***	0.064***	0.002***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Construction	0.103***	0.004***	0.103***	0.004***	0.103***	0.004***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Transportation and postal services	0.110***	0.004***	0.111***	0.004***	0.111***	0.004***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Financial services	0.040***	0.002***	0.036***	0.001***	0.036***	0.001***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Industry unkown	-0.263***	-0.010***	-0.235***	-0.009***	-0.236***	-0.009***
	(0.02)	(0.00)	(0.04)	(0.00)	(0.04)	(0.00)
Year 2000	-0.008	0	0.009	0	0.01	0
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Year 2001	-0.030***	-0.001***	-0.026***	-0.001***	-0.023***	-0.001***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Year 2003	-0.005	0	-0.007	0	-0.007	0
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Year 2004	-0.025***	-0.001***	-0.026***	-0.001***	-0.031***	-0.001***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Year 2005	-0.103***	-0.004***	-0.107***	-0.004***	-0.113***	-0.004***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)

Table 2.13: Estimation results Heckprob–Financial distress (full sample)

Model:	Basis		Bank type		Bank characteristics	
Statistics:	Coefficient	Marginal	Coefficient	Marginal	Coefficient	Marginal
Dependent variable: Financial Distress	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-2.495***		-2.461***		-2.468***	
	(0.01)		(0.01)		(0.03)	
Observations	3,040,000		2,540,000		2,477,819	
LR Chi2	85,143		74,899		73,384	
log likelihood	-231,000		-195,000		-190,000	

Source: MUP (ZEW) 2011, author's own calculations.

Table 2.14: Estimation results after Heckprob - Market exit (given distressed; full sample)

Model:	Basis		Bank type		Bank characteristics	
Period after episode of distress:	t+1	t+4	t+1	t+4	t+1	t+4
Dependent variable: Market Exit	(1)	(2)	(3)	(4)	(5)	(6)
Sparkasse			0.030*	0.005	0.028	0.025
			(0.02)	(0.02)	(0.02)	(0.02)
Cooperative Bank			0.003	-0.019	-0.001	0.022
			(0.02)	(0.02)	(0.02)	(0.02)
Bank size (ln)					-0.002	0.013**
					(0.01)	(0.01)
Bank Loan Loss Provision (emp wght)						-0.014***
						(0.01)
Local bank competition (switch)	5.646***	3.218**	5.661***	3.136*	5.711***	3.340**
	(1.48)	(1.49)	(1.61)	(1.63)	(1.61)	(1.65)
No of bank relations	0.028***	0.033***	0.049***	0.041***	0.051***	0.039***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Real estate	-0.143***	-0.123***	-0.147***	-0.133***	-0.147***	-0.132***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Management team	0.054*	-0.034	0.049	-0.038	0.05	-0.04
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Management team unknown	0.062***	0.007	0.051**	-0.002	0.051**	-0.005
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Master Craftsman	-0.027	-0.067***	-0.026	-0.063**	-0.026	-0.066**
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
University degree	-0.013	-0.024	-0.006	-0.023	-0.005	-0.022
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Limited liability	0.432***	0.498***	0.430***	0.482***	0.430***	0.482***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Debt Collection open	-0.366***	-0.251***	-0.365***	-0.236***	-0.362***	-0.234***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Debt Collection fully paid	-0.935***	-0.726***	-0.948***	-0.719***	-0.945***	-0.717***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Debt Collection partly paid	-0.484***	-0.375***	-0.497***	-0.374***	-0.494***	-0.369***
	(0.07)	(0.07)	(0.08)	(0.07)	(0.08)	(0.08)
Debt Collection not paid	0.234***	0.211***	0.268***	0.254***	0.271***	0.255***
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)
History of MoP decline	-0.043***	-0.002	-0.048***	-0.008	-0.048***	-0.007
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Firms size (emp, ln)	0.019	0.089***	0.025	0.091***	0.026	0.091***
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
Firm size2	0.059***	0.034***	0.057***	0.035**	0.057***	0.034**
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Firm size3	-0.008***	-0.006***	-0.008***	-0.006***	-0.008***	-0.006***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Firm age 3 - 7	-0.001	-0.060***	0.007	-0.053**	0.006	-0.056**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Firm age 8 - 12	-0.056***	-0.195***	-0.03	-0.179***	-0.031	-0.181***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
Firm age 13 - 19	-0.095***	-0.252***	-0.065**	-0.236***	-0.066**	-0.237***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Firm age 20 - 49	-0.094***	-0.282***	-0.069**	-0.270***	-0.072**	-0.278***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Firm age > 49	-0.038	-0.244***	-0.043	-0.254***	-0.049	-0.252***
	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Firm age unknown	-0.078	0.004	-0.024	0.051	-0.018	0.048
	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
delta local market exits	-0.011	-0.01	-0.014	-0.021*	-0.013	-0.022*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
East Germany	0.103***	0.092***	0.117***	0.102***	0.118***	0.107***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Cutting edge technology	0.158	-0.13	0.143	-0.15	0.143	-0.153
	(0.10)	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)
High technology	-0.053	-0.081	-0.104	-0.124*	-0.104	-0.133*
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Low-tech manufacturing	-0.060**	-0.052*	-0.072***	-0.057*	-0.071***	-0.052*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High-tech services	0.002	-0.043	-0.003	-0.045	-0.006	-0.051
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Knowledge intensive services	-0.084**	-0.081**	-0.091**	-0.097**	-0.091**	-0.090**
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Corporate oriented services	-0.036	-0.017	-0.04	-0.008	-0.039	-0.01
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Consumer oriented services	-0.025	-0.03	-0.042**	-0.047**	-0.041**	-0.049**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Construction	-0.085***	-0.074***	-0.083***	-0.068***	-0.083***	-0.066***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Transportation and postal services	0.008	0.037	0.009	0.034	0.009	0.031
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Financial services	-0.122***	-0.099***	-0.170***	-0.124***	-0.172***	-0.131***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)

Table 2.14: Estimation results after Heckprob – Market exit (given distressed; full sample)

Model:	Basis		Bank type		Bank characteristics	
Period after episode of distress:	t+1	t+4	t+1	t+4	t+1	t+4
Dependent variable: Market Exit	(1)	(2)	(3)	(4)	(5)	(6)
Industry missing	-0.219***	-0.209***	-0.163	-0.16	-0.163	-0.182
	(0.08)	(0.08)	(0.11)	(0.11)	(0.11)	(0.11)
Year 2000	-0.314***	-0.280***	-0.288***	-0.266***	-0.287***	-0.269***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Year 2001	-0.163***	-0.121***	-0.149***	-0.108***	-0.150***	-0.114***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Year 2002	0.032*	0.023	0.025	0.012	0.026	0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Year 2003	0.047**	0.037**	0.032	0.024	0.031	0.029
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Year 2004	0.133***	0.101***	0.128***	0.083***	0.128***	0.087***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Constant	0.068	0.565***	-0.041	0.513***	-0.035	0.389**
	(0.16)	(0.16)	(0.17)	(0.17)	(0.18)	(0.18)
ρ Constant	-0.128**	-0.151***	-0.104*	-0.127**	-0.101	-0.124**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Observations	3,040,000	3,040,000	2,540,000	2,540,000	2,540,000	2,480,000
LR Chi2	5,435	4,756	4,904	4,214	4,885	4,139
log likelihood	-265,000	-265,000	-223,000	-223,000	-222,000	-219,000

Source: MUP (ZEW) 2011, author's own calculations.

Table 2.15: Main results – Heckprob on financial distress and markt exit (marginal effects; mature firms only)

Specification:		Base			Bank Type			Bank Characteristics		
Dependent Variable:	Distress	Exit in t+1	Exit in t+4	Distress	Exit in t+1	Exit in t+4	Distress	Exit in t+1	Exit in t+4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Index Quality	0.002***			0.002***			0.002***		
	(0.00)			(0.00)			(0.00)		
Investigation	0.009***			0.008***			0.008***		
	(0.00)			(0.00)			(0.00)		
same Hausbank	(0.00)			(0.00)			(0.00)		
(Creditreform and firm)	(0.00)			(0.00)			(0.00)		
Sparkasse				-0.001***	0.013*	-0.002	-0.001***	0.012*	0.005
				(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Cooperative Bank				-0.002***	0.011*	-0.003	-0.003***	0.011	0.01
				(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)
Bank size (ln)							(0.00)	-0.003	0.003
							(0.00)	(0.00)	(0.00)
Bank Loan Default Rate							0.000***	-0.005**	-0.006**
							(0.00)	(0.00)	(0.00)
local bank competition (switch)	0.137***	1.535*	0.826	0.152***	1.987**	1.042	0.157***	1.995**	1.172
	(0.02)	(0.72)	(0.72)	(0.02)	(0.77)	(0.77)	(0.02)	(0.78)	(0.78)
No of bank relations	0.001***	0.016***	0.015***	(0.00)	0.017***	0.014***	(0.00)	0.016***	0.013**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)

Note: This table presents the marginal effects of selected variables after the Heckprob model. Columns (1), (4) and (7) present the marginal effects of the first step probit on firms financial distress. Columns (2)-(3), (5)-(6), and (8)-(9) provide the marginal effects on market exit within one period (t+1; half year) and within 4 periods (t+4; 2 years) after the episode of financial distress. Standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels of significance.
Source: MUP (ZEW), 2012, author's own calculations.

Table 2.16: Regression results – Local banking market competition

Specification:	HHI - Banking Market		Bank Intensity		Switch Main Bank	
	Distress	Exit t+4	Distress	Exit t+4	Distress	Exit t+4
Quality Index	0.059***		0.064***		0.071***	
	(0.01)		(0.01)		(0.01)	
	0.002***		0.002***		0.003***	
	(0.00)		(0.00)		(0.00)	
Investigation	0.245***		0.245***		0.244***	
	(0.01)		(0.01)		(0.01)	
	0.009***		0.009***		0.009***	
	(0.00)		(0.00)		(0.00)	
same Hausbank	0.002		0.003		0.005	
(Creditreform branch	(0.01)		(0.01)		(0.01)	
and firm)	0		0		0	
	(0.00)		(0.00)		(0.00)	
Sparkasse	-0.039***	0.023	-0.036***	0.024	-0.035***	0.025
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
	-0.002***	0.007	-0.001***	0.007	-0.001***	0.008
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Cooperative Bank	-0.072***	0.021	-0.073***	0.019	-0.070***	0.022
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
	-0.003***	0.005	-0.003***	0.004	-0.003***	0.005
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Bank size (ln)	0	0.014**	-0.003	0.01	-0.001	0.013**
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
	0	0.005**	0	0.004	0	0.005**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank Loan Default Rate	0.013***	-0.014***	0.013***	-0.015***	0.013***	-0.014***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
	0.001***	-0.005***	0.000***	-0.005***	0.001***	-0.005***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
local bank competition	0.065***	0.013	-3.492***	-5.03	4.581***	3.340**
	(0.02)	(0.07)	(0.95)	(3.14)	(0.49)	(1.65)
	0.002***	0.007	-0.135***	-2.002	0.177***	1.420**
	(0.00)	(0.03)	(0.04)	(3.14)	(0.02)	(0.60)
No of bank relations	0.017***	0.042***	0.017***	0.042***	0.012***	0.039***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
	0.001***	0.016***	0.001***	0	0.000***	0.015***
	(0.00)	(0.00)	(0.00)	0.016***	(0.00)	(0.00)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.449***	0.410**	-2.393***	0.480***	-2.468***	0.389**
	(0.03)	(0.18)	(0.03)	(0.18)	(0.03)	(0.18)
athrho						
Constant		-0.126**		-0.126**		-0.124**
		(0.06)		(0.06)		(0.06)
Observations	2,480,000	2,480,000	2,480,000	2,480,000	2,480,000	2,480,000
LR Chi2	73,315	4,134	73,298	4,137	73,384	4,139
log likelihood	-191,000	-219,000	-191,000	-219,000	-190,000	-219,000

Note: Coefficients and related standard errors are presented in the first and second row of each variable. Marginal effects and related standard errors in third and fourth row. *,**, and *** denote significance level on the 10, 5, and 1% levels of significance.
Source: MUP (ZEW), 2012, author's own calculations.

Chapter 3

An Information Economics Perspective on Main Bank Relationships and Firm R&D

3.1 Introduction

Investments in R&D are crucial for firm success. They allow firms to produce unique knowledge as the basis for distinctive products and efficient processes. Firms can increase their competitiveness by investing in R&D and innovative firms face lower default probabilities. Securing adequate funding for strategic investments in R&D is therefore directly linked to firm performance. But there are shortcomings in capital markets providing funds for R&D investments. These are typically explained by the nature of R&D projects, which suffer both from information imperfections and asymmetries (for a comprehensive review see Hall (2005)). Information imperfections stem from inherent uncertainties about the technological and commercial viability of novel products for which no ex-ante probabilities of success exist (Amit et al., 1990). Information asymmetries arise from the fact that firms possess knowledge of the value of their R&D projects, which is superior to that of external investors (Ahuja et al., 2008). These investors, therefore, bear the extra risk of hidden information and hidden actions.

For the vast majority of firms, banks are the cornerstone for external financing. But in theoretical or empirical models explaining financing of private R&D, banks are nearly completely absent. It is assumed that banks suffer equally from information uncertainties and asymmetries in the evaluation of R&D projects. Bank finance is seen to be ill-equipped to provide necessary funding. The literature therefore considers available funds for R&D investments as largely restricted to internal cash flows or venture capital investments, whereupon venture capital investments are scarce. For Germany, the fourth largest economy in the world with a population of roughly 3 million firms, Bureau van Dijks ZEPHYER database records only 250 venture capital investments per year during the last decade.

Banks' role in financing R&D might be underestimated in the literature. We argue that a firms main bank relationship can make a difference for its R&D investment and that

some banks may be better equipped to support innovative firms than others. We address this issue and develop a theoretical model of bank financing for firm R&D investment, which rests on identifying heterogeneity among banks. Our approach challenges core assumptions of existing literature, which treats banks as homogeneous in their inability to obtain R&D related information of their clients and make adequate risk evaluations. The identification of these heterogeneities among banks makes the bank choice a strategic variable for managers.

We adopt a novel perspective based on information economics theory by challenging the dominant assumption that all banks are equally subject to suffering from information asymmetries in financing private R&D projects. We acknowledge that banks cannot produce the relevant information on technological innovation themselves. However, banks are uniquely positioned to aggregate the outcomes of the information production of other firms in the industry in the client portfolio, i.e. information externalities (Stiglitz, 2002) originating from heterogeneous client portfolios of different banks exist. We contrast this perspective by relying on portfolio theory, which posits the opposite relationship: Correlated risks in specialized bank portfolios should make R&D investment in client firms less likely (Markowitz, 1991). Within this framework we incorporate findings from banking and finance literature which has a renewed interest in examining firm innovation and growth (e.g. Herrera and Minetti (2007); Benfratello et al. (2008)).

We test our theoretical framework empirically for more than 5,000 high-tech firm observations on R&D investments in Germany between 2002 and 2007. Unique access to the database of Germanys leading credit rating agency on the population of German firms and their main bank relationship allows us to construct novel variables on the overall portfolio of each of the firms main bank. We have the rare opportunity to link this information to firm characteristics, R&D investment, patent statistics and venture capital investments based on a direct, non-heuristic link. In terms of industry, firm and variable coverage, the data set is, to the best of our knowledge, unique in its breadth and representativeness.

The empirical results corroborate our theoretical model. Firm R&D investment is higher if its main bank is either highly diversified or very active in its particular industry. The information externality effect is restricted to knowledge intensive sectors in which major uncertainties about commercial application exist. On the one hand we find that firm investments increases with their main bank's industry market share. Banks that serve a large share of the firm's industry are more experienced and capable of evaluating innovative firms. On the other hand, banks need to diversify. Firm R&D investment decreases with an increase in the industry share within the bank's client portfolio. A concern might be that a firm selected its main bank relationship with respect to planed R&D investments. We control for this by adopting an IV regression approach instrumenting main bank switch using different variables describing the local banking market.

The remainder of the paper is structured as follows. Following this introduction, we outline our theoretical framework culminating in the derivation of hypotheses. In the subsequent section we present our empirical study including data, variables and methodologies. We present the results of these analyses followed by derived conclusions in the last two sections.

3.2 Conceptional Framework

We choose information economics theory as our main theoretical building block (Stiglitz, 2002; Ahuja et al., 2008). We combine research from finance literature on bank lending decisions (Rajan and Zingales, 2001) with the literature on knowledge production through R&D.

A firms R&D investment decisions can be described as a function of the characteristics of its industry, its existing knowledge, and the available funds. This study will focus on available funds, while industry characteristics and knowledge are largely treated as control variables. We conceptualize a firms available funds as a general liquidity pool from which a firm can draw financial resources for its R&D investment. We explicitly acknowledge that R&D investment competes with other firm functions (e.g. marketing) for these funds. The pool of available funds determines the cost of capital for a company. Firms will invest in projects (R&D or other) only if the expected returns exceed the cost of capital based on a net present value rational. The pool of funds has three primary components: Internal cash flows, equity finance, and bank loans.

Most firms rely on internal cash flows for their R&D projects (Kim et al., 1998). When it comes to external financing of innovations, venture capital financing has received a lot of attention in the literature (Bottazzi and Da Rin, 2002; Audretsch and Lehmann, 2004; Levitas and McFadyen, 2009). It is generally acknowledged that access to venture capital is constrained for the majority of firms because of limited availability and the highly selective nature of venture capital investors who target a small number of investments with the potential for high returns (Eckhardt et al., 2006). Banks, however, as the primary provider of external financing for the vast majority of firms, appear ill-equipped to finance R&D investments (Bozkaya and De La Potterie, 2008).

Assuming a perfect market for capital, financing R&D investments should not be different from any other investment decision and firms should opt for all projects with a positive net present value (Modigliani and Miller, 1958). However, the assumption does not hold because of the nature of R&D (for recent reviews, see Hall (2005) and Hall (2009)). The outcomes of R&D are generally uncertain. This uncertainty has two primary dimensions (Amit et al., 1990). First, there is a substantial degree of technological uncertainty about the success of an R&D project. Materials and procedures are almost by definition new and largely untested. Probability distributions for the success of an R&D project are difficult or even impossible to predict at the early stages (Hall, 2005). R&D investments provide very little collateral. Half of all R&D expenditures finance wages for skilled scientists and engineers (Hall, 2005). Investments in physical research assets and laboratories are often highly specific to a firm or even a project making it difficult to re-deploy, sell or use for others (Vincente-Lorente, 2001). Secondly, there is a large degree of uncertainty about whether the firm will be economically successful with its technologically new products and processes. A significant proportion of product innovations end up as economic failures because they do not meet customer needs or because competitors are quick in their imitation or substitution activities, which erodes margins from the pioneering advantage (Dos Santos and Peffers, 1995; Gourville, 2006).

Even so, research shows that these underlying uncertainties are not equally exogenous

to managers and external capital providers. Endogenous uncertainty can be overcome by firm activities over time while exogenous uncertainties exist independently of any firm actions (Folta and O'Brien, 2004; Cuypers and Martin, 2010). Firms perform R&D to resolve endogenous uncertainties through experimentation, testing and simulation. In that sense, R&D is a sequential process in which firms uncover information and reduce endogenous uncertainty at each stage of the process (Cuervo-Cazurra and Annique, 2010). There is a long time span between the start of an R&D project and the appearance of revenues from it, i.e. when the uncertainty is ultimately resolved and success or failure is apparent to actors outside of the firm. Empirical estimates predict this time duration to be between four and five years albeit with significant differences across industry (Pakes and Schankerman, 1984). Hence, firms have significant time advantages in discovering potentials or failures within R&D projects over external partners, from whom the same uncertainties remain exogenous. This gives rise to an information asymmetry that insiders can exploit (Aboody and Lev, 2000; Ahuja et al., 2008).

Banks are even more disadvantaged in this situation than equity investors because banks have limited opportunities for directing/monitoring the use of their funds and they do not benefit from any resulting profits beyond the contractually fixed interest rate (Hennart, 1994). Moreover, in their lending decisions, all banks are equally subject to legal and regulatory constraints imposed by their institutional environment (e.g. Bank for International Settlement, 2005).

Financing R&D investments is therefore characterized by a combination of information that is either unavailable (exogenous uncertainty) or asymmetrically distributed between the firm and its external capital providers (endogenous uncertainty). Appropriate risk premiums for individual borrowers cannot be assessed (Stiglitz, 2002) and firms find themselves credit-constrained because banks will only set high, average risk premiums (Aghion et al., 2012). As a result, the pool of funds available for R&D investment in a firm is deprived of bank financing.

An emerging stream of literature from finance and strategic management is beginning to emphasize heterogeneities among banks. The literature on banks and innovation financing is still scarce. Positive relations have been found for the development of the regional banking system (Benfratello et al., 2008) and relationship length (Herrera and Minetti, 2007). Negative relationships stem from government ownership of banks (Sapienza, 2004; Haselmann et al., 2009).

3.3 Hypotheses

All of the theory presented so far rests on the important assumption that all banks draw from identical pools of information and should therefore suffer from identical degrees of information deficits. We question this assumption and argue that information is distributed asymmetrically between banks, too. We concede that the specific uncertainties related to R&D investments of a particular firm are equally exogenous to all banks. However, information - on technological feasibility as well as market success - is produced by other firms in the same industry. At least parts of the uncertainties are therefore endogenous to these firms. We argue that banks are heterogeneous in their ability to access this information

based on information externalities from the composition of their existing client portfolio. What is more, we will set out the opportunities for the focal firm i to signal the value of its R&D activities and influence the availability of bank financing.

Banks differ in their level of engagement with client firms. Boot and Thakor (2000) present a dichotomy of bank lending with varying levels in between. Transaction lending is closely related to brokerage activities where it is sufficient for the bank to lend based on a standardized transaction. Relationship lending, though, requires borrower-specific information for activities such as screening and monitoring (for a review see (Boot, 2000)). The relation specificity can provide banks with access to private data about the financed firm which can lead to a quasi monopolistic banking position and superior benefits from future business with the particular client (Boot et al., 2000). We will focus on a specific relationship, i.e. a firms main bank, defined as the bank that a firm considers its primary source for all banking services. Within all relationship lending, main banks are uniquely positioned for acquisition of information about their client firms (Herrera and Minetti, 2007).

We construct a simple theoretical model to investigate the effect of the client portfolio of a firms main bank on the firms R&D investment which can be easily extended. We assume two identical firms, i_s and j_s. Both operate in industry $_s$. Bank A is the main bank of firm i_s, bank B is the main bank of firm j_s. Banks A and B are identical, except for their client portfolio. Each bank has only two firms in its portfolio. Bank As portfolio consists of firm is and identical firm ks which operates in the same industry; for short PA(j_s, k_s). It is further assumed that industry $_s$ consists only of three firms i_s, j_s and k_s. Bank Bs portfolio encompasses firm j_s and identical firm lt from a different industry $_t$; in short *PB(j_s, l_t)*. We will develop a purely comparative argument for the R&D investments of firms is and j_s. We make the following assumptions: All firms have equal propensities to invest in R&D. The underlying uncertainties and adverse selection problems for the particular R&D investments are identical for bank A and B. They are fully exogenous to each bank. However, the portfolio composition can provide bank A with an information advantage over bank B. Firms can overcome endogenous uncertainties through various forms of R&D, market research, prototyping, simulations, etc. Hence, there is a pool of relevant information produced by firms in the industry. All firms reveal information to their main banks through their transactions and loan applications. Substantial parts of this information can be expected to be private and not available to the general public. This information may include competitive interactions, future product and market plans as well as revenue streams (Boot and Thakor, 2000). It is important to note that the private information is produced by the individual firm and only aggregated by its main bank which is uniquely positioned to do so. The bank does not necessarily learn in the narrow sense of exploring causal relationships but benefits from information externalities based on its client portfolio (Stiglitz, 2002). It is an externality because the bank does not directly and economically reimburse its other clients for the provision of this particular information. Hence, bank A and bank B draw from different pools of information in their lending decisions. The bank with the more relevant information can be expected to be in a position to assess risk premiums for individual firms more accurately than the general, high-risk premium. As a result, more funds will be available to its clients and, all

other things being equal, the firm doing business with this bank should be able to make a comparatively greater investment in R&D.

The relevance of the information externality of the main bank for firms is and j_s is greatest if the information stems from a similar technological and market context, i.e. from competitors in the same industry (Dussauge et al., 2000). Hence, *PA(i_s, k_s)* can be expected to deliver more relevant information externalities than *PB(j_s, l_t)* because bank A can obtain information from firm ks which operates in the same industry as is. Given that the pool of relevant information is finite, i.e. from all firms in a given sector, a bank that has a greater number of such firms as its clients is more likely to benefit from information externalities. Hence, information asymmetries between bank A and bank B emerge from their market share with firms in sector $_s$.

In a typical loan application process a bank will benchmark the information of a prospective borrower against key figures from its other clients in the same sector. This comparison is often times based on information stemming from other lending contracts which is not publicly available. The quality of such benchmarks is expected to be higher for banks that draw from a larger pool of industry information than banks with a comparatively narrower pool. In theory, firms could be expected to avoid certain banks in the first place because of the danger of unintentional knowledge spillovers to competitors. However, in reality strong safeguards are in place to prevent banks from revealing information about one client to another client. The penalties would be high both in terms of legal liability and a lose of reputation (e.g. (Degryse and Ongena, 2001)). In sum, all firms in an industry produce a pool of information with the potential to reduce R&D uncertainties but some banks have access to a larger share of this information than others. We propose:

Hypothesis 1 *R&D investment of a firm increases with the degree of market share of its main bank in its industry.*

However, the degree of composition of its client portfolio is not an isolated information provision tool for the bank. A high degree of specialization in one industry would also imply that the risks involved from the technology or market side are highly correlated. This follows the basic rationale that banks manage the risks originating from their clients for the portfolio as a whole rather than individually (Markowitz, 1991). Banks can reduce the systemic risk of the overall portfolio by combining uncorrelated risks (Markowitz, 1952). Following this portfolio theory logic, *PA(i_s, k_s)* contains more risk than *PB(j_s, l_t)* because the risks originating from firms j_s and l_t can be expected to be less correlated since they operate in different sectors, i.e. market and technology environments, respectively. Bank A can be expected to demand a higher risk premium from its client i_s than does bank B from j_s based solely on the risk exposure of its portfolio. As a result, available funds for is should be comparatively lower, resulting in less R&D investment. We suggest:

Hypothesis 2 *R&D investment of a firm decreases with the degree of specialization of its main banks corporate client portfolio in its industry.*

3.4 Description of the Data Set

We construct a unique panel data set for testing the theoretical predictions. Data requirements are extensive because comprehensive information is required for banks and their client portfolio across multiple industries. What is more, the bank information needs to be linked to firm R&D investment. We achieve this by linking multiple databases in Germany.

The crucial starting point is the MUP. This is a firm-level database collected by *Creditreform*, the leading credit rating agency in Germany. The *Creditreform* data cover nearly the entire population of 3 million German firms. The *Creditreform* data are also the German input for the widely used AMADEUS database. *Creditreform* provides credit information and insurance services based on its data. Hence, the *Creditreform* data covers information that allows an assessment of a firm's credit worthiness. Most importantly for our study, it contains firms bank relationships, including the bank that firms' consider as their main bank. Data quality can be considered to be high since keeping information on financial solvency and relationships up to date is a core part of Creditreforms business model and firms are not overly concerned about revealing their bank relationships (similar information could be found on a typical invoice).

Given the population character of the database, we can calculate the industry composition of each banks client portfolio. The bank information is very precise based on the German eight-digit bank code, which allows a precise identification of the banks location and type (e.g. private bank vs. *Sparkasse*). Based on this information, we can track 2,432 banks. The banking code is mandatory for banks in Germany for obtaining a banking license. Coverage is therefore not limited. It should be acknowledged that the database does not contain information on the extent of each banks lending engagement with individual firms. To the best of our knowledge, no such database is publicly available or accessible.

We link this data set to the MIP which provides information on firm R&D investment; the dependent variable of our analyses. The data set is drawn as a representative, stratified random sample based on the German MUP firm population. In contrast to other studies analyzing bank-based financing for innovation we can therefore form perfect matches between the two databases, i.e. we do not have to rely on regional banking indicators (e.g. Benfratello et al. (2008)) or heuristic matching. The MIP survey is conducted annually by the ZEW on behalf of the German Federal Ministry of Education and Research.

The MIP survey targets R&D decision makers. These can be heads of R&D departments, innovation managers or CEOs which is most likely the case in smaller firms where no elaborate functional structures exist. Several mechanisms are in place to secure the quality of the survey and its results. All core constructs in the survey follow the OECDs Oslo Manual on measuring innovation inputs, outputs and processes (OECD, 2005). Furthermore, the MIP is the German contribution to the Community Innovation Survey (CIS) of the European Union. CIS methodology and questionnaires have been refined over the years in international application. They are subject to extensive pre-testing and piloting in various countries, industries and firms with regard to interpretability, reliability and validity (Laursen and Salter, 2006). This multinational application of CIS guarantees

quality management and assurance.

The merged dataset contains precise identifiers for the European Patent Office statistics as well as the Bureau van Dijk ZEPHYR since it is also the basis for the AMADEUS database. The former linkage allows us to obtain the number of patents granted to each firm, the second one tracks venture capital investments.

The degree of uncertainty (both exogenous and endogenous) is not equally distributed across all industries. Some industries follow at least partially predictable technological trajectories while others experience discontinuous and hence uncertain changes (Dosi, 1982). The latter follow innovation patterns which are closer to scientific discovery. Knowledge is a crucial input for firms in these high-tech sectors and the underlying uncertainties in its production are therefore especially pronounced. They require a research stage within firm R&D, which is not yet directed at a particular product. Technological and market potentials are highly uncertain at this stage compared to the development stage in which potential revenue streams are beginning to emerge (for a recent review see Czarnitzki et al. (2011). We argue that the distance to application increases the uncertainty of the innovation activities in an industry. This, in turn, increases the potentials for benefitting from information asymmetries because the final resolution of fundamental uncertainties through observable market success is further removed in the future. At the same time, the risk of financing R&D increases if potential revenue streams are further delayed in the future (Czarnitzki et al., 2011). In this analysis we restrict our sample to firms in medium-tech manufacturing, high-tech manufacturing, or knowledge intensive service industries. An industry is defined as either low-, medium-, or high-tech based on the average R&D intensity of firms in the respective General Industrial Classification of Economic Activities in the European Communities (NACE) three digit class. The final data set contains 5,134 observations from 3,166 firms between 2002 and 2007 encompassing firm, innovation and R&D characteristics, bank information, patent activity and venture capital investments.

3.5 Empirical Model

A logical inference from our theoretical reasoning is that some firms may not be able to invest in R&D at all, i.e. their R&D investment equals zero. Hence, a technique is required that takes into account that the dependent variable is censored at zero. We estimate censored panel regression models. In particular we estimate random effects Tobit models. Fixed effects Tobit models are only beginning to emerge and existing approaches have been criticized for delivering inconsistent estimates as well as being overly demanding on assumed data and variation (Cameron and Trivedi, 2005; Grimpe and Kaiser, 2010). The inconsistency stems primarily from the finite nature of empirical samples. Non-linear, fixed-effects models suffer especially from inconsistency issues because estimates are more likely to be influenced by incidental parameters (Neyman and Scott, 1948; Heckman, 1987). Inconsistencies can be assumed to be reduced if the sample encompasses more than eight time periods and random effects estimators are more commonly applied (Cameron and Trivedi, 2005). Given our data availabilities we opt for a random effects model. We run several model specifications and include the independent variables of interest stepwise.

As discussed above our interest is whether and how firm R&D investment is influenced

by its main bank relationship, and in particular by the main banks' portfolio characteristics. We estimate the following equation:

$$
\begin{aligned}
\text{R\&D activity/intensity} \;=\; & \beta_0 \text{ Constant} \\
& \left.\begin{array}{ll}
+ & \beta_1 \text{ Bank industry spec.} \\
+ & \beta_2 \text{ Bank industry share} \\
+ & \beta_3 \text{ Bank size} \\
+ & \beta_4 \text{ Bank spatial spec.} \\
+ & \beta_5 \text{ Bank type}
\end{array}\right\} \text{Firms' main-bank} \\
& + \beta_6 \text{ Firm controls} \\
& + \beta_7 \text{ Industry controls} \\
& + \beta_8 \text{ Year controls}
\end{aligned}
\tag{3.1}
$$

In Table 3.1, we provide descriptive statistics for the sample as well as a comprehensive overview of variable observation, definitions, and scales. As the dependent variables we use R&D activities and R&D intensity. R&D activities is an indicator variable equals one for firms with R&D expenditures. Within the panel nearly half of the firms invested in R&D. This high figure reflects the restriction on industries with above average R&D expenditures. On average R&D expenditures to sales were 4%. Restricting to R&D active firms R&D expenditures to sales was nearly 8%.

Firm-bank relationship information is observed in the MUP. The majority of firms have a main relationship with a private bank. *Sparkassen* serve as main-bank relationship for 30% of all sample firms, *Landesbanken* for 4% and cooperative banks for 17%. Compared to the underlying population (the MUP) private banks show larger market shares for the sample at hand. This can be explained by two factors: First, on average, sample firms are larger. Second, we focus on high-tech industries only. Analyses based on the MUP reveal that large, private banks have higher market shares in in both groups.

Bank portfolio information is provided by the ZEW Banking Panel and with respect to the firms' main bank relationship as observed in the MUP. *Bank size* (β_3) is often used as a proxy for organizational hierarchic structure and measured by total assets (Berger and Black, 2011). In public available bank balance sheet data sets, such as Bankscope, total assets is missing for many especial small banks. We therefore measure *Bank size* as the number of people employed by firms' the bank serves as main-bank. In the main regression we divide the four large banks (*Deutsche Bank*, *Dresdner Bank*, *Commerzbank*, and *HypoVereinsbank*) into regional subdivision based on the 2 digit German banking code. As robustness we will present also regressions with the total size. The spearman rank correlation between total assets provided by Bankscope and bank size used in the paper varies between 0.7163 and 0.7358 in the years 2002-2006.

Our two main identifying variables are *Bank industry specialization* (β_1) and *Bank industry share* (β_2). *Bank industry specialization* is the share of a firm's industry within the banks' portfolio. On average, the share of a firms' industry in the bank portfolio is 7%. We expect the coefficient of the variable *Bank industry specialization* being negative (see Hypothesis 1). *Bank industry share* instead, is the share of firms in the industry (on NACE 2 digit) served by this particular bank. On average the banks' market share in the industry within Germany is 4‰. We expect the coefficient of the variable *Bank industry share* being positive (see Hypothesis 2). We consider that both variables are

not correlated. Consider a niche industry as an example. A bank could serve the whole industry (*Bank industry share* equals one) but because this industry is small the industry would make only a small fraction within the bank's portfolio.

Table 3.1: Descriptive statistics

Variable	Mean	S.D.	Min	Max	Description
R&D activity	0.498	0.500	0	1	1 if for firms with R&D expenditures
R&D intensity	0.039	0.106	0	1	$= \frac{\text{R\&D expenditures}}{\text{Sales}}$
Bank size	65,586	86,751	98	547,715	$= \sum Firms_{i,b} \times Employees_{i,b}$
Bank industry specialization	6.691	8.192	0.008	85.049	$= \frac{\sum Firms_{i,b,NACE2dig} \times Employees_{i,b,NACE2dig}}{\text{Bank size}_b} \times 100$
Bank industry share	0.365	0.573	<0.001	4.301	$= \frac{\sum Firms_{i,b,NACE2dig} \times Employees_{i,b,NACE2dig}}{\sum Firms_{i,NACE2dig} \times Employees_{i,NACE2dig}} \times 100$
Bank spatial specialization	0.650	0.348	0	0.998	$= \frac{\sum Firms_{i,b,d} \times Employees_{i,b,d}}{\sum Firms_d \times Employees_{i,d}}$
Non-private banks	0.459	0.498	0	1	1 if main bank relationship with a Sparkasse, Landesbank, or Cooperative bank
No. of bank relations	2.071	1.183	1	6	Number of bank relationships
Switch of bank relation	0.148	0.356	0	1	Switch of main bank relationship within the last three years
Return on sales previous year	0.030	1.003	-1.416	2.064	$\frac{\text{Return class./.Avg. of Return class}}{\text{S.D. of return class}}$
No. of employees	146.257	339.605	1	4,329	$= \sum Employees_i$
Patentstock per empl. prev. Year	0.002	0.008	0.000	0.071	$\frac{\sum Patent_i}{\sum Employees_i}$
Firm age	15.793	12.855	1	98	Company age since foundation in years
Gov. R&D subsidy	0.202	0.402	0	1	1 if firm received public R&D subsidies in the year of observation
Credit rating	−0.001	0.823	-3.055	5.113	$\frac{\text{Rating./.Avg. of rating}}{\text{S.D. of rating}}$
Public stock company	0.041	0.198	0	1	1 if firm has a legal form of a stock company ("Aktiengesellschaft")
Private Equity	0.005	0.070	0	1	1 if firm received Private Equity since foundation
Part of company group	0.389	0.488	0	1	1 if firm is part of group company
Location east Germany	0.383	0.486	0	1	1 if firm is located in eastern Germany
Medium-tech-manuf.†	0.418	0.493	0	1	1 if firm is a medium-tech manufacture
High-tech manuf.	0.121	0.326	0	1	1 if firm is a high-tech manufacture
Knowledge-intens. services	0.461	0.498	0	1	1 if firm provides knowledge intensive services
Year 2003†	0.209	0.406	0	1	1 if your of observation is 2003
Year 2004	0.083	0.276	0	1	1 if your of observation is 2004
Year 2005	0.253	0.435	0	1	1 if your of observation is 2005
Year 2006	0.172	0.377	0	1	1 if your of observation is 2006
Year 2007	0.284	0.451	0	1	1 if your of observation is 2007
No. of banks in district	38.300	28.948	9	139	Number of banks operating at least one branch in firm's district
No. of firms in district	13,023	20,521	726	90,833	Number of firms located in the district
Bank intensity (district)	0.005	0.002	0.001	0.017	$= \frac{\sum Banks_d}{\sum Firms_d}$
Local banking market competition	0.008	0.003	0.001	0.049	$= \frac{\sum Firms_d \vert \text{main bank switch}}{\sum Firms_d}$

Note: This table presents descriptive statistics of the main explanatory variables used. In this table, I use the following indices and abbreviations: i for firm; b for bank; d for district; NACE2dig for the 2 digital code of the NACE industry classification.
† Serve as base category in regressions.
Source: MIP and MUP (ZEW) 2012, author's own calculations.

Next to main bank relationships, the MUP contains up to five additional bank relationships per firm. The average number of bank relationships within the sample is two. The Panel structure of the MUP allow to observe a switch of the firm-main bank relationship. Nearly 15% of sample firms switched their main bank relationship within the previous 3 years.

The following variables are used as firm control variables. Average firm size of panel firms is 146 employees. The largest sample firm has 4,329 employees. We further control for the fact that the firm is part of a larger company group. *Return on sales* is provided in classes. In order to employ a single variable we generated a standardised index. On average firms hold two Patents per 1,000 employees. Both variables, return on sales and patent stock per employees, are with respect to previous year. 20% of the sample firms received governmental R&D subsidies while 5‰used private equity. Most sample firms are incorporated as limited company. 4% of sample firms have the legal form of a stock company. We further control for industries and year of observation. We present industry

definitions in table 3.7.

For the instrumental variable approach we use further variables describing the local banking market. We consider a bank to be active in the firms' district if the bank operates at least a single bank in that district. On average there are 38 banks active per district. We count the number of firms that are located in a district. On average 13,000 firms are located in a district. The largest district in terms of number of firms is Berlin (90,000 firms). With approximately 3.4 million inhabitants Berlin is by far the largest district with a large industry share of trade, retailers and services. On average, there are 5 banks active in a district per 1,000 firms. We measure local banking market competition as the share of firms in a given district that recently switched their main-bank relationship. The mean district switching rate is 8‰. The district with the highest switching rate, that is considered as the one with the most competitive banking market, has a switching rate of 5%. We further use the concentration of the local banking market measured as the sum of squared market shares in main-bank relationships in a district.

We inspect the data set for multicollinearity based on correlations and variance inflation factors and find no evidence by any conventionally applied standard (e.g. Chatterjee and Hadi (2006). The mean variance inflation factor equals 1.63 with the highest individual variance inflation factor equaling 3.94.

3.5.1 Results

Main Results - Main bank industry specialization and market share Table 3.2 presents the estimation results of the logit and tobit models testing hypotheses 1 and 2. Specification (1)-(3) presents the results for the logit model. Specification (1) contains only control variables and can serve as a benchmark for all other models. Significant effects remain stable across models and the quality of model fit increases (log likelihood and Chi squared test). Specification (2) further includes banking related variables. Specification (3) includes the main effects of bank specialization and industry market share. Specification (4)-(6) presents the results for the Tobit model. In Specification (4) and (5) we either use bank industry specialization or bank industry share. In specification (6), we present the full set of variables.

The effect of bank specialization is negative and highly significant, supporting hypothesis 2. A banks market share in the focal firms industry has a positive and highly significant effect on R&D investment. Hence, hypothesis 1 is supported, too. We calculate effect sizes based on a one standard deviation difference from the average in main bank industry specialization and market share. In Table 3.3, we present the marginal effect of R&D activity (Specification (1) and (2)) and R&D intensity (Specification (3)). Bank industry specialization reduces firm R&D activity as well as intensity. Bank industry share increases both. Hence, the effects are not just significantly different from zero but also have a sizeable impact on firm R&D. This result reinforces the theoretical logic that both portfolio and information externality theory can inform predictions of firm R&D investment through the main banks client portfolio. A firms main bank with a larger market share in the industry allows more firm R&D spending while the increasing industry specialization within a banks portfolio allows less.

Table 3.2: Main results (coefficients) – Main-bank characteristics and firm's R&D activity

Model	Logit			Tobit		
Dependent Variable	R&D activity			R&D intensity		
	(1)	(2)	(3)	(4)	(5)	(6)
Bank industry			-0.026^{***}	-0.002^{***}		-0.003^{***}
specialization			(0.006)	(0.000)		(0.001)
Bank industry share			0.264^{**}		0.013^{**}	0.022^{***}
			(0.090)		(0.006)	(0.006)
Bank size (ln)		-0.045	-0.121^{**}	-0.001	-0.002	-0.006^{*}
		(0.039)	(0.045)	(0.003)	(0.003)	(0.003)
Bank spatial		0.013	0.036	0.000	0.000	0.000
specialization		(0.153)	(0.154)	(0.000)	(0.000)	(0.000)
Sparkassen and		-0.383^{**}	-0.414^{***}	-0.038^{***}	-0.029^{***}	-0.035^{***}
cooperative banks		(0.117)	(0.119)	(0.008)	(0.008)	(0.008)
No of bank relations		0.057	0.062	-0.001	-0.002	-0.001
		(0.041)	(0.041)	(0.002)	(0.002)	(0.002)
Switch of bank relation		0.137	0.122	0.013	0.013	0.012
		(0.106)	(0.106)	(0.008)	(0.008)	(0.008)
Return on sales	0.048	0.053	0.054	-0.007^{**}	-0.007^{**}	-0.007^{**}
(t-1, stand. index)	(0.041)	(0.041)	(0.041)	(0.003)	(0.003)	(0.003)
Patent stock	48.879^{***}	47.979^{***}	47.237^{***}	2.105^{***}	2.172^{***}	2.119^{***}
per employees (t-1)	(12.573)	(12.488)	(12.405)	(0.382)	(0.393)	(0.376)
No of employees (logs)	0.218^{***}	0.185^{***}	0.201^{***}	-0.002	-0.004	-0.002
	(0.030)	(0.032)	(0.033)	(0.002)	(0.002)	(0.002)
Firm age (years, ln)	-0.169^{**}	-0.205^{***}	-0.207^{***}	-0.013^{***}	-0.013^{***}	-0.013^{***}
	(0.055)	(0.059)	(0.059)	(0.004)	(0.004)	(0.004)
Gov. R&D subsidy	3.457^{***}	3.451^{***}	3.441^{***}	0.178^{***}	0.180^{***}	0.178^{***}
	(0.156)	(0.155)	(0.155)	(0.010)	(0.010)	(0.010)
Credit rating	-0.069	-0.057	-0.053	0.001	0.001	0.001
(stand. index)	(0.053)	(0.054)	(0.054)	(0.004)	(0.004)	(0.004)
Public stock company	0.998^{***}	0.962^{***}	0.898^{***}	0.034^{**}	0.039^{***}	0.034^{**}
	(0.243)	(0.240)	(0.237)	(0.014)	(0.014)	(0.014)
Private Equity	1.819^{**}	1.777^{**}	1.644^{*}	0.118^{*}	0.131^{**}	0.119^{*}
	(0.630)	(0.649)	(0.646)	(0.063)	(0.063)	(0.062)
Part of company group	0.361^{***}	0.319^{***}	0.296^{**}	0.01	0.01	0.009
	(0.089)	(0.091)	(0.091)	(0.006)	(0.006)	(0.006)
East Germany	-0.477^{***}	-0.555^{***}	-0.564^{***}	-0.019^{***}	-0.014^{**}	-0.017^{**}
	(0.096)	(0.100)	(0.101)	(0.007)	(0.007)	(0.007)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.791^{***}	-0.061	0.684	-0.017	-0.015	0.029
	(0.202)	(0.492)	(0.530)	(0.034)	(0.036)	(0.036)
sigma						
Constant				0.145^{***}	0.146^{***}	0.145^{***}
				(0.007)	(0.007)	(0.007)
Observations	5314	5314	5314	5314	5314	5314
LR Chi2	-2615.89	-2601.9	-2584.56			
log likelihood				73.68	52.24	83.39

Note: Clustered standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: MIP and MUP (ZEW) 2012, author's own calculations.

Control variables All models contain an identical set of control variables. Their influence on firm R&D intensity is consistent across all models with regard to significance levels and directions. We have not developed theoretical predictions for any control variables but significant effects should be discussed briefly. First, it is noteworthy that out of all control variables at the bank level bank size and the type of bank have a significant influence on firm R&D investment. An average firm working with a *Sparkasse* or cooperative main bank invests significantly less in R&D. This result supports other studies (Haselmann et al., 2009) which emphasize the inefficiencies in bank decision making induced by political influence through government ownership (Porta et al., 2002; Sapienza, 2004). Further more, large banks, especially the large private banks, are more likely to have sufficient cases in a certain industry to build an in-house competence center. This might not be reflected in the variables industry specialization or share. The large private banks also do not have a mandate to serve for any firm but can strategically invest in competence of specific industries or technological fields. Large private banks also have more direct international connections that might be beneficial for exporting firms with high R&D investments. In order to rule out potential endogeneity problem due to high correlation between R&D investment and exporting we did not incorporate export information in the regressions.

Table 3.3: Main results (marginal effects) – Main-bank characteristics and firm's R&D activity

Model	Logit	Tobit	
Dependent Variable	R&D activity	R&D intensity	
	(dydx)	$\Pr > 0$	$\mathrm{E}(\frac{R\&D}{Sales} \mid > 0)$
	(1)	(2)	(3)
Bank size (ln)	−0.019**	−0.015*	−0.002*
	(0.045)	(0.003)	(0.003)
Bank industry specialization	−0.004***	−0.007***	−0.001***
	(0.006)	(0.000)	(0.000)
Bank industry share	0.042**	0.057***	0.006***
	(0.090)	(0.006)	(0.006)
Bank spatial specialization	0.006	0.028	0.003
	(0.154)	(0.010)	(0.010)
Sparkassen and cooperative banks	−0.067***	−0.094***	−0.011***
	(0.119)	(0.008)	(0.008)
No of bank relations	0.01	−0.002	0.000
	(0.041)	(0.002)	(0.002)
Switch of bank relation	0.02	0.032	0.004
	(0.106)	(0.008)	(0.008)

Note: Clustered standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: MIP and MUP (ZEW) 2012, author's own calculations.

R&D intensity increases with firm size but decreases with firm age. Similarly, incorporated firms having access to the stock market invest more in R&D. This provides evidence for the close relationship between overall resource availability for R&D investments (Ahuja et al., 2008) as well as R&D as part of a growth strategy for young firms (King et al.,

1993). Similarly, the negative relationship between return on sales and R&D investment can be interpreted as an investment in generating the potential for future revenue streams in which the positive performance effects of current R&D are on average, four to five years removed (Pakes and Schankerman, 1984). The significant industry dummies (medium tech manufacturing is the reference group) indicate that the R&D investment is a direct reflection of technological opportunities and competitive pressures. R&D investment increases with the knowledge intensity of the industry in both manufacturing and services. Low knowledge-intensive service sectors such as transportation are the exception reflecting fewer technological opportunities (e.g. Lyons et al. (2007)).

3.5.2 Consistency and Robustness Checks

We estimate several additional empirical specifications to demonstrate the robustness of our findings. In Table 3.4, we present different variations of our main model. In specification (1) we control for firm and in specification (2) for bank fixed effects. We find, that the effects of our main explanatory variable remain stable. Above, we discussed potential differences of the effect on firm R&D investment between bank types. In specification (3) and (4) we split the sample between private and non-private (*Sparkassen*, *Landesbanken*, and cooperative banks) in order to check whether firm R&D investment is driven by the type of its main-bank. The core findings on the effects of main bank market share and sector specialization remain intact for both sub-samples. We further follow up on the results of the control variables regarding significant differences for *Sparkassen* and cooperative banks. We have dedicated controls for bank size and geographic scope in every model. However, banks may also differ in their structure. Especially large private banks with a national branch system can benefit from accessing the knowledge pool/risk diversification of the group as a whole. We recalculate all portfolio variables at the group level and present the results in specification (5). Our core findings remain stable indicating that the effects are not dependent on assumptions about the aggregation level of the banks or limited to certain bank types.

Finally, our theoretical argument is strictly comparative in nature and combinations of firms and their main bank are assumed as given. This is largely in line with our descriptive statistics indicating that 85% of the firms in our sample did not switch their main bank during the three year observation period. Nevertheless, firms and banks have made choices about this relationship at a certain point in time but this selection is unobservable to us. In order to test, whether the bank choice is correlated with the error term and may therefore bias the results, we estimate an additional instrument variable tobit model. The only bank choice variable available to us is whether the firm has changed its main-bank in the preceding three years. We use this variable as the dependent variable in the first stage equation of the instrument variable estimation (Table 3.5).

Table 3.4: Robustness checks – Model variation

	Fixed Effects		Bank type		Bank Unit
	Firm	Bank	Private	Non-Private	
	(1)	(2)	(3)	(4)	(5)
Bank industry specialization	−0.001**	−0.003***	−0.003***	−0.003***	−0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bank industry share	0.020***	0.027***	0.021***	0.064***	0.001**
	(0.007)	(0.007)	(0.007)	(0.024)	(0.001)
Bank size (ln)	−0.008*	−0.010**	−0.008*	−0.007*	−0.005*
	(0.005)	(0.005)	(0.004)	(0.004)	(0.003)
Bank spatial specialization	0.000*	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sparkassen and cooperative banks	0.011	−0.141**			−0.053***
	(0.016)	(0.062)			(0.018)
No. of bank relations	0.005	0.000	−0.004	0.003	−0.001
	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
Switch of bank relation	−0.007	0.009	0.012	0.013	0.012
	(0.006)	(0.008)	(0.011)	(0.013)	(0.008)
Return on sales (stand. index, t-1)	−0.003	−0.008**	−0.009**	−0.004	−0.007**
	(0.002)	(0.003)	(0.004)	(0.004)	(0.003)
Patent stock per employee (t-1)	−0.527	2.006***	2.237***	1.815***	2.071***
	(0.400)	(0.442)	(0.592)	(0.361)	(0.370)
No. of employees (ln)	0.01	−0.003	0.002	−0.006	−0.002
	(0.008)	(0.003)	(0.004)	(0.004)	(0.002)
Company age (years, ln)	0.023*	−0.012***	−0.011**	−0.015***	−0.013***
	(0.012)	(0.004)	(0.005)	(0.006)	(0.004)
Gov. R&D subsidy	0.020***	0.171***	0.183***	0.168***	0.177***
	(0.005)	(0.010)	(0.013)	(0.015)	(0.010)
Credit rating (stand. index)	0.009	0.002	0.001	0.000	0.002
	(0.015)	(0.005)	(0.006)	(0.006)	(0.004)
Public stock company	0.155*	0.030**	0.025*	0.04	0.032**
	(0.079)	(0.014)	(0.015)	(0.026)	(0.014)
Private Equity	0.071**	0.118*	0.135*	0.045	0.116*
	(0.033)	(0.066)	(0.076)	(0.031)	(0.063)
Part of company group	−0.017***	0.006	−0.005	0.026***	0.01
	(0.005)	(0.007)	(0.008)	(0.009)	(0.006)
Location east Germany	−0.006	−0.023***	−0.016*	−0.017	−0.017***
	(0.051)	(0.009)	(0.009)	(0.011)	(0.007)
Industry dummies	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
Constant	0.155*	0.123**	0.033	0.039	0.039
	(0.083)	(0.049)	(0.056)	(0.043)	(0.037)
Sigma constant	0.050***	0.134***	0.148***	0.139***	0.144***
	(0.001)	(0.006)	(0.008)	(0.010)	(0.007)
Observations	5314	5314	2875	2439	5314
log likelihood	3967.86	529.13	140.19	−39.52	99.03

Note: Clustered standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: MIP and MUP (ZEW) 2012, author's own calculations.

Table 3.5: Robustness check – IV-approach main-bank switch

Model	Bank intensity		No. of banks		Banking market competition		Banking market concentration		Intensity & Competition		Competition & Concentration	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Bank intensity		−8.156***								−8.595***		
		(2.859)								(2.827)		
No. of active banks (ln)				0.023*								
				(0.012)								
Share of bank switches						6.659***				6.257***		5.810***
						(1.826)				(1.991)		(1.878)
HHI Banking market								−0.173***				−0.135**
								(0.063)				(0.064)
Bank industry	−0.002***	−0.001	−0.002***	−0.001	−0.003***	−0.001	−0.003***	−0.001	−0.003***	−0.001	−0.003***	−0.001
specialization	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bank industry share	0.018**	0.014	0.017*	0.012	0.022***	0.013	0.021***	0.012	0.020***	0.014	0.021***	0.012
	(0.007)	(0.014)	(0.009)	(0.014)	(0.006)	(0.014)	(0.007)	(0.014)	(0.006)	(0.014)	(0.006)	(0.014)
Bank size (ln)	−0.004	−0.014**	−0.002	−0.013**	−0.006*	−0.010*	−0.005	−0.009	−0.005	−0.015**	−0.005*	−0.010*
	(0.004)	(0.006)	(0.005)	(0.006)	(0.003)	(0.006)	(0.003)	(0.006)	(0.003)	(0.006)	(0.003)	(0.006)
Bank spatial	0.000	−0.001***	0.001	−0.001***	0.000	−0.001***	0.000	−0.001***	0.000	−0.001***	0.000	−0.001***
specialization	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sparkassen and	−0.046***	0.045***	−0.052***	0.045***	−0.036***	0.044***	−0.039***	0.042***	−0.040***	0.048***	−0.037***	0.044***
cooperative banks	(0.012)	(0.016)	(0.018)	(0.016)	(0.010)	(0.016)	(0.011)	(0.016)	(0.010)	(0.016)	(0.009)	(0.016)
No of bank relations	−0.001	0.002	−0.001	0.002	−0.001	0.002	−0.001	0.001	−0.001	0.002	−0.001	0.001
	(0.003)	(0.006)	(0.003)	(0.006)	(0.002)	(0.006)	(0.002)	(0.006)	(0.002)	(0.006)	(0.002)	(0.006)
Switch of bank relation	0.268		0.398		0.021		0.091		0.128		0.046	
	(0.177)		(0.341)		(0.109)		(0.174)		(0.115)		(0.108)	
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.037	0.365***	−0.071	0.229***	0.027	0.220***	0.009	0.303***	−0.001	0.334***	0.021	0.259***
	(0.064)	(0.082)	(0.103)	(0.071)	(0.048)	(0.071)	(0.057)	(0.072)	(0.051)	(0.083)	(0.047)	(0.073)
alpha constant		−0.257		−0.386		−0.009		−0.079		−0.117		−0.034
		(0.176)		(0.341)		(0.110)		(0.174)		(0.116)		(0.108)
Ins constant		−1.930***		−1.930***		−1.930***		−1.930***		−1.930***		−1.930***
		(0.046)		(0.046)		(0.046)		(0.046)		(0.046)		(0.046)
Inv constant		−1.050***		−1.049***		−1.051***		−1.050***		−1.052***		−1.051***
		(0.017)		(0.017)		(0.017)		(0.017)		(0.017)		(0.017)
Observations	5,314		5,314		5,314		5,314		5,314		5,314	
LR Chi2	393.48		342.67		455.92		447.22		438.92		453.69	
log likelihood	-1,874.99		-1,878.69		-1,873.94		-1,877.41		-1,866.81		-1,870.65	

Note: Clustered standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: MIP and MUP (ZEW) 2012, author's own calculations.

We rely on four regional variables (district level) as instruments: the number of bank operating a branch within a district (ln), bank intensity (number of banks related to number of firms in the district), the share of firms switched their main-bank relationship in the previous year, and the concentration of the regional banking market. In table 3.5 we present six specifications. Columns with even numbers show coefficients on the instrumental variable bank switch. Columns (2), (4), (6), and (8) show that each single variable is statistically significant at least on the 10% level. Firms in regions with more active banks have a higher probability switching the main bank (column(4)). Once the firm population is taken into account the effect turns negative (column (2)). Firms are less likely to switch in concentrated banking markets (column (8)) and more likely in markets with high competition (column(6)). In column (10) we jointly use bank intensity and competition and in column (12) competition and concentration. The instruments are jointly significant at the 98% significance level. We conduct an additional Sargan test on potential overidentification which is rejected. Columns with uneven numbers contains the coefficients of the Tobit estimation results related to the dependent variable R&D intensity with the bank change being instrumented. Estimation results on our main hypothesis tests remain stable. In sum, we are confident that our empirical analyses provide reliable tests of our theoretical framework.

3.5.3 Signaling

So far, we have considered mechanisms only on the bank side and their ability to overcome information asymmetries through externalities. However, firms have additional opportunities to overcome the information asymmetries by signaling the value of their R&D activities. We follow Ndofor and Levitas (2004) and define a signal as *"conduct and observable attributes that alter the beliefs of, or convey information to, other individuals in the market about unobservable attributes and intentions."* This is a deviation from the theory outlined in the previous section as firms i_s and j_s in the model are no longer considered to be identical. They differentiate themselves through firm-specific signaling. A credible signal will allow a bank to provide a more accurate risk assessment on a firms R&D investment, resulting in more available funds and subsequently increased R&D investment. We will explore signals based on firm's past actions (patenting) as well as legitimacy that can be transferred from ties to established actors and institutions (government R&D subsidies and venture capital investors).

The value of signaling through past actions is rooted in theory of firm reputation (Rindova et al., 2005). Levitas and McFadyen (2009) investigates the value of patents as signals for attracting venture capital investors and corroborates it for a sample of firms from the pharmaceutical industry. Patents are a tangible representation of a successful innovation. Moreover, the patent office requires a certain degree of novelty in order to grant a patent (Encaoua et al., 2006). The existence of a patent therefore also allows inferences to be drawn about the quality of the underlying R&D. Patents can be interpreted as signals of future revenue streams. These may come from possessing a temporary advantage on the product market or through generating license fees (Levitas and McFadyen, 2009). Hence, a main banks risk concerns based on correlated risks in its client portfolio should

be reduced.

Other potential signals are not rooted in a firms past actions but in being associated with authoritative actors (Rindova et al., 2005). This perspective is rooted in institutional theory. Organizations can gain legitimacy and hence access to resources through external validation in establishing institutional linkages with established institutions or succeeding in contests (Baum and Oliver, 1991; Rao, 1994). We focus predominantly on a firms ability to attract external funds for R&D or, more precisely, government R&D subsidies and venture capital investment. Venture capital investors are known to be highly selective in their investment decisions (Eckhardt et al., 2006). They monitor firms intensely, conclude growth/performance-oriented contracts, facilitate crucial personnel decisions and provide additional services (e.g. access to strategic alliances (Gompers and Lerner, 2001)). As a result, the chances that the firm will be successful in the future and generate positive returns should increase. On the basis of this signal, banks should therefore be able to provide additional funds for the firm and its R&D investment. Similarly, many governments provide R&D grants for firms to stimulate R&D investment. Information requirements in applications are extensive and competition for grants is intense (Czarnitzki and Toole, 2007). Successful grant awards are highly selective and can signal the exceptional value of an R&D project (Aerts and Schmidt, 2008; Kleer, 2010). Banks may therefore rely on this external assessment for overcoming information asymmetries.

Our main results in Table 3.2 show that the main effects of all of these factors are positive and significant. This is fully in line with existing research emphasizing complementarity effects of R&D with existing knowledge stocks embodied in patents (Cohen and Levinthal, 1989), as well as additional effects from government R&D subsidies (Aerts and Schmidt, 2008), and growth-oriented venture capital investments (Levitas and McFadyen, 2009). However, the signaling effect that these factors may have on a firms main bank is novel. We add separate multiplicative interaction effects with each factor and bank industry specialization and market share. We use separate models for each interaction to avoid potential issues arising from multicollinearity. In table 3.6 we present the results of the specification including interaction terms. Column (1) include interaction terms with firm's patent stock, column(2) with Venture Capital investment, and column (3) with governmental R&D subsidies.

All main effects remain stable. For the patent stock, only the interaction effect with the main banks degree of portfolio specialization is positive and significant (column (1)). The findings suggest that firm's capable to signal their R&D quality by their patent stock relax the main bank's need of diversification. A bank might consider that those firms are less affected by industry shocks. Firms received venture capital and simultaneously have a relationship with a bank that has a high market share in the firm's industry show significantly higher R&D investments in addition to both base effects. Input-oriented signals originating from successfully attracting government R&D subsidies (column (3)) fail to alter the risk assessments or information position of banks. We suspect that this is due to the fact that they are general in nature and can be interpreted positively even without in-depth industry experience of a bank.

Table 3.6: Robustness check – Signaling: Patent, VC, public R&D grant

	Patent stock (1)	Venture Capital (2)	Public R&D (3)
Bank industry	−0.003***	−0.002***	−0.003***
specialization	(0.000)	(0.000)	(0.000)
Bank industry share	0.023***	0.019***	0.020***
	(0.006)	(0.005)	(0.006)
Patentstock per empl.	1.730***	1.915***	1.934***
prev. year (ratio)	(0.336)	(0.313)	(0.315)
Int: Patents *	0.003**		
bank industry spec.	(0.001)		
Int: Patents *	−0.008		
bank industry share	(0.011)		
Private Equity	0.131***	0.114***	0.133***
	(0.031)	(0.031)	(0.031)
Int: Venture Capital *		0.051	
bank industry spec.		(0.028)	
Int: Venture Capital *		0.145***	
bank industry share		(0.037)	
Gov. R&D subsidy	0.115***	0.115***	0.108***
	(0.006)	(0.006)	(0.007)
Int: Gov. R&D subsidy *			0.001
bank industry spec.			(0.001)
Int: Gov. R&D subsidy *			0.007
bank industry share			(0.008)
Sparkassen and	−0.035***	−0.036***	−0.035***
cooperative banks	(0.007)	(0.007)	(0.007)
Bank size (ln)	−0.005	−0.005	−0.006*
	(0.003)	(0.003)	(0.003)
Bank spatial specialization	0	0	0
	(0.000)	(0.000)	(0.000)
No of bank relations	−0.001	−0.001	−0.001
	(0.003)	(0.003)	(0.003)
Switch of bank relation	0.003	0.003	0.003
	(0.006)	(0.006)	(0.006)
Further firm controls	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Constant	0.033	0.034	0.039
	(0.033)	(0.033)	(0.033)
Constant σ	0.123***	0.121***	0.123***
	(0.003)	(0.003)	(0.003)
Constant ϵ	0.085***	0.085***	0.085***
	(0.002)	(0.002)	(0.002)
Observations	5,314	5,314	5,314
LR Chi2	756	791	752
log likelihood	513.83	525.75	511.63

Note: Clustered standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: MIP and MUP (ZEW) 2012, author's own calculations.

3.6 Conclusion

In this study we question the general assumption that all banks suffer to the same degree from information deficits or asymmetries when providing funds for R&D intensive clients. We concede that banks cannot produce the necessary technological information themselves. They are, however, uniquely positioned to benefit from the information production of the firms in their client portfolio. Hence, they can benefit from an information externality which becomes important if the information is relevant to the technological and market environment of its clients, i.e. the bank has a large market share in the clients industry. We compare and contrast this effect with portfolio considerations and predict a negative relationship between a firms R&D investment and the industry specialization of its main bank. These theoretical predictions are supported by our empirical test for Germany based on a dataset that is, to our knowledge, unique in terms of variable coverage, representativeness, and comprehensiveness. With regard to the signaling that the firm can provide itself about the quality of its R&D, we find that only patents and venture capital provide valuable signals to banks, and not government R&D subsidies. These findings have major implications for academic research as well as for practical management and policy development.

Our core contribution to strategic management theory is to bring a differentiated perspective on the role of banks into the discussion of financing firm R&D. This factor has been absent within a theory stream that has acknowledged the shortage of funding for R&D (Cuervo-Cazurra and Annique, 2010) as well as its root causes of information being either not available or asymmetrically distributed (Vincente-Lorente, 2001). Ex-ante strategic management literature has emphasized attracting highly selective equity investors as the primary source of external funds for R&D (Chaddad and Reuer, 2009; Levitas and McFadyen, 2009). Our findings show that bank financing is a neglected variable in firms R&D decisions and that heterogeneity can be identified among banks based on information externality and portfolio theory. The findings show also that opportunities for signaling to banks are limited to reputation effects from past patent activity and venture capital investment.

These theoretical contributions have direct implications for management practice as banks are the primary provider of external financing for the vast majority of firms (Phelps and Tilman, 2010). Our theoretical and empirical findings are strictly comparative in nature and interpretations on opportunities of active search and selection (either through banks or firms) have to be made carefully. We find clear evidence that a firms main bank makes a significant difference in the availability of funds for R&D investment. Hence, it follows only logically that firms should be better off working with highly diversified banks. The positive effects of working with leading banks in a firms industry are limited to knowledge-intensive sectors. Interestingly, risk considerations stemming from specialization in a banks industry portfolio are a less pressing issue for firms with opportunities to signal the value of their R&D activities through patents. Venture Capital investments are recognized by bank's with high industry market shares but do not affect their need for diversification. Governmental R&D subsidies are, in themselves, valuable for firms but provide no further signaling effect to a firms main bank.

On the policy making side, we show that heterogeneities among banks have substantial implications for their client's R&D investment. This is of high relevance as many governments aim at strengthening private R&D investment as a tool for generating economic growth, employment and competitiveness. The European Unions Europe 20-20 Strategy provides a fitting example by targeting R&D investment of 3% of Gross Domestic Product (GDP) in its member states as a core objective. At the same time, bank regulation reform is a major topic in many countries following the recent, worldwide financial crisis. Our results provide a nuanced answer on the banks that can provide funding for firms and their R&D investment. We cast doubts on a general call for banks specializing in financing innovation. Banks with a broad industry portfolio are equally valuable because they can manage risks through diversification, especially for firms operating in more stable technological environments.

In sum, our research provides a novel perspective on the relationship between banks, their information availabilities and the R&D investment of their firms. This provides fruitful avenues for future research. First, we develop and test strictly comparative arguments. This is partly due to the fact that the vast majority of the firms in our sample (85%) never changes its main bank. However, more detailed insights into how firms and banks select these relationships would be an important addition to our current model both theoretically and empirically. Secondly, we are able to investigate our research question empirically for a large economy with a well-established, diverse financial system. However, European economies have been described as being especially reliant on bank financing. Comparative studies in Anglo-American settings could provide valuable insights into the international generalizability of our findings. Thirdly, we have focused on the firms R&D input side of the firm. Banks may influence not just overall R&D investment but also the nature of firm R&D as well as the outcomes. We suspect that this particular research question lends itself more to qualitative research but we are confident that our comprehensive, quantitative analyses provides a reliable basis for it.

3.7 Appendix

Table 3.7: Industry classification

Industry	NACE Code	Industry Group
Mining and quarrying	10-14	Low-tech manufacturing
Food and tobacco	15-16	Low-tech manufacturing
Textiles and leather	17-19	Low-tech manufacturing
Wood / paper / publishing	20-22	Low-tech manufacturing
Chemicals / petroleum	**23-24**	**Medium high-tech manufacturing**
Plastic / rubber	25	Low-tech manufacturing
Glass / ceramics	26	Low-tech manufacturing
Metal	27-28	Low-tech manufacturing
Manufacture of machinery and equipment	**29**	**Medium tech manufacturing**
Manufacture of electrical machinery	**30-32**	**High-tech manufacturing**
Medical, precision and optical instruments	**33**	**High-tech manufacturing**
Manufacture of motor vehicles	**34-35**	**Medium tech manufacturing**
Manufacture of furniture, jewellery, sports equipment and toys	36-37	Low-tech manufacturing
Electricity, gas and water supply	40-41	Low-tech manufacturing
Construction	45	Low-tech manufacturing
Retail and motor trade	50, 52	Low knowledge-intensive services
Wholesale trade	51	Low knowledge-intensive services
Transportation and communication	60-63, 64.1	Low knowledge-intensive services
Financial intermediation	**65-67**	**Knowledge-intensive services**
Real estate activities and renting	70-71	Distributive services
ICT services	**72, 64.3**	**Knowledge-intensive services**
Technical services	**73, 74.2, 74.3**	**Knowledge-intensive services**
Consulting	**74.1, 74.4**	**Knowledge-intensive services**
Low-tech business-oriented services	74.5-74.8, 90	Low knowledge-intensive services

Chapter 4

Corporate Main Bank Decision

4.1 Introduction

Building up close main-bank relationships can be beneficial to small and medium sized firms for several reasons. For mature firms, relationship lending eases access to bank finance (Berger and Black, 2011; Elsas and Krahnen, 1998; Petersen and Rajan, 1994; Cole, 1998) and positively affects firm innovation activity (Herrera and Minetti, 2007). As a further advantage, a relationship bank is able to *"lean against the wind"* if a firm is in financial distress (Petersen and Rajan, 1997). Based on the information gathered by multiple interactions, a relationship bank is better informed and therefore capable of evaluating a firm's going concern value. Such a bank makes more efficient liquidations keeping financing distressed but viable firms (Chemmanur and Fulghieri, 1994). Relationship banking therefore provides an insurance for liquidity and is especially attractive for high risk firms. But firms face transaction costs in providing information. Furthermore, banks have an informational monopoly and bind firms to this relationship, which allows inter-temporal cost sharing and bank rent seeking. Therefore, cost sensitive firms with low risk might ask for more transaction oriented banking.

A bank's ability to offer relationship banking depends on its portfolio characteristics, investment in specialization, and strategy. Berger and Black (2011) argue that hierarchal banks are less capable of processing soft-information, such as an entrepreneur's trustworthiness. They show empirically that larger banks are less capable of passing along soft-information within the hierarchy and are therefore less involved in relationship lending. Brown et al. (2012) show that larger banks react more strongly to hard-facts, such as credit ratings, than do small banks. There is a further literature shows that the characteristics of the bank portfolio affect a firm's probability of experiencing distress and subsequent market exit (Peek and Rosengren (2005), Fukuda et al. (2009), and Höwer (2009)) or innovation activity (Höwer et al., 2011). Furthermore, banks need to invest in specialization in order to offer relationship banking (Boot and Thakor, 2000). For banks that have higher refinancing costs than others, it is hard to invest in specialization to offer the advantages of relationship banking and simultaneously offer competitive interest rates. Matthey (2010) argues that such banks have incentives to compete in debt repayments. In other words, those banks offer cheap loans and services to cost sensitive firms with low default risk and which do not demand liquidity insurance.

Do firms select the main bank relationship according to their risk or preferences for being helped in difficult times? I empirically test this for newly established German firms. High market shares of *Sparkassen* and cooperative banks make the German banking system particularly interesting with regard to this question. Both *Sparkassen* and cooperative banks have a mission statement and implicit or explicit guarantees, reducing refinancing costs. But private banks are not restricted to a certain lending or liquidation policy and have incentives to offer transaction oriented banking, thus attracting low risk firms. I analyse a firm's main bank choice related to its demand for liquidity insurance, its sensitivity to costs, and its ex ante default risk. For my analyses, I identify the main bank initially chosen, as well as banks that were also available to the firm. The set of alternatives varies over firms, depending on the local banking market. I focus on newly established firms since there is no previous financial track record or entrepreneurial experience in that particular business and the bank choice is not influenced by the decision or timing of switching the main bank.

The KfW/ZEW Start-up Panel, a representative sample of young firms in Germany, paints a rich picture of firm and entrepreneurial characteristics. It includes detailed information on firms' criteria for choosing a main bank relationship, the selected bank, and previous private relationships with that bank. I use nearly 1,900 observations on firms established between 2009 to 2011. Alternative banks and their characteristics are identified using the ZEW Bank Panel. I test for risk considerations in a firm's initial main bank choice in two steps. In the first step, I employ a logit model to estimate the probability of choosing a certain bank type. In the second step, I employ a nested logit model to estimate the probability of choosing a bank out of a set of alternative banks.

The empirical analysis suggests that the firm chooses a bank and not the reverse. Only 13% of all firms were restricted in their choice in terms of a bank's refusal to offer an account or grant a loan. I find that firms for which *"expected bank support in financial distress"* is of the utmost importance choose a relationship oriented bank. Entrepreneurs who consider their personal bank relationship to be valuable to their firm are also more likely choose a relationship oriented bank. However, I do not find that firms select their main bank according to ex ante risk measured by predicted default probability. Cost sensitive firms are more likely to choose a private bank. Furthermore, I find that a bank's local competence is an important selection factor. Banks with a high regional market share and those that are regionally concentrated are more likely to be chosen. The distance between firm location and bank branch is not economically significant.

The present paper is structured as follows. In the following section, I review the literature on relationship banking and describe the institutional background of the German banking system. In Section 4.3, I describe the data set used. In Section 4.4, I present the logit model for firm decisions as to the type of main bank. In Section 4.5, I present a nested logit model. In this model, a firm chooses a particular bank out of a set of alternatives. In Section 4.6, I discuss the results and provide further robustness checks. Section 4.7 concludes.

4.2 Relationship vs. Transaction Oriented Banking

The choice of a bank is related to transaction costs and to the bank services offered. But firms may also take into account that their main financing partners can influence their decisions, and are able to liquidate the firm. In the first part of this section, I review the literature on relationship banking. I elaborate characteristics that describe whether a firm is more likely to demand relationship oriented banking or transaction oriented banking. In the second part of this section, I describe the German banking system. Institutional differences within the banking sector help to discriminate between banks that are more likely to offering relationship oriented banking than to offer transaction oriented banking.

4.2.1 Firm Characteristics and the Demand for Relationship Banking

The literature on firm financing and financial intermediation stresses that the probability a firm is being liquidated depends on the source of its financing, and that a firm selects its financing sources according to the firm's default risk or the risk preferences of its owners. Chemmanur and Fulghieri (1994) argue that bank loans are more expensive than publicly traded debt. They show that firms with a higher liquidation risk select bank loans over publicly traded debt, because renegotiation is easier with a single or a few banks than with anonymous debt holders. Wilner (2000) argues that trade credit partners have a stake in the firm and are less likely to liquidate a firm in financial distress than are banks. Petersen and Rajan (1997) and Huyghebaert et al. (2007) find empirical evidence that credit constrained firms are more likely to use the more expensive trade credit instead of bank financing. But differences exist even within banking, and there is usually a distinction made between relationship and transaction oriented banking.

Ongena and Smith (1998) define relationship banking as "the connection between a bank and a costumer that goes beyond the execution of simple, anonymous, financial transactions". It is characterized by "close monitoring, renegotiability, and implicit long-term contractual agreements" (Berlin and Mester, 1998). A bank gains an informational advantage over its competitors by privately observing the client's payment behavior. Banks further reduce the information asymmetries between themselves and the firm and gain inside information by observing a firm's financial and entrepreneurial decisions (Fama, 1985; James, 1987).

A close bank–firm relationship can be beneficial for the firm for several reasons. First, asymmetric information in credit markets can lead to credit constraints (Stiglitz and Weiss, 1981). Gathering information over time can therefore improve the firm's access to finance. Harhoff and Koerting (1998) as well as Angelini et al. (1998) show that the probability that a firm gets a credit is positively related to the length of the firm–bank relationship. I therefore expect that firms seeking bank finance choose a relationship orientated bank.

Second, relationship banking offers greater flexibility when renegotiation is needed (Petersen and Rajan, 1994). Discretion in the decision to liquidation is vital for the bank as well as for the firm. Banks' investing in screening and monitoring are better in evaluating distressed projects. Such a bank makes more efficient liquidation decisions, than a bank that follows a strict liquidation rule (Chemmanur and Fulghieri, 1994).

From the firm's perspective, the attempt on the part of a relationship oriented bank

for efficient liquidation can be seen as implicit liquidity insurance. In the case of a liquidity shock, such a bank puts more effort into the evaluation of a firm's solvency. That bank will continue financing if the firm is considered to be solvent and the costs can be recouped by future transactions. Relationship lending can be seen as a commitment to continue doing business together through financially tough times (Ongena and Smith, 1998), and such banks "would lean against the wind" (Petersen and Rajan, 1994). Elsas and Krahnen (1998) find that main banks in Germany with strong firm relationships do so, and do continue to lend to customers after a worsening of the client's credit rating. Also Höwer (2009) find that financially distressed firms that have close bank relationships have a lower market exit probability. Especially firms with high default risk have incentives to choose a financing partner offering such an implicit liquidity insurance.

Relationship banking is related with higher pecuniary and non-pecuniary costs. Boot and Thakor (2000) argue that banks need to invest in relationship banking. The screening and monitoring costs need to be reimbursed by the bank's clients. In relationship banking, both the costumer and the bank are willing to make temporary sacrifices in order to obtain future benefits (Ongena and Smith, 1998).[9] Thus, clients are willing to accept higher up-front interest payments if the relationship promises liquidity insurance or lower repayments in the future. Non-pecuniary costs arise through interactions between the entrepreneur and the bank, such as the provision of confidential information and transaction costs for meetings.

Based on the above literature review regarding relationship banking of mature firms, I expect the following behavior of newly established firms. Firms with comparably high default risks or managed by entrepreneurs asking for liquidity insurance are more likely to select a relationship oriented bank. In contrast, cost-sensitive firms and those with low default risk are more likely to select a transaction oriented bank.

4.2.2 The German Banking System and Identification of Relationship Oriented Banks

In the literature, relationship banking is identified by either using firm–bank relationships or bank characteristics. Identification based on the characteristics of the firm–bank relationship use its duration (Elsas and Krahnen, 1998) or its scope (i.e., financing volume (Degryse and Ongena, 2005)). This however is not useful in the context of this study. My interest is in testing whether newly established firms with certain characteristics are more likely to choose a transaction or a relationship oriented bank. Similar to Elyasiani and Goldberg (2004), I use bank characteristics to distinguish between transaction and relationship oriented banks.

In this study, I use the differences in ownership and governance within the German banking system to distinguish between relationship and transaction oriented banks. The German banking system can be characterised as a "Three Pillar System," referring to pub-

[9] Studies concerning the effect of relationship banking on interest rates analyze the intertemporal behavior and find mixed results. Chemmanur and Fulghieri (1994) predict decreasing interest rates and collateral requirements while the relationship matures (see also Santikian (2011)). In contrast, Greenbaum et al. (1989); Rajan (1992) predict increasing interest rates since lenders recoup the initially subsidized interest rates. I am not aware of studies analyzing the differences in interest rates and fees between relationship oriented and transaction oriented banks for equally risky firms.

lic, cooperative, and private banks, all active as universal banks (Engerer and Schrooten, 2004). *Sparkassen* have a "public mandate" to foster regional development and support firms as long as is economically reasonable. In Germany, this objective is codified in the laws governing *Sparkassen*. *Sparkassen* are owned by the district or municipality. Local politicians are represented in the board of supervisors to ensure that the bank fulfils its mandate. *Landesbanken* are the central banks of the *Sparkassen*, but also have their own business clients. These banks are jointly owned by the regional *Sparkassen* association and the federal states. Until 2005, the owners of *Sparkassen* and *Landesbanken* provided an unlimited cover in case of the bank's financial distress (so-called *Gewährträgerhaftung* and *Anstaltslast*). This regulation was removed for competitive reasons. However, the *Sparkassen* banking sector still provides implicit guarantees by either direct bail–out or mergers within the sector, and a bank's risk from former financial contracts are covered until 2015.[10]

Most cooperative banks are organized locally, whereas some cooperative banks are active nationwide but specialize in certain industries (e.g. the *Deutsche Apotheker und Ärztebank* specialized for pharmacies and medical practitioners). Cooperative banks are owned by members which can be private persons or firms. A cooperative bank's aim is "to promote the acquisition and the business of members" (Engerer, 2006). Hakenes and Schnabel (2011) show that cooperative banks perform the same functions as *Sparkassen*. Members face an additional payment liability in case of bank insolvency, which lowers the costs of refinancing. They are represented in the board of supervisors to ensure the fulfilment of the bank's mission. *Sparkassen* and especially cooperative banks have a close branch network. This makes them more capable of collecting soft information than are private banks.

Private banks have no mission statement similar to those *Sparkassen* and cooperative banks, but are shareholder value oriented. It is argued that private banks face higher refinancing costs, because these are neither protected by (explicit or implicit) guarantees nor by the owners' additional liability. As Matthey (2010) point out, *"to what extent the true objective functions differ is subject to debate. But public banks usually have the mandate to support the economy, which they cannot publicly breach. Accordingly, most borrowers assume that if they take out a loan from the public bank their firm will not get liquidated at the first sign of financial difficulties. Independently of the public bank's true objective function this perception may suffice to allow private banks to enter the market, separate the borrower pool, and obtain profits in equilibrium"*. In the theoretical model of Matthey (2010), private banks have incentives for offering more attractive loans to safe firms by a lending policy that includes the liquidation of any distressed borrower. The expected returns of safe firms are higher than those of risky firms, and private banks can offer lower interest rates that overcome their cost disadvantage. Even explicit guarantees of *Sparkassen* to phase out the mandate do not. *Sparkassen* and cooperative banks still describe their business model as being oriented "towards common welfare, based on economic performance" (DSGV, 2008). A Private bank's liquidation policy needs to be credible. This does not rule out intensive firm–bank relationships where private banks

[10]The bail–out of *Landesbanken* by *Sparkassen* associations and states in the aftermath of the financial crisis serves as anecdotic evidence.

collect confidential information by multiple interactions with the firm. But entrepreneurs need to believe that renegotiation is much harder with private than with non-private banks, and self select accordingly.

Table 4.1: Bank business area and market share by bank type (2009)

Bank type	Statistic	Bank business area			Total
		regional (1)	super-regional (2)	national (3)	(4)
Public banks	**# banks**	**395**	**41**	**3**	**439**
	market share	*0.42*	*0.06*	*0.01*	*0.49*
Cooperative banks	**# banks**	**904**	**233**	**17**	**1,154**
	market share	*0.20*	*0.07*	*0.01*	*0.28*
Private banks	**# banks**	**114**	**62**	**32**	**208**
	market share	*< 0.01*	*0.01*	*0.22*	*0.23*
Total	**# banks**	**1,413**	**336**	**52**	**1,801**
	market share	*0.62*	*0.13*	*0.24*	*1.00*

Note: This table presents the number of banks according to their bank type and scope of business area, as well as the share of German banks that have a main bank relation with a particular bank. Information on the number of banks active in banking with businesses is provided in the ZEW Banking Panel. Information on firm shares is estimated based on the Mannheim Enterprise Panel. Banks are classified as follows: portfolio firms spread over up to ten districts as regional, between eleven to 40 districts as supra-regional, and more than 40 districts as national.
Source: ZEW Bank Panel and MUP (ZEW) 2012, author's own calculations.

Another aspect of the German banking system is that some banks have restricted spatial business areas. The so–called "regional principle" should ensure that *Sparkassen* and most cooperative banks have a natural interest in their region's performance. This restriction influences the pool of alternative banks from which a firm can choose. I classify a bank in terms of its spatial business area as being either regionally, supra-regionally, or nationally active. The scope of action of a bank is determined on the basis of the spatial distribution of its clients. For each bank, I count the number of districts in which its clients are located. In some cases, banks have only a single client in a district. To avoid inflating the figures with such cases, I only consider firm–bank relationships if the following criteria hold: First, at least three clients are located in a given district. Second, the share of observed firm–bank relationships of a given district to all firm–bank relationships observed is larger than 0.24%. This criterion is equivalent to a bank with clients equally distributed among the 412 German districts. Banks with clients in up to ten districts are defined to be regionally active banks, between eleven and 40 districts, super-regionally active, and above 40 districts, nationally active.

In Table 4.1, I present the number of active banks in 2009 according to their ownership type and the scope of their spatial business area. The table shows that 395 *Sparkassen* sector banks were regionally active. These banks served as the main bank for 42% of all firms active in Germany. Nearly two out of five cooperative banks are active on the regional level only, serving as the main bank relationship for 20% of all customers.

4.3 Description of the Data Set

My analysis is based on the KfW/ZEW Start-up Panel. This panel is a representative sample of newly established firms in Germany. The KfW/ZEW Start-up Panel is a stratified random sample, drawn from the MUP that has a nearly full coverage of the economically

active firms located in Germany. Firm level data of the MUP is collected by Creditreform, which is the largest credit rating agency in Germany. The stratification criteria are the year of establishment, the firm's industry coding, and KfW support.[11] Firms in high-tech industries and with KfW support are oversampled in order to ensure having sufficiently many observations to evaluate either group. The KfW/ZEW Start-up Panel is a yearly survey and started in 2008. The survey is conducted using computer assisted telephone interviews. The sample screening ensures that only independent businesses, i.e., businesses that do not belong to a group of companies, are interviewed (see Fryges et al., 2010, for a more detailed description of the data set).

The KfW/ZEW Start-up Panel contains information on the funding, economic activity and the managers of newly established firms. The fifth wave of the KfW/ZEW Start-up Panel, which was conducted in 2012, contains information regarding the firm's main bank decision. In addition to the ordinary questionnaire, firms founded in the years 2009 to 2011 were asked the questions presented in Figure 4.1. In the interviews, 3075 firms classified their main bank as either *Sparkasse*, cooperative, private, or non-existent (question (1) of Figure 4.1).

Figure 4.1: Bank choice related part of the KfW/ZEW Start-up Panel questionnaire

1.	**To which banking group does your Hausbank belong to?**	Yes				
(a)	Sparkassen *(INT: also Landesbanken)*	☐				
(b)	Cooperative banks *(INT: Sparda-Bank, PSD-Banken)*	☐				
(c)	Large or private banks *(INT: Deutsche Bank, Commerzbank, former Dresdner Bank, Postbank, HypoVereinsbank, other regional banks, direct banks, affiliates of international banks)* *INT: Please do not read aloud the following options:*	☐				
(d)	No house bank/main bank	☐				
(e)	Do not know / Refuses to answer	☐				
2.	**Did you or another member of the management team participate in a private or business relationship with your Hausbank before it became the official Hausbank of your firm?**	Yes ☐	No ☐			
3.	**Which criteria were important to you while searching for an adequate Hausbank?** Please rank the following criteria on a scale of 1 to 5 with 1 being of utmost importance and 5 being of no importance.	of utmost importance	of great importance	somewhat important	not very important	of no importance
	Prog: Rotate answers	1	2	3	4	5
(a)	Specialized industry expertise of the bank	☐	☐	☐	☐	☐
(b)	Expected support in case of a critical business development	☐	☐	☐	☐	☐
(c)	Supply of specialized financial services, i.e. international trade	☐	☐	☐	☐	☐
(d)	Geographical proximity to the bank	☐	☐	☐	☐	☐
(e)	Favorable market conditions	☐	☐	☐	☐	☐
4.	**With which other banks did you have conversations about house bank relationships? With (other) ...** *INT: In case of several members of the board of management, one member conversing with the bank will suffice.*	Yes	No			
(a)	Sparkassen	☐	☐			
(b)	cooperative banks	☐	☐			
(c)	large or private banks	☐	☐			
5.	**Did one of the banks with which you had these talks reject running a debit account, a loan or other business relationships?**	Yes ☐	No ☐	Do not know / Refuses to answer ☐		

Note: These questions were part in the fifth wave of the KfW/ZEW start-up Panel conducted as a computer assisted telephone interview (CATI) in 2012. The query was limited to firms up to the age of three.

[11] Certain industries are excluded, such as agriculture. KfW is a promotional bank at the federal level in Germany. KfW provides support not only by promotional loans but also by other subsidies, such as financial funds for entrepreneurial coaching. A firm is stratified as KfW supported if it received any kind of support from the KfW.

In addition to the survey data, the MUP contains, for most of the firms, information on the bank's name, local branch, and type of the bank that serves as the firm's main bank relationship, as well as for up to five further bank relationships. In Table 4.2, I show that for 1862 cases, or 52%, the main bank information provided in the MUP is consistent with the KfW/ZEW Start-up Panel (Column (1)). Column (2) shows that in 10% of the cases, the bank type information is inconsistent. The bank information in the MUP is missing for 1330 firms (37%).

The data set is complemented by the ZEW Bank Panel. This panel contains information about the characteristics of each bank's portfolio, regarding business clients. The characteristics are calculated based on the firm–main bank relationships observed in the MUP. There are two advantages in using the ZEW Bank Panel, compared to the publicly available data, such as the bank balance sheet data from Bankscope provided by Bureau van Dijk, which is often used in empirical studies. First, especially for small banks, balance sheet data is often not available. See, however from Table 4.1, that regionally active, typically small, banks have a large market share in terms of main bank relationships. The ZEW Bank Panel covers any bank having relationships with German firms. Second, the ZEW Bank Panel allows a more detailed analysis of the characteristics of the banks' portfolio, such as industry concentration or market shares in local banking markets, than does the balance sheet data.

Table 4.2: Sample structure and identification of main-bank relationsships

Year of foundation	Statistics	KfW/ZEW Start-up Panel bank information is ... consistent with MUP (1)	inconsistent with MUP (2)	unknown in MUP (3)	Total
2009	**obs.**	**644**	**139**	**312**	**1,095**
	%	*0.59*	*0.13*	*0.28*	*1.00*
2010	**obs.**	**648**	**106**	**432**	**1,186**
	%	*0.55*	*0.09*	*0.36*	*1.00*
2011	**obs.**	**570**	**119**	**586**	**1,275**
	%	*0.45*	*0.09*	*0.46*	*1.00*
Total	**obs.**	**1,862**	**364**	**1,330**	**3,556**
	%	*0.52*	*0.10*	*0.37*	*1.00*

Note: This table presents the sample structure and the identification of a firm's main bank relation. The KfW/ZEW Start-up Panel provides information on the type of the firm's main bank relation. The Mannheim Enterprise Panel (MUP) provides information a firm's main bank and bank type. The table presents the number of observations and share of firms for which information from both data sets regarding firms' main bank type is either consistent, inconsistent, or missing in the MUP.
Source: KfW/ZEW Start-up Panel and MUP (ZEW) 2012, author's own calculations.

4.4 Logit Model Approach

To examine firms' criteria and characteristics for choosing a main bank relationship I employ a logit regression model. The model employed has the following specification:

$$\begin{aligned} ln[\tfrac{p(\text{Non-Private Bank}_i=1)}{1-p(\text{Non-Private Bank}_i=1)}] = \alpha_0 \quad & +\alpha_1 \times \text{ex ante risk} \\ & +\alpha_2 \times \text{Criteria} \\ & +\alpha_3 \times \text{Previous personal relation} \\ & +\alpha_4 \times \text{Seeking external finance} \\ & +\alpha_5 \times \text{Signal: No gov. support} \\ & +\alpha_6 \times \text{Export / Born global} \\ & +\varepsilon \end{aligned} \tag{4.1}$$

4.4.1 Variable Description

Dependent Variable In this model, "Non-private bank$_i$" is an indicator of the bank type that serves as the main bank relationship for firm$_i$. As a result of the discussion in Section 4.2.2 regarding the German banking system, one can infer that private banks are more transaction oriented whereas non-private banks are more relationship oriented. The dummy variable is unity if the selected bank is either a *Sparkasse*, a *Landesbank*, or a cooperative bank. In Table 4.3, I present the distribution of the main bank relationship by bank type within the sample. *Sparkassen* have the highest share of main bank relationships, serving 49% of all newly established firms. *Landesbanken* only serve a small fraction, 2%. Nearly one–third of newly established firms have their main relationship with a cooperative bank, whereas these banks have the closest branch network (44% of all observed branches are from cooperative banks). The variable "Non-private bank" is zero for the following banks: *Deutsche Bank* (6% market share in main bank relationships with newly established firms), *Commerzbank* (7%), *Postbank* (3%), and *HypoVereinsbank* (Member of *UniCredit*; 2%), as well as other private banks (2%).[12] The distribution of banking groups for start-up firms within the sample is representative for Germany and is similar to those of established small and medium sized firms.

Independent Variables—Ideal data set and proxies used I present the descriptive statistics of the main explanatory variables in Table 4.4. The table shows the mean values within the sample, as well as the mean conditional on the type of the main bank chosen. In addition, the table shows the expected sign for the logit regression with private banks as base category.

My main interest is in the role of firm risk in the entrepreneur's initial main bank choice. In an ideal setting, I would be able to distinguish between a bank's supply of a liquidity insurance and a firm's demand for such. The firm demand for an insurance depends on the firm risk and the entrepreneur's belief that the insurance is valid. Previous research has shown that firm risk need not correlate with the entrepreneur's confidence or risk assessment. A confident entrepreneur might see a low probability of becoming

[12] During the years of observation, *Postbank* was taken over by *Deutsche Bank*. *Postbank* is left as an option since it still operates under the brand "*Postbank*."

Table 4.3: Main-bank relationships of newly established firms

	Public banks		**Cooperative banks**	**Private banks**	
firm obs	946		559	357	
share	51%		30%	19%	
	Sparkasse	**Landesbank**	**Cooperative banks**	**Large banks**	**other pr. banks**
firm obs	906	40	559	326	31
share	49%	2%	30%	18%	2%
No. of active banks†	429	10	1,154	4	205
No. of bank branches†‡	1,946	71	2,516	890	286

Note: This table presents descriptive statistics on the main bank choice as a decision tree. Figures for firm observation and firm shares are taken from the KfW/ZEW Start-up Panel for consistent observation with the MUP. Figures for Number of active banks and bank branches are from the ZEW Banking Panel and restricted to main business bank relations observed by *Creditreform*.
† Figures presented for the year 2010; ‡ No. of bank branches reflect the count of branches that are identified by *Creditreform* and must not reflect branch network definition of a particular bank.
Source: ZEW Bank Panel and MUP (ZEW) 2012, author's own calculations.

financially distressed, and hence not ask for liquidity insurance no matter the true risk. Therefore, an ideal set of variables would contain a measure of ex ante default risk and of the entrepreneur's subjective risk assessment.

A firm's credit rating, generally available in the MUP as provided by *Creditreform*, would perform as an adequate proxy of firm ex ante risk. However, the *Creditreform* rating information is not available for the firm's initial year (see Brown et al. (2012)). Therefore, I use a prediction of firm market exit probability as a proxy for ex ante risk. The KfW/ZEW start-up panel contains a core set of variables for each firm related to its initial year. The information on market exit is either provided by the survey or by the MUP. I use a 90 % random subsample of the firms founded in 2005 to 2007, estimating a probit regression model for firm market exit within three years after its establishment, on firm and entrepreneurial characteristics. In Table 4.10 in the Appendix, I present the definitions, the descriptive statistics, and the estimated coefficients of the variables employed. The variable "*market exit probability*" is an out-of-sample prediction for the sample firms founded in 2009 to 2011.

In order to test the goodness-of-fit, I use the remaining 10% subsample of firms founded in 2005 to 2007 with known market exit for an out-of-sample prediction. In Figure 4.3 in the Appendix, I plot the Receiver Operator Characteristics (ROC) curve. This curve draws the probability of detecting a true state (sensitivity) against the probability detecting a false state (1 – specificity). The area under the curve provides a measure of the discrimination. The diagonal line (Area under ROC curve = 0.5) suggests no discrimination whereas 1 would be perfect discrimination. The estimated area under ROC curve coefficient of 0.73 is considered an acceptable level of discrimination (Hosmer and Lemeshow, 2000). For a self selection strategy adopted by private banks to be successful, ex ante high risk firms would need to choose a non-private bank. I therefore expect a positive sign for ex ante risk and non-private banks.

A sound measure for entrepreneurial confidence and subjective risk assessment is missing in the data. However, in the interview, entrepreneurs were asked to rank the importance of the following criteria for selecting their initial main bank, on a five point Likert

scale: "Expected support in case of a critical business development" (Question 3 (b) of Table 4.1). This measures the entrepreneur's demand for liquidity insurance in difficult times. It might not be directly related with the entrepreneur's subjective probability of becoming financially distressed. Even if an entrepreneur would consider this as an extreme event, it is severe for firm survival. No matter the reason, firms with a demand for liquidity insurance should be more likely to choose a relationship oriented bank. I therefore expect a positive sign in the logit regression. The measure is noisy for at least two reasons. First, the entrepreneur must be willing to give the bank a stake in the firm. Otherwise the bank will have no interest in supporting the firm. Second, the entrepreneur needs to expect that at least some banks would support the firm. The latter reason is not a problem for identification because if an entrepreneur did not expect support from a single bank, this criteria would be of no importance for that entrepreneur. For the interpretation of this variable, one has to keep in mind that during the telephone interview, entrepreneurs respond to the question up to three years after the initial bank was selected. Therefore, it cannot ruled out that the entrepreneurs' answers were biased by either business developments or by experience with the bank selected.

The descriptive statistics in Table 4.4 reveal that bank support is a very important criterion for over one–third of all firms. It further provides univariate evidence that firms that expect bank support in difficult times are more likely to choose a non-private bank. The share of firms for which this criterion is of utmost importance is 39% for *Sparkassen* and 38% for cooperative banks, compared to 24% for private banks.

Table 4.4: Firm characteristics and selected bank type

Question table 4.1		Mean conditional on chosen main bank type: Public	Cooperative	Private	Mean Full Sample	Exp. Sign Base: Private Bank
1.	No. of observations	(869)	(508)	(323)	(1,700)	
2.	Previous bank relation	69%	62%	54%	64%	+
3.(a)	Criteria: Industry competence†	9%	11%	9%	10%	+/-
3.(b)	Criteria: Support in crisis†	39%	38%	24%	36%	+
3.(c)	Criteria: Specialized fin. services†	6%	5%	9%	6%	-
3.(d)	Criteria: Favorable market conditions†	27%	31%	34%	29%	-
3.(e)	Criteria: Closeness to bank†	48%	48%	24%	43%	+
4.	Talks with multiple banks	51%	58%	59%	54%	+
5.	Bank loan/service denied	13%	14%	12%	13%	+/-
	Market Exit Prob (3 years)	16%	16%	17%	16%	+
	Demand for bank finance	57%	61%	32%	53%	+
	Signal: No Governmental support	33%	31%	55%	37%	-
	Demand for equity finance	4%	5%	8%	5%	-
	Export	11%	11%	14%	12%	-

Note: † Criterion was of utmost importance (5 scale likert).
Source: KfW/ZEW Start-up Panel and MUP (ZEW) 2012, author's own calculations.

Based on the discussion of relationship banking, I employ two further variables, previous personal bank relationship and seeking bank financing. First, I use the indicator variable *"previous personal bank relations"* (Question 2 of Figure 4.1). Personal relationships are valuable if the firm seeks a close bank relationship and the managers consider the bank as capable of processing personal information. Previous private bank relationships

cannot reduce information asymmetry between the firm and bank about the new project, but banks can use the information about the managers personal trustworthiness and liability. This can become especially important if firms are in financially difficult times. The identification of this variable is the reverse. Given that personal information is of less value for private banks, such entrepreneurs would need to build a new relationship anyway. Since relationship-oriented firms are more capable to process this type of information, those might be better able to bind those clients. Therefore, I expect a positive sign of *"previous personal bank relation"*. Table 4.4 shows that nearly two third of all firms use a bank that served as personal main bank relationship of the entrepreneur. 66% of firms that choice a non-private bank already had previous personal relationships. This share is smaller within the group choosing a private bank (55%).

Second, I consider firms seeking bank finance in the initial year. With increasing debt the financiers' influence increases. The financiers can decide to liquidate the firm if necessary. Further, relationship banking might increase access to finance. Following Brown et al. (2012), I define firms with demand for external finance if the firm reported difficulties and/or used external finance. Demand for bank finance includes the use of long-term, short-term debt, and promotional loans, as well as reported difficulties seeking bank finance.[13] I expect the coefficient to be positive for non-private banks. Descriptive statistics already indicate such a relationship. The share of firms seeking bank finance is higher for firms that choose a *Sparkasse* (56%) and cooperative (59%) compared to a private bank (32%).

I use two variables to identify firms seeking transaction-oriented banks. First, firms stating *"favorable market conditions"* as a very important criterion selecting a bank (Question 3 (b) of Figure 4.1) may not be willing to accept higher costs from relationship-oriented banks. The share of firms for which favorable market conditions are of utmost importance is higher for private banks (36%) compared to *Sparkassen* (28%) or cooperative banks (31%).

Second, firms can signal their low risk status to transaction-oriented banks by forgoing public support. Such is offered by the German federal and state governments to newly established firms. On their web page the German federal ministry of economics and technology lists 193 different public programs available for newly established firms. The executing institutions also provide assistance applying for subsidies to keep firms' adminstration costs at a low, affordable level. The chance to receive funding is relatively high. Based on figures of the KfW/ZEW Start-up Panel only 8% of firms seeking public funding were denied. Not demanding public support then can serve as a signal for low risk. I expect the sign to be negative. Demand for governmental support is defined as the use and/or stated difficulties attracting either promotional loans, state guarantees, start-up grants from the federal employment agency, or other forms of subsidies. The share of firms not demanding public support is higher for private main banks (55%) compared to *Sparkassen* or cooperative banks (36% and 32%).

As further criteria, I control for banks' *"industry competence"* and *"specialized financial products"*. An entrepreneur might consider that banks with high competence or experi-

[13]Loans from the KfW (on the federal level) and other state promotional banks are mostly granted by a firms' main bank, while the promotional bank covers up to 80% of the main bank's loan default risk.

ence in the firms business is better able to assess the firms business model. Höwer et al. (2011) show that firms with relationship to a bank experienced in the firms industry invest more in R&D. Large, private banks might find it easier organising competence centers for special fields due to the number of customers. However, especially in the cooperative banking sector industry specialized banks exist. For this reason there is no expectation regarding the coefficient's sign. Depending on their business models firms might also demand specialized financial services, e.g. export financing. Large, private banks are directly connected internationally. Those banks can offer specialized financial products in-house. Smaller *Sparkassen* and cooperative banks instead need to cooperate with their central institutes. Entrepreneurs might consider that *Sparkassen* and cooperative banks are less competent in that field and expect higher (transaction) costs. Descriptive statistics reveal that the share of firms for which specialized financial services was of utmost importance is higher for private (9%) compared to cooperative banks (5%) or *Sparkassen* (6%). I therefore expect the coefficient to be negative.

Further, I employ a set of control variables that have a potential influence on main bank choice. A full list of variable definition and descriptive statistics is provided in Table 4.11 in the Appendix. Next to loans, banks offer a variety of financial services. The share of firms for which specialized financial products was a very important criterion, as well as for exporting firms, is higher for private banks. Export is an indicator variable that takes on the value of one if the firm was able to sell products on international markets. I also control for firm size at start-up, entrepreneurs' education, industry experience, and demand for external equity (e.g. Venture Capital, Business Angels, mezzanine capital). Firm size is measured as the number of employees at start-up, with an indicator variable that equals one if the firm was founded by a team. I account for entrepreneurs with a university degree and those that hold a master craftsman's diploma. For entrepreneurial experience, I distinguish between successful entrepreneurs that sold a previous business or run multiple businesses from unsuccessful ones (restarter). I control for ten industries, including four high-tech (see Table 4.15 in the Appendix for industry classification).

The variables *"bank intensity"*, *"local banking market competition"* and regional classification control for regional aspects the where firm is located. *"Bank intensity"* is measured as the number of banks active in the firm's district divided by the number of active firms in that district. I measure *"local banking market competition"* as the number of firms that switched their main bank relationship within the firm's district in proportion to the number of active firms. Further, districts are classified based on the population density as either metropolises, major cities, hinterland, urban areas, or rural areas, defined by the federal office for building and regional planing.

4.4.2 Results of the Logit Model

In Table 4.5 I present the results of the logit model of the firm's main bank selection. As dependent variable I use non-private banks (*Sparkassen*, *Landesbanken*, and cooperative banks) with private banks as the base category. From the discussion on bank types above, non-private banks are supposed to be more relationship-oriented than private banks. A positive coefficient therefore suggests that respective firms are more likely to choose a

relationship-oriented bank. Next to the coefficient I present the marginal effects (dydx). All three specifications presented are based on the sample of consistent bank information (see Table 4.2 column (1)).

The first specification is used as the base model. It includes variables on entrepreneurial, firm, and regional characteristics. In the second specification, I introduce choice criteria. The third specification additionally covers variables regarding firms' demand for external finance. The number of observations drops by a quarter because firms entering the panel a year after start-up are asked regarding demand for external finance only. The main explanatory variable coefficients remain stable in all specifications and also for other specifications were I additionally use observations with missing bank information in the MUP (see Table 4.2 column (3)).

Variables indicating relationship orientation I first consider the variables indicating relationship oriented firms. As discussed above, private banks do not have a mission statement or mandate and entrepreneurs might anticipate renegotiations in episodes of distress to be much tougher with private compared to non-private banks. Consistent with expectations, I find that entrepreneurs for whom *"expected support in case of a critical business development"* was of utmost important criteria while searching the main bank relationship are more likely to choose a non-private bank. Those entrepreneurs have a 8% higher probability of choosing a *Sparkasse* or cooperative bank. A successful self selection strategy, offering low cost transaction oriented banking as discussed by Matthey (2010), would require attracting low default risk firms. The results of my empirical model do not confirm such a pattern. The effect of the variable *"predicted default probability"* of choosing a non-private bank is not statistically significantly different from zero.

There are at least two explanations for this. First, an entrepreneur's demand for liquidity insurance need not depend on an objective risk measure. An entrepreneur might also want to be insured against an event that is unlikely but existential for the firm. Second, an entrepreneur's own beliefs regarding the probability of distress might not correlate with the predicted market exit probability. As an attempt to control for entrepreneurs' (over)confidence and expectations, I employed further specifications including indicator variables *"implementing business ideas"*, and *"expected higher salary"* as motives for start-ups, as well as *"expected sales decline"*. None of these three variables are significant. For expected sales decline, this might be the case because entrepreneurs build up their business in the first years. In the sample, only a small fraction of firms' expected sales decline from the initial year to the second. Both motivations might be related to higher an entrepreneurial confidence higher than for those that start business as a way out of (expected) unemployment. However, the introduction of these variables do not change the results for the main explanatory variables.

Although private banks might not attract low risk clients to a larger extent than non-private banks, a self selection strategy by private banks could still be fruitful. Bank clients do not necessarily demand bank financing. The average risk in private bank's loan portfolio could be lower if only low risk firms demand bank financing or if private banks employ stricter rules. I find that firms with *"demand for bank finance"* (used or reported difficulties with bank finance) have a 10% higher probability choosing a non-

Table 4.5: Main results – Chosen main-bank type (logit model)

Dependent Variable: Non-private Bank (Base: Private Bank)	Base Coef. (S.E.) (1)	Base Margin (2)	Choice Criteria Coef. (S.E.) (3)	Choice Criteria Margin (4)	Financing sources Coef. (S.E.) (5)	Financing sources Margin (6)
Personal prior relation			0.445**	0.059**	0.601***	0.078***
			(0.139)		(0.164)	
Talks with multiple Banks			-0.297*	-0.039*	-0.328	-0.042
			(0.146)		(0.172)	
Bank loan/service denied			0.405	0.053	0.122	0.016
			(0.216)		(0.256)	
Market Exit Prob (3 years)			-2.041	-0.269	-0.878	-0.113
			(1.413)		(1.789)	
Criteria: Industry competence			-0.314	-0.041	-0.342	-0.044
			(0.254)		(0.309)	
Criteria: Support in crises			0.596***	0.079***	0.584**	0.075**
			(0.164)		(0.194)	
Criteria: Specialized financial services			-0.698**	-0.092**	-0.672*	-0.087*
			(0.265)		(0.330)	
Criteria: Favorable market conditions			-0.645***	-0.085***	-0.671***	-0.087***
			(0.156)		(0.183)	
Criteria: Short distance to bank			0.929***	0.122***	1.129***	0.146***
			(0.153)		(0.181)	
No. of bank relations			0.114	0.015	0.062	0.008
			(0.197)		(0.247)	
Demand for bank finance					0.813***	0.105***
					(0.191)	
No demand gov support					-0.374*	-0.048*
					(0.178)	
Demand for external equity					-0.429	-0.055
					(0.326)	
Export					-0.029	-0.004
					(0.241)	
Sales	-0.125	-0.018	-0.111	-0.015	-0.019	-0.003
	(0.220)		(0.228)		(0.293)	
Proprietorship	-0.449**	-0.063**	-0.583**	-0.077**	-0.380	-0.049
	(0.148)		(0.182)		(0.227)	
Firm size (employees)	0.114**	0.016**	0.121**	0.016**	0.070	0.009
	(0.038)		(0.038)		(0.041)	
Management team	0.023	0.003	0.013	0.002	0.129	0.017
	(0.154)		(0.160)		(0.185)	
Entrepreneurial record	-0.418**	-0.059**	-0.427*	-0.056*	-0.334	-0.043
	(0.159)		(0.174)		(0.189)	
University degree	-0.068	-0.010	-0.040	-0.005	-0.080	-0.010
	(0.167)		(0.173)		(0.200)	
Master craftsman	0.289	0.041	0.216	0.028	0.193	0.025
	(0.200)		(0.209)		(0.252)	
Metropolises	-1.190***	-0.168***	-1.021***	-0.134***	-0.746*	-0.096*
	(0.235)		(0.244)		(0.298)	
Major city	-0.410*	-0.058*	-0.344	-0.045	-0.351	-0.045
	(0.175)		(0.181)		(0.209)	
Urban area	0.072	0.010	0.121	0.016	-0.108	-0.014
	(0.248)		(0.264)		(0.302)	
Rural area	-0.636**	-0.090**	-0.588**	-0.077**	-0.603*	-0.078*
	(0.211)		(0.222)		(0.267)	
Bank intensity (district)	0.225	0.032	0.287	0.038	0.410	0.053
	(0.287)		(0.300)		(0.361)	
Banking competition (district)	-46.012	-6.494	-38.152	-5.024	-16.159	-2.086
	(24.574)		(25.403)		(30.489)	
Year Dummies	Yes		Yes		Yes	
Industry Dummies	Yes		Yes		Yes	
Constant	1.646***		1.370**		0.719	
	(0.374)		(0.524)		(0.649)	
Observations	1,700		1,700		1,273	
LR Chi2	133		233		235	
log likelihood	-760.18		-710.00		-518.63	

Note: In this table I present the results after a logit regression for observations with consistent bank type information in the KfW/ZEW Start-up Panel and Mannheim Enterprise Panel. I use "Non-private bank" as the dependent variable in all specifications. This indicator variable is one if the selected main bank is non-private and zero otherwise. The regressions are based on three samples: "Base" includes entrepreneurial and regional characteristics. "Criteria" additionally includes variables regarding selection criteria. Sample sice reduces for "Financing sources" since demand for finance and exports for the initial year is asked if the firm enters the Panel in its second year only. Standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: ZEW Bank Panel, KfW/ZEW Start-up Panel, and MUP (ZEW) 2012, author's own calculations.

private bank. This might be the case because firms think that non-private banks are more likely to grant loans. Other empirical studies have shown that firms seeking bank finance face more difficulties if their main bank is a private bank (Brown et al., 2012), as well as having a more relaxed access to bank financing due to relationship banking (Elsas and Krahnen, 1998). When a firm uses bank financing, the bank's stake in the firm increases. I used two interaction terms to control for a joint effect of *"demand for bank finance"* and *"predicted default probability"*, as well as *"demand for bank finance"* and the criterion *"expected support in case of difficult business development"*. Neither of these two interaction terms is significant (not reported in the table). This could be the case because the variable *"demand for bank finance"* is restricted to the firm's initial year. Fryges et al. (2012) show that the fraction of firms using external finance increases with firm age. 70% of all five year old firms used external financing at least once, with bank finance as the most important source of external finance. Firms that anticipate future demand for bank finance might consider support in financial distress as important. This however can hardly be observed in the initial year.

I find that entrepreneurs who had previous personal or business related relationships with the firm's main bank have a nearly 10% higher probability of selecting a non-private bank. If entrepreneurs consider personal relationships to be meaningless, they would choose a bank for other reasons and the coefficient would have been insignificant. An entrepreneur could also stay with their personal prior bank relationship just for convenience. This, however, should not be related to bank type, and the coefficient should again be insignificant. I therefore infer that entrepreneurs' evaluations of personal relationships and their being valuable for a firm main bank relationship, differ across bank types. An entrepreneur with a previous personal bank relationship to a *Sparkasse* or cooperative bank might expect that heir bank is capable of processing personal information also for the new firm. A *Sparkasse* or cooperative bank is therefore more capable of binding those customers that seek to build a close firm–bank relationship. An entrepreneur with a private bank as their previous personal relationship might consider this personal information as less valuable for a new firm–bank relationship. Such an entrepreneur would need to build up a firm–bank relationship without personal information anyway. Compared to *Sparkassen* and cooperative banks, private banks are therefore less able to bind such entrepreneurs. In these considerations, I assume that the choice of a personal main bank relationship was not influenced by a potential future start-up. I also control for entrepreneurial experience to rule out the described effect's not being influenced by previous firm–bank relations.

Variables indicating a transaction orientation The variables indicating transaction oriented firms also have expected signs. Firms for which *"favorable market conditions"* are of utmost importance are more likely to choose a private bank. The coefficient is statistically significant and the marginal effect suggests that cost sensitive firms are nearly 8% less likely to choose a non-private bank. The results indicate that those entrepreneurs consider that non-private banks offer services and loans at higher costs, and so choose a private bank. The distinction between relationship and transaction oriented banks by their type can serve as an explanation. Relationship-oriented banks need to invest in specialization (Boot and Thakor, 2000). Entrepreneurs might infer that this investment

comes with higher costs. For entrepreneurs, comparing costs for bank services can become very difficult due to cross selling and interest rate differences. Even if cost differences did not exist, would be sufficient that entrepreneurs expect them to exist. In addition, entrepreneurs take into consideration the higher transaction costs related to relationship oriented banks that are due to the higher frequency of meetings and the need to provide information. Firms that are cost sensitive do not consider relationship lending as important use a private bank.

I find a weak negative significant effect of firms' foregoing governmental support on their choice of a non-private bank. As described in subsection 4.4.1, the cost of applying for governmental support is affordable and the chances of receiving it are quite high. So why do firms "leave money on the table" and why are those firms more likely to end up with a private bank? Public subsidies are intended to improve the situations of high risk firms. Low risk or good performing firms should not be subsidized. I find that firms that did not apply for subsidies in their initial year have a nearly 5% lower probability of using a non-private bank. Firms approaching a private bank could therefore use "not demanding subsidies" as a signal to indicate their low level of risk.

Results for the control variables Firms seeking specialized financial products, e.g., export financing or warranty guarantees, are more likely to choose a private bank. The majority of firms that choose a private bank have a relationship with one of the large banks. These banks have better and more direct international connections. In general, *Sparkassen* and cooperative banks also offer all types of bank services. However, specialized services are provided by their central banks. Local *Sparkassen* and cooperative banks therefore might be less experienced and the transaction costs might increase, as a further institution is involved. Private banks instead have in-house competence center for specialized financial services.

Entrepreneurial and firm characteristics seem not to play a major role in the choice of the main bank. Larger firms, in terms of the number of employees at the start of their business, have a higher probability of choosing a non-private bank, whereas firms in the legal form of a limited liability company are more likely to use a private bank. Entrepreneurs with previous entrepreneurial experience are also more likely to choose a private bank. But the findings for these three variables are not robust and vanish as soon as I introduce variables regarding demand for external finance.

There are two interesting effects regarding regional characteristics. First, firms in regions classified as metropolitan areas or major cities are less likely to choose a non-private bank than are firms located in urban areas. Second, and even more interesting, firms located in rural areas are less likely to choose a non-private bank than are firms in urban areas. This is surprising, because it is often argued that *Sparkassen* and cooperative banks are dominant in rural areas. The descriptive statistics of the distance by bank type and regional type also reveal that *Sparkassen* and cooperative banks are located closer to firms than are private banks. The mean distance of the closest *Sparkasse* in rural areas is 2.2 km, of cooperative banks 2.3 km, and of private banks 12 km.[14] In rural areas, those

[14]The direct distance presented seems quite close for rural areas. But note that firms are most likely to choose a location close to any existing infrastructure.

branches of *Sparkassen* and cooperative banks are typically small and provide services for private households. Firms seeking bank financing or with a demand for specialized services might be asked to approach the bank's headquarter or a better suited branch. Even if local branch managers might be in close contact with these units and are asked about the entrepreneur's reliability, the entrepreneur would have to face travel costs. Due to these transaction costs, entrepreneurs in rural areas might be more likely to choose a private bank than are entrepreneurs in urban areas.

4.5 Nested Logit Model Approach

The empirical model presented above is imprecise in that a firm chooses a bank and not just a bank type. Now I use a model that allows each firm to choose a main bank from a set of alternative banks. This version of a nested logit model (McFadden, 1978) is well suited to deal reasonably flexible with the size of firm observations, bank alternatives, and a large set of observed variables describing firms' choice. Each firm i chooses a bank k out of a set of alternatives from which to choose. The individuals are firms established in the year of observation. The alternatives from which to choose are the universal banks active in business financing. Each bank belongs to a single banking group j (either non–private or private).

The firm's utility obtained from choosing a bank k out of a banking group j can be expressed as

$$U_{jk} = V_{jk} + \varepsilon_{jk} \tag{4.2}$$

with $k = 1, 2, ..., K_j$, $j = 1, 2, ..., J$.

The nested logit model arises when the error terms ε_{jk} have the generalized extreme value distribution with joint cumulative distribution

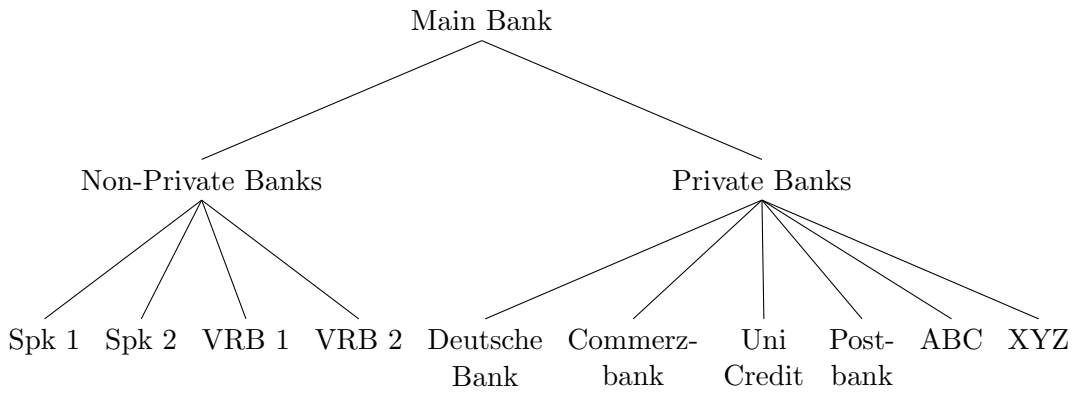
$$G(Y) = \sum_{j=1}^{J} (\sum_{k=1}^{K_j} Y_{jk}^{1/\rho_j})^{\rho_j} \tag{4.3}$$

where the scale or dissimilarity parameter ρ_j is inversely related to the correlation between ε_{jk} and ε_{jl}. The parameter ρ_j can be interpreted as the degree of independence of the error terms among alternatives within a nest. The larger the ρ, the greater the independence and the less the correlation between the error terms. The outcome variable Y_{jk} either takes the value unity if the bank alternative is chosen as the main bank relationship, or zero otherwise. The parameter V_{jk} from Equation 4.2 can be evaluated as

$$V_{jk} = z_j'\alpha + x_{jk}'\beta_j \tag{4.4}$$

where z_j is a vector of variables varying over firms (individual-specific) and x_{jk} is a vector of variables varying over banks or both firms and banks (individual-alternative specific). The probability of the nested logit model with generalized extreme value distribution can

Figure 4.2: Decision tree — Main bank choice



be expressed as

$$p_{jk} = \frac{exp(z_j\alpha + \rho_j I_j)}{\sum_{m=1}^{J} exp(z'_m\alpha + \rho_m I_m)} \times \frac{exp(\frac{x'_{jk}\beta_j}{\rho_j})}{\sum_{l=1}^{K_j} exp(\frac{x'_{jl}\beta_j}{\rho_j})} \tag{4.5}$$

where

$$I_j = \ln(\sum_{l=1}^{K_j} exp(\frac{x'_{jl}\beta_j}{\rho_j})) \tag{4.6}$$

is the inclusive value. The nested logit model can be decomposed into two logits ($p_{jk} = p_j \times p_{k|j}$). That is the probability that firm i chooses the banking group j (the first part of Equation 4.5, that is similar to the logit model presented above) times the probability that the firm chooses bank k conditional on choosing bank group j (second part of equation 4.5). The inclusive value I_j serves as a convenient statistical test of whether the two decisions should be nested. If the coefficient of the inclusive value is zero, there is no nesting of the decisions and Equation 4.5 reduces to the unconditional probability of choosing bank k times the probability of choosing the banking group.

4.5.1 Sampling the Set of Alternatives

The definition of the decision tree and the set of alternatives is crucial for this kind of analysis. First, I test for the optimal number of nests. As mentioned in Section 4.2.2 universal banks active in business finance are organized in three banking groups, but *Sparkassen* and cooperative banks have similar business concepts (Engerer, 2006; Hakenes and Schnabel, 2011). I employ a Hausman test of the independence of irrelevant alternatives after a conditional logit model for the choice of bank type, with alternative varying variables. The test results suggest pooling *Sparkassen*, *Landesbanken*, and cooperative banks in a single nest.

In Figure 4.2, I present the tree structure used. In the first layer, the firm chooses one of the nests, either non-private (*Sparkassen*, *Landesbanken*, and cooperative banks) or private banks. In the second layer, the firm selects a bank from among the alternatives in the chosen nest.

For technical and practical reasons, I need to reduce the set of alternatives from which each firm can choose. The likelihood function requires that there is an observation for each firm and alternative. Technically, the number of parameters getting estimated for each variable added is multiplied by the number of alternatives. Practically, firms are not able to choose any bank active in Germany because some have constrained geographical business areas. In general, those banks are allowed to serve clients within their business area only. This policy is not that strict in practice and one observes relationships with firms especially in neighboring regions. However, it is unlikely that a *Sparkasse* in southern Germany would actively attracts firms in northern Germany. Because there are no clearly defined local banking markets in Germany, I use three strategies to sample banks into a set of alternatives from which a particular firm can choose.

Sampling based on bank branch network In the first sampling strategy, I assign banks to a firm's choice set if the bank operates a branch close to the firm's location. Each set of alternatives consists of eleven banks. It contains the branch with the closest distance of a *Landesbank* and each large bank (*Deutsche Bank*, *Commerzbank*, *Postbank*, and *UniCredit*). The firm can further choose from among two *Sparkassen*, two cooperative banks, and two private banks, that have the branches closest to the firm's location. If the chosen main bank relationship does not belong to the sampled set, a randomly selected bank of the same type gets replaced.

Sampling based on 25 a km radius Within the sample, the 90th percentile firm has its main relationship with a bank branch located 25 kilometers away from the firm. In the second sampling strategy, I therefore assign a bank to a firm's choice set if the bank operates a branch within 25 kilometers of the location of the firm. If a bank operates several branches within that distance, I use the information of the closest branch. A sampled bank branch gets replaced if the chosen bank branch is from the same bank. The selected main bank is added if it does not operate a branch within the 25 km radius. The number of alternatives varies over firms according to local bank intensity.

Sampling based on bank client structure Both of these sampling strategies are based on bank branch networks. Although most firms choose a bank from among those with a branch close to the firm, this does not fully reflect the firm's options. Banks that are active nationwide but operate only a few branches are less likely to be sampled into a firm's set of alternatives. Those banks might be specialized in the firm's industry and therefore be potentially attractive as a financing partner.

The third strategy is therefore based on the bank's client structure. Basically, a bank is sampled if it has clients in the firm's region. There is a trade-off between false sampling and not sampling. False sampling might accrue, because a bank's client moved to another region but kept its relationship. But, a nationwide bank might not be sampled because it is small and does not yet have sufficient number of customers in the region yet. For sampling, I use the classification of nationally, supra-regionally, and regionally active banks, introduced in Section 4.2.2 (see also Table 4.1). First, the firm can choose any bank that is nationally active. Second, a firm can choose a supra-regionally active bank if that bank

serves clients in the firm's regional planning area. Third, a firm can choose a regionally active bank if that bank serves clients in the firm's district.

The number of alternatives varies, over firms, from 57 to 195, according to local bank intensity. The number of alternatives and parameters is still high. McFadden (1973) shows that using a random subsample of alternatives one can obtain efficient and consistent estimates of multinomial logit models with alternative varying variables. In the regression, I use a random sample of one–third of the bank alternatives per firm. The number of alternatives per firm varies between 19 and 65. Again, if the chosen main bank relationship does not belong to the sampled set, a randomly selected bank of the same type gets replaced.

4.5.2 Empirical Equation and Data Used

Since bank level information is required, I use the sample of observations with consistent bank type information in both the KfW/ZEW Start-up Panel and the MUP (column (1) in Table 4.2). In order to test for the hypothesis by taking alternative banks into account, I estimate the following specification of a nested logit model:

$$
\begin{aligned}
\text{Main Bank (0;1)} \;=\; & \rho \text{ Dissimilarity parameter} \\
& + \alpha_1 \text{ ex ante risk} \\
& + \alpha_2 \text{ Criteria} \\
& + \alpha_3 \text{ Previous personal relation} \\
& + \alpha_4 \text{ Seeking external finance} \\
& + \alpha_5 \text{ Signal: No gov. support} \\
& + \alpha_6 \text{ Export / Born global} \\
& + \beta_1 \text{ Market share} \\
& + \beta_2 \text{ Bank size} \\
& + \beta_3 \text{ Bank industry and spatial concentration} \\
& + \beta_4 \text{ Distance (firm - bank branch)}
\end{aligned}
\qquad (4.7)
$$

(individual specific; Base: Private bank) (alternative varying; chosen main bank)

Dependent Variable The indicator variable "main bank" serves as the dependent variable. The variable is unity if the bank is selected as the main bank relationship and zero otherwise. Explanatory variables are grouped into either firm specific variables α or alternative varying variables β.

Data for the bank type nest (α) I use the variable "non-private bank" for identification of the first layer. This indicator variable is unity for non-private banks and zero for private banks. The vector of variables z_j to estimate α consists of the same set of individual specific variables used in the logit regression model above. In addition, I estimate ρ as the dissimilarity parameter that indicates the correlation of errors within the nest.

Data for individual banks (β_j) The vector x'_{jk} includes a set of variables varying over firms and alternatives. As alternative variables I employ bank portfolio characteristics using the ZEW Bank-Panel calculated based on firm–bank relationships observed in the MUP. Since loan volume is missing from the MUP, all characteristics are based on firm–main bank relationships of nearly all firms in Germany. Weighting by the firm's labor force reflects the fact that, in general, larger firms demand higher loan volumes and more intensive financial services. I excluded observations of large firms with more than 50,000

employees for the calculation of this measure. Even after the data cleaning process, e.g., controlling for sales figures in the employment data field or double counting, there are potential errors. The effect of this error on bank characteristics increases with the number of employees. I tested 10,000 and 40,000 employees as alternative thresholds, without severe effects on the results.

The descriptive statistics on these variables are shown in Table 4.6. Note that these statistics are for banks that serve as the main bank relationships of the observed firms. The interpretation of the table is as follows. Consider the figures regarding the bank market share in the firm's district for non-private banks in the first row of Table 4.6. The mean market share in the firm's district is 27% for *Sparkassen*, 7% for cooperative, and 13% for private banks. The market share of banks serving as a main bank relationship in the full sample is 18%. The values of the bank portfolio characteristics are asymmetrically distributed among the three banking groups (see Table 4.12 in the Appendix).

Table 4.6: Characteristics of chosen main banks

	Mean given chosen main bank is:			Mean Full	Definition	Exp.
	Public	Coop.	Private	Sample		Sign
No of observations	(869)	(508)	(323)	(1,700)		
Bank size (division)	60	16	101	55	$= \frac{\sum_{b=1}^{Bank} Firm_{i,b} \times Emp_i}{1{,}000}$	
Bank size (total)	60	16	3,014	608	$= \frac{\sum_{b=1}^{Bank} Firm_{i,b} \times Emp_i}{1{,}000}$	
Bank market share in district	0.27	0.07	0.13	0.18	$= \frac{\sum_{b=1}^{Bank} Firm_{i,d,b} \times Emp_i}{\sum_{d=1}^{District} Firm_{i,d} \times Emp_i}$	+
Bank regional concentration	0.63	0.57	0.03	0.50	$= \sum_{b=1}^{Bank} (\frac{Firm_{i,d,b} \times Emp_i}{Banksize_b})^2$	+
Bank industry specialization	0.03	0.04	0.03	0.04	$= \frac{\sum_{b=1}^{Bank} Firm_{i,ind,b} \times Emp_i}{Banksize_b}$	+
Distance to bank branch	11	17	45	19	Direct distance between firm location and bank branch location in km.	-
Distance to Bank headquarter	16	24	257	64	Direct distance between firm location and bank headquarter location in km.	-

Definition of indicators: i = firm; b = bank; d = district; ind = industry
Source: ZEW Bank Panel, KfW/ZEW Start-up Panel, and MUP (ZEW) 2012, author's own calculations.

In the empirical banking literature, bank size is often used as a proxy for a bank's ability to process soft information (e.g. Stein, 2002; Berger and Black, 2011). Bank size is usually measured by the bank's total assets. In the publicly available data bases for bank balance sheet information, such as Bankscope, the total assets are missing for a large share of the banks. This would reduce the sample size significantly. Therefore, I measure *"bank size"* as the total labor force of the firms for which the bank serves as the main bank. The Spearman rank correlation between the total assets reported in bank scope and bank size provided in the ZEW Bank panel for the year 2009 is 0.80, and significant at the one percent level. I incorporate a squared term that controls for a potential non-linear effect of bank size on the firm's main bank choice. Large banks are mostly organized in regional divisions. I calculated the bank size of large banks according to their regional reporting required by German banking supervisory authorities. These regions correspond in general to the states (*Bundesländer*). Cooperative banks are the smallest banks, followed by

Sparkassen and *Landesbanken*. Although large banks are split regionally, those are much bigger than the banks from the other groups.

I use the variable *"bank market share in district"* to control for a bank's engagement in the firm's region. I measure bank market share as the total labor force of the firms for which the bank serves as the main bank and that are located in the entrepreneur's district in proportion to the total number of labor employed in the entrepreneur's district. I expect a positive correlation of bank market share and firm's main bank choice.

The variable *"banking market concentration"* provide information about the regional concentration within a bank's portfolio. It is measured in the same way as the Herfindahl Index: taking the sum of squared district shares within the bank portfolio. District shares are calculated as the total labor force of the firms located in a particular district for which the bank serves as a main bank, divided by the *"bank size"*. The variable *"bank industry expertise"* is related to the industry of each firm. I calculate this variable as the total labor force of the firms with the same industry code as the observed firm for which the bank serves as a main bank, divided by *"bank size"*.

Since entrepreneurs also might consider traveling costs when choosing a main bank relationship, I incorporate the variable *"distance to branch/headquarter"*. I expect a negative sign for distance. I use the STATA program "geodist" to calculate the distance as a direct line between the firm and the bank branch/headquarter. The geocodes are imported from google maps and based on the postal codes and city for the bank branches and the exact addresses for the firms and bank headquarters.

4.5.3 Results of the Nested Logit Model

In Table 4.7, I present the main results of the nested logit model. For comparison, I show the three sampling strategies: (1) closest distance to bank branch; (2) banks with branches within 25 km of the firm's location; and (3) client structure – banks active in the firm's district. For each sampling strategy, I present a base specification with the bank's market share and regional concentration, a specification with the bank size and industry specialization, as well as a specification that further includes the distance between the firm and the bank branch. Table 4.14 in the Appendix presents results with the full set of variables.

I calculate the average marginal effects after the nested logit using the method presented in Cameron and Trivedi (2009). I increase the value of an observed alternative varying variable for non-private banks by one standard deviation. Presented marginal effects correspond to the mean of the difference in predicted probabilities before and after the amendment. I present the marginal effects of the alternative varying variables for all three specifications in Table 4.8.

I first consider the estimated dissimilarity parameter, which indicates to what extent the error terms within a nest are correlated. A dissimilarity parameter of unity would indicate that there is no such correlation, and the nest might be inappropriate. The test of dissimilarity rejects the hypothesis that the dissimilarity parameter equals unity for all specifications. The value of the estimated coefficient ρ differs over specifications. In specifications based on the branch network (1) and (2), $\hat{\rho}$ is smaller for private than for

Table 4.7: Main results (coefficients) – Chosen main-bank relationship (nested logit model)

Sampling Strategy:	Closest Branch			Branches within 25 km			Client Structure		
	Base	Size	Distance	Base	Size	Distance	Base	Size	Distance
Dependent Variable:									
Main bank	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Alternative varying (β)									
Bank market share in district	1.743**	2.242***	3.573***	2.548***	3.138***	3.184***	5.312***	6.301***	6.483***
	(0.73)	(0.62)	(0.63)	(0.80)	(0.75)	(0.76)	(0.73)	(0.73)	(0.71)
Bank regional concentration	0.383**	0.764***	1.171***	0.01	0.198**	0.203**	0.459***	0.863***	0.619***
	(0.17)	(0.23)	(0.24)	(0.04)	(0.08)	(0.09)	(0.08)	(0.14)	(0.13)
Bank size (ln)		0.367***	0.561***		0.622***	0.641***		0.850***	0.825***
		(0.14)	(0.17)		(0.18)	(0.18)		(0.20)	(0.20)
Bank size (ln, sq)		−0.018**	−0.030***		−0.032***	−0.033***		−0.037***	−0.036***
		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)
Bank industry specialization		4.030***	4.835***		3.915***	4.061***		2.370***	3.940***
		(1.26)	(1.26)		(1.07)	(1.11)		(0.48)	(0.71)
Distance to bank branch in km			0.008***			0.000			−0.006***
			(0.00)			(0.00)			(0.00)
Individual specific (α)									
Criteria:									
Industry competence	−0.288	−0.27	−0.23	−0.114	−0.087	−0.077	−0.233	−0.176	−0.123
	(0.31)	(0.31)	(0.32)	(0.34)	(0.34)	(0.34)	(0.32)	(0.33)	(0.34)
Support in crises	0.574***	0.569***	0.551***	0.553***	0.540**	0.539**	0.549***	0.560***	0.558***
	(0.19)	(0.20)	(0.20)	(0.21)	(0.21)	(0.21)	(0.20)	(0.20)	(0.20)
Specialized fin services	−0.702**	−0.718**	−0.727**	−0.773**	−0.756**	−0.760**	−0.743**	−0.805**	−0.797**
	(0.33)	(0.33)	(0.34)	(0.36)	(0.36)	(0.36)	(0.35)	(0.36)	(0.36)
Favorable market conditions	−0.674***	−0.693***	−0.629***	−0.652***	−0.665***	−0.665***	−0.648***	−0.695***	−0.716***
	(0.18)	(0.18)	(0.19)	(0.19)	(0.20)	(0.20)	(0.19)	(0.19)	(0.19)
Short distance to bank	1.121***	1.126***	1.108***	1.194***	1.193***	1.190***	1.092***	1.073***	1.064***
	(0.18)	(0.18)	(0.18)	(0.20)	(0.20)	(0.20)	(0.19)	(0.19)	(0.19)
Firm Characteristics:									
Personal prior relation	0.630***	0.606***	0.582***	0.705***	0.697***	0.707***	0.637***	0.579***	0.608***
	(0.16)	(0.16)	(0.16)	(0.17)	(0.17)	(0.17)	(0.16)	(0.17)	(0.17)
Talks with multiple Banks	−0.313*	−0.311*	−0.319*	−0.327*	−0.328*	−0.323*	−0.289	−0.284	−0.264
	(0.17)	(0.17)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Bank loan/service denied	0.121	0.129	0.106	0.17	0.188	0.192	0.181	0.21	0.206
	(0.26)	(0.26)	(0.26)	(0.28)	(0.28)	(0.28)	(0.26)	(0.27)	(0.27)
No. of bank relations	0.084	0.004	−0.063	0.099	0.036	0.038	0.116	−0.004	0.043
	(0.24)	(0.24)	(0.24)	(0.25)	(0.26)	(0.26)	(0.25)	(0.25)	(0.25)
Demand for bank finance	0.822***	0.799***	0.759***	0.782***	0.771***	0.773***	0.882***	0.912***	0.928***
	(0.19)	(0.19)	(0.19)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
No demand gov support	−0.366**	−0.375**	−0.399**	−0.456**	−0.471**	−0.477**	−0.379**	−0.382**	−0.375**
	(0.18)	(0.18)	(0.18)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry and year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ρ Non-private banks	0.350**	0.547***	0.788***	0.276***	0.411***	0.422***	0.332***	0.537***	0.592***
	(0.15)	(0.16)	(0.15)	(0.09)	(0.10)	(0.10)	(0.05)	(0.07)	(0.07)
ρ Private banks	0.250**	0.349***	0.450***	0.237***	0.367***	0.392***	0.420***	0.638***	0.911***
	(0.11)	(0.11)	(0.10)	(0.08)	(0.10)	(0.10)	(0.07)	(0.09)	(0.13)
LR Chi2	316	296	286	320	303	297	298	278	257
Observations	13,992	13,992	13,992	39,720	39,720	39,451	38,998	38,998	38,998
Cases	1,272	1,272	1,272	1,182	1,182	1,176	1,273	1,273	1,273
Alternatives per cases:									
Minimum	11	11	11	4	4	4	19	19	19
Average	11	11	11	33.6	33.6	33.5	30.6	30.6	30.6
Maximum	11	11	11	136	136	136	65	65	65

Note: Standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: ZEW Bank Panel, KfW/ZEW Start-up Panel, and MUP (ZEW) 2012, author's own calculations.

non-private banks, but for client structure (3), the reverse. The value of the estimated coefficient ρ increases once I introduce the variable distance to branch in km for the specifications "closest branch" and "client structure." This might be driven by the fact that far away alternatives have a stronger effect. For the specification "closest branch," this is the case because a chosen main bank relationship that is far away enters the set of alternatives. In the specification "client structure," nationwide banks with few branches enter the choice set, affecting the mean distance.

Table 4.8: Main results (marginal effects) – Chosen main-bank relationship (nested logit model)

Sampling Strategy		Closest Branch	Branch within 25km	Client Structure
Bank size	public	0.018263	0.006797	0.009460
	private	−0.015219	−0.015867	−0.010071
Bank market share	public	0.081273	0.015848	0.044148
	private	−0.067727	−0.036997	−0.046999
Bank regional	public	0.026846	0.000195	0.000295
concentration	private	−0.000687	−0.000456	−0.000314
Bank industry share	public	0.018263	0.006797	0.009460
	private	−0.015219	−0.015867	−0.010071
Distance to bank	public	0.000203	−0.000002	−0.000044
	private	−0.000169	0.000006	0.000047

Note: This table presents the results of the marginal effect of bank individual specific variables after the Nested Logit model. Marginal effects are estimated as the mean of the difference in predicted probability after an increase of each variable for private banks by one standard deviation.

Source: ZEW Bank Panel, KfW/ZEW Start-up Panel, and MUP (ZEW) 2012, author's own calculations.

All the results of the main explanatory variables presented for the logit model above remain stable in the nested logit. For the control variables, I find that firm size in terms of the number of employees is positive and significant. This finding suggests that larger firms are more likely to choose a non-private bank. The finding on firm size of the logit version was similar but not robust.

I now consider the alternative varying variables. I find an inverse U–shaped relationship of bank size with a firm's main bank choice, with a positive effect on bank size and a negative effect on the squared term of bank size. The results on bank size suggest that firms choose a bank of a sufficiently large size whereas the bank should not be too large. On the one hand, larger banks are more hierarchically structured (Berger and Black, 2011). In more hierarchic institutions it becomes harder to pass soft information up the hierarchy. On the other hand, banks that are too small might have difficulties in building the competence required by entrepreneurs. Growth oriented entrepreneurs might also take into consideration that a small bank's lending policy will be limited by bank capital requirements.

The bank's market share in the firm's district has a positive effect on the entrepreneur's main bank choice. For the client structure specification, a marginal increase of market share for non-private banks increases the probability that a bank of this type is chosen by 4.4 percentage points, whereas it decreases the probability that a private bank is chosen by 4.7 percentage points. Banks with a high market share in the firms region have detailed local knowledge. Those banks are more capable of assessing a firm's riskiness and market chances, especially for firms with a local market orientation. Those banks can also use

their local knowledge to assess the entrepreneur's trustworthiness.

The probability of being chosen for a main bank relationship increases with the bank's regional concentration. Regional concentration can also be interpreted as a measure of a bank's hierarchic structure, similar to bank size. The more regionally concentrated is the bank, the shorter is the distance between the branch and the headquarters. The bank staff might thus be more closely related, and find it easier to share information. The bank's policy in general might be more regional focused. The marginal effect of bank's regional concentration is rather small. In the specification for client structure, a marginal increase in a non-private bank's concentration increases the probability that a private bank is chosen by 0.003 percentage points and decreases the probability that a non-private bank is chosen by 0.003 percentage points.

Although bank competence in the firm's industry is not an important criterion when choosing a banking group, it influences the selection of a particular bank. The results on alternative specific variables reveal that a bank's likelihood of being chosen increases with the share of the firm's industry within the bank's portfolio. The results suggest that firms do not relate industry competence with a banking group. From a firm's perspective, bank industry competence could ease the firm's access to bank finance, since the bank is more capable of evaluating the firm's project. The economic effect of an increase of industry competence for non-private banks on the probability of choosing a private vs. non-private bank is quite small.

In specifications (3), (6), and (9), I introduced the distance between the firm's location and the bank branch as a further control variable. The sign of the estimated coefficient in the sampling strategy "closest bank branch" is positive. This effect is driven by the sampling strategy, because banks were replaced if the bank with a higher distance did not belong to the original set of alternatives. This sampling effect is less severe for the strategy "branches within 25 km" and non–existent in the strategy "bank client structure." In both, the coefficient is negative. As travel costs increase for the entrepreneur and the banker, who potentially considers on–site visits, the bank is less likely to be chosen. This is consistent with the finding for the individual specific variables, that closeness to the bank is an important criterion for choosing a non-private bank. But the effect of actual distance to the chosen bank is quite small. As the distance of a non-private bank increases by 1 km, the probability that such a bank is chosen reduces by 0.005 percentage points for the "client structure" sampling strategy. Given that most chosen banks are within 25 km, distance is not economically relevant. There are two potential explanations for this. First, Petersen and Rajan (2002) argue that distance might become less important due to improved lending technologies. They state that public information increases also for small firms and banks need less direct contact. This is not the case for the firms under observation. Most firms are proprietorship and do not need to publish financial statements; and their credit ratings are published only as the firms get older. Second, and more likely, bank intensity is relatively high in Germany. Firms have many alternative bank branches within a short distance from the firm's location. Therefore, differences in transaction costs might not be severe.

4.6 Discussion

In this section I discuss further aspects that might a influence firm's selection of a main bank. The chosen nested logit model specification should closely reflect the entrepreneur's decision making process. In the following, I discuss alternative decision trees. In Table 4.9 I present a subsample analysis for high-tech industries, personal bank relationships prior to the start of the business, and talks with multiple banks, in general supporting the decision tree used in the main model presented above. It is often argued that banks are less capable of evaluating high-tech industries than traditional industries, and therefore high-tech firms face more difficulties seeking bank finance (Colombo and Grilli (2007); Brown et al. (2012)). Due to these differences, the importance of the selection criteria might differ between firms in traditional and in high-tech industries. I split the sample according to these two industry types and present the coefficients after a logit model in column (1) for traditional industries and (2) for high-tech industries in Table 4.9. The results suggests that the criteria are not important for high-tech industries.

An alternative tree structure could be that firms first decide whether to stay with the bank with which they already have a personal relationship. If not, they might choose a bank according to the decision tree presented above. The descriptive statistics reveal that approximately two–thirds of all firms use their personal relationship for their firm as well. But these groups do not differ with respect to other choice variables, such as a firm's seeking bank finance or talking to multiple banks. In columns (3) and (4) of Table 4.9, I present a subsample analysis with respect to prior personal bank relationship. The results suggest that there are no big differences in the significance and magnitude of the coefficients.

Firms that use the bank with prior personal relationships might talk with multiple other banks in order to reduce the financing costs. In a further specification, I find evidence for such a strategy. I used an interaction term of talks to multiple banks and the criterion of *"favorable market conditions"*. In this specification both indicator variables were insignificant whereas the interaction term becomes significant.

This finding suggests that firms first decide whether they approach a single bank or talk to multiple banks. Due to the transaction costs for bank talks, one can expect that firms need specific criteria to be fulfilled in order to choose a main bank relationship. In columns (5) to (8) of Table 4.9, I present the subsample analysis for the logit and nested logit model. For firms that talked with only a single bank, the criteria *"short distance," "favorable market conditions,"* and *"demand for bank finance"* are also significant. For firms that talked to multiple number of banks, *"support in financial distress"* and s*"specialized financial services"* are significant, in addition. This is in line with the expectation that those firms that talk to multiple banks are more likely to have certain criteria that need to be fulfilled. The signs of the coefficients are also in line with expectations regarding relationship/transaction-orientation.

The analysis is based on the assumption that the firm chooses a bank, whereas banks remain passive. This might not be the case and banks might play a more active role. Banks can use different marketing and selection strategies to attract new customers. They might also differ in their screening methods. Next to scoring models, banks could, e.g.,

Table 4.9: Results of subsample analyses – Chosen main-bank type

	Logit						Nested Logit	
Specification:	Hightech		Prior relations		Bank talk		Client Structure Bank talk	
	No	Yes	No	Yes	Single	Multiple	Single	Multiple
Dependent Variable Main Bank	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank market share in district							8.225***	6.259***
							(1.32)	(0.94)
Banking market concentration							0.786***	0.599***
							(0.22)	(0.19)
Bank size (ln)							0.867**	0.933***
							(0.34)	(0.30)
Bank size (ln, sq)							−0.037*	−0.042**
							(0.02)	(0.02)
Bank industry specialization							3.785***	4.650***
							(1.03)	(1.12)
Distance to bank branch in km							−0.004***	−0.009***
							(0.00)	(0.00)
Non-Private Bank								
Personal prior relation	0.743**	0.393			0.459	0.754***	0.376	0.780***
	(0.24)	(0.24)			(0.27)	(0.22)	(0.27)	(0.23)
Demand for bank finance	0.720**	0.873**	1.157***	0.636*	0.833**	0.847***	0.902***	0.998***
	(0.27)	(0.29)	(0.31)	(0.27)	(0.31)	(0.26)	(0.34)	(0.27)
Talks with multiple Banks	−0.352	−0.494*	−0.605*	−0.272				
	(0.26)	(0.25)	(0.29)	(0.23)				
Criteria: Industry competence	−0.361	−0.54	−0.11	−0.821	0.451	−0.703	0.646	−0.35
	(0.39)	(0.57)	(0.46)	(0.45)	(0.62)	(0.38)	(0.69)	(0.42)
Criteria: Support in crises	0.855**	0.46	0.739*	0.636*	0.363	0.683**	0.313	0.678**
	(0.29)	(0.28)	(0.32)	(0.26)	(0.32)	(0.25)	(0.35)	(0.27)
Criteria: Specialized fin services	−0.499	−1.029	−0.668	−0.747	0.03	−1.055**	−0.759	−1.080**
	(0.43)	(0.57)	(0.52)	(0.46)	(0.73)	(0.41)	(0.77)	(0.44)
Criteria: Favorable market conditions	−0.996***	−0.415	−0.697*	−0.804**	−0.748*	−0.688**	−0.728**	−0.740***
	(0.27)	(0.27)	(0.28)	(0.26)	(0.32)	(0.24)	(0.34)	(0.26)
Criteria: Short distance to bank	0.979***	1.441***	1.212***	1.175***	1.476***	1.015***	1.368***	1.031***
	(0.27)	(0.27)	(0.29)	(0.25)	(0.30)	(0.24)	(0.33)	(0.26)
Market Exit Prob (3 years)	0.063	−2.376	−0.669	−1.082	2.207	−3.682	3.928	−0.585
	(2.60)	(2.64)	(2.76)	(2.54)	(2.85)	(2.49)	(2.65)	(2.23)
No. of bank relations	0.43	−0.174	0.469	−0.113	−0.113	0.052	−0.608	0.269
	(0.36)	(0.36)	(0.43)	(0.32)	(0.41)	(0.33)	(0.46)	(0.33)
Bank loan/service denied	0.115	0.29	−0.056	0.779		0.172		0.331
	(0.34)	(0.41)	(0.35)	(0.44)		(0.27)		(0.28)
No demand gov support	−0.45	−0.369	−0.682*	−0.219	−0.477	−0.381	−0.417	−0.403
	(0.28)	(0.24)	(0.30)	(0.24)	(0.27)	(0.25)	(0.30)	(0.27)
Demand for external equity	−0.178	−0.665	−1.242*	−0.044	−0.272	−0.539	0.175	−0.658
	(0.54)	(0.45)	(0.54)	(0.47)	(0.53)	(0.45)	(0.58)	(0.48)
Export	−0.622	0.598	−0.276	0.34	−0.358	0.115	−0.379	0.218
	(0.35)	(0.36)	(0.36)	(0.36)	(0.42)	(0.32)	(0.46)	(0.34)
Sales	−0.076	−0.018	−0.728	0.093	0.512	−0.546	0.281	−0.056
	(0.53)	(0.37)	(0.54)	(0.37)	(0.43)	(0.44)	(0.44)	(0.40)
Proprietorship	−0.444	−0.431	0.064	−0.814**	−0.273	−0.515	−0.413	−0.098
	(0.34)	(0.32)	(0.37)	(0.31)	(0.35)	(0.32)	(0.35)	(0.31)
Firm size (employees)	0.083	0.044	0.078	0.037	0.022	0.134*	0.035	0.123**
	(0.06)	(0.07)	(0.06)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Management team	0.111	0.225	0.135	0.126	0.398	−0.131	0.45	−0.141
	(0.28)	(0.26)	(0.31)	(0.25)	(0.29)	(0.26)	(0.31)	(0.27)
Entrepreneurial record	−0.690*	0.035	−0.403	−0.289	−0.334	−0.237	−0.14	−0.215
	(0.29)	(0.26)	(0.32)	(0.26)	(0.29)	(0.26)	(0.32)	(0.28)
University degree	−0.013	−0.043	0.115	−0.169	−0.445	0.27	−0.427	0.462
	(0.31)	(0.28)	(0.34)	(0.27)	(0.31)	(0.28)	(0.34)	(0.29)
Master craftsman	0.172	0.408	−0.263	0.724	0.367	0.22	0.462	0.423
	(0.33)	(0.41)	(0.39)	(0.39)	(0.44)	(0.33)	(0.47)	(0.34)
Industry and Year Dummies	Yes		Yes		Yes		Yes	
Regional controls	Yes		Yes		Yes		Yes	
public_tau								
Constant							0.614***	0.667***
							(0.11)	(0.11)
private_tau								
Constant							1.066***	0.957***
							(0.23)	(0.18)
Constant	1.92	0.479	1.095	1.596	−0.272	1.475		
	(1.02)	(0.93)	(1.11)	(0.82)	(1.04)	(0.90)		
Observations	759	514	450	823	579	694	17,715	21,283
LR Chi2	120	104	116	156	116	152	106	147
log likelihood	-250.28	-254.85	-201.02	-290.94	-216.31	-284.86	-940.26	-1,282.49

Note: In this table I present the results of subsample analysis. In column (1) only lowtech and in column (2) only hightech firms are sampled. In column (3) firms are sampled where entrepreneurs did not have a personal relationship with the selected bank prior the start of the business and in column (4) if the entrepreneur did have such a relationship. Firms in columns (5) and (7) are sampled if the firm did not have talks to multiple banks. In columns (6) and (8) only firms are sampled if the firm talked to multiple banks. Standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels, respectively.
Source: ZEW Bank Panel, KfW/ZEW Start-up Panel, and MUP (ZEW) 2012, author's own calculations.

use behavioral models that use information on entrepreneur's personal cash management. The model used by a particular bank is unknown. However, such behavioral models would require that data from previous personal relationships are available. Throughout the empirical models, I control for previous personal bank relationships. Another aspect of a more active role of banks is that banks can deny a relationship. This need not happen offensively, and a bank could deny single financial services or offer them only at a high cost. The entrepreneurs were asked whether a bank denied a loan, current account, or other financial services. I use this information to control for whether a firm's choice set was restricted. Only a small fraction of firms were denied by any bank. Only a couple of firms reported not having a main bank relationship. The results suggest that in most cases, the main bank relationship is selected by the firm.

During the process of starting a business, banks give advice to entrepreneurs. If the advice depends on the banking group, it could lead to potential endogeneity difficulties. I discuss the two variables most prone to endogeneity problems: not demanding governmental support, and the firm's legal form. Banks are involved in many schemes of public funding in Germany. Private banks (24%) less frequently offer a combination of own and publicly supported funding by themselves, than do *Sparkassen* and cooperative banks (40% and 42%; Source: KfW/ZEW Start-up Panel). However, the endogeneity problems might not be severe, for two reasons. First, information about public subsidies is easily accessible on the internet. Second, most entrepreneurs ask chambers of commerce for general advice before starting a business. Any firm, including a bank, is a mandatory member of the chamber of commerce. Therefore, chambers of commerce do not have incentives to provide different information about governmental subsidies and types of main bank relationships. Formally, the entrepreneur's personal financial liability depends on the firm's legal form. Banks use different contracts to secure credit provided to the firm by the entrepreneur's personal wealth if the firm is a limited liability. The techniques do not differ between bank types and there is no reason to believe that the advice in favor of or against a legal form depend on the bank type.

4.7 Conclusion

Financing sources differ in their liquidation policies. The theoretical literature predicts that firms choose financing sources according their own risk. *Sparkassen* and cooperative banks have a mandate or mission statement to support troubled but viable firms. Private banks have no restrictions on their lending strategy. These banks have incentives to offer transaction oriented banking and attract low risk firms. Employing a rich data set on newly established firms, I test whether firms chose their main bank relationship according to their risk. I find that firms for which bank support in financially difficult times is of utmost importance are more likely to choose a *Sparkasse* or cooperative bank. Entrepreneurs who consider previous personal relationships as important for the firm–bank relationship are more likely to "stay" with a non-private bank. Firms seeking bank finance in their initial year are also more likely to choose a non-private bank. Cost sensitive firms, however, are more likely to choose a private bank. Firms not asking for governmental subsidies might signal their low risk to private banks. But I did not find significant differences in the

predicted default probability among bank types.

The findings suggest that private banks might be expected to be tougher in renegotiation. But if a self selection strategy by private banks exist, it might not work out well. Such a strategy would be successful if private banks attract clients with a low risk of default. An entrepreneur's risk assessment might not be correlated with the "objective" risk. The risk portfolio observed is that of all clients, and need not reflect the average risk of a banks' loan portfolio. However, because switching rates are low in general, banks grant loans mostly within their existing portfolio. The results further indicate that private banks have less rent seeking potential. Private banks attract cost sensitive clients that are probably more likely to switch the bank relationship.

4.8 Appendix

Table 4.10: Market exit - Descriptive statistics and probit results

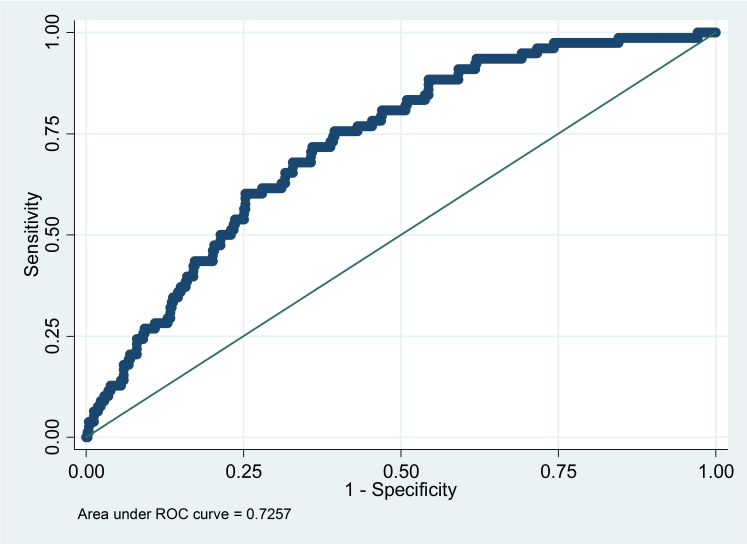
Variable	Descriptive Statistics					Market Exit	
	N	Mean	Min	Max	SD	Coefficient	S.E.
Firm size and Team							
No. of employees (full time equivalent)	5795	1.27	0.00	282.5	6.139	0.01	(0.01)
No. of team members	5.795	1.41	1	12	0.818	0.00	0.00
Age of oldest team member	5.795	39.60	16	93	9.870	-0.015	(0.03)
Age of oldest team member (sq.)	5.795	1665.65	256	8649	828.716	0.00	(0.00)
Material expenses	5.795	0.63	0.00	1	0.483	0.00	(0.00)
Female Entrepreneur (at least one)	5.795	0.19	0.00	1	0.389	-0.013	(0.11)
Entrepreneur was unemployed prior foundation	5.795	0.17	0.00	1	0.375	0.00	(0.00)
No. Of team members with entrepreneurial experience	5.795	0.20	0.00	3	0.568	0.00	(0.00)
No. of patents granted prior foundation	5.795	0.20	0.00	180	4.175	0.002	(0.01)
craft	5.795	0.27	0.00	1	0.444	-0.298**	(0.13)
Limited liability	5.795	0.30	0.00	1	0.459	-0.704***	(0.12)
Motivation							
Motivation - Implementation of a business idea*	5.795	0.33	0.00	1	0.471	0.114	(0.10)
Motivation - Avoiding a situation of unemployment*	5.795	0.18	0.00	1	0.383	0.252**	(0.12)
Motivation - Others*	5.795	0.03	0.00	1	0.183	0.007	(0.23)
Education and Experience							
Industry experience (years)	5.795	13.56	1	54	9.419	0.00	(0.00)
Industry experience (years, sq.)	5.795	272.54	1	2916	340.463	0.00	(0.00)
Qualification in business	5.795	0.26	0.00	1	0.438	0.00	(0.00)
Qualification in business and technology	5.795	0.06	0.00	1	0.244	0.00	(0.00)
Qualification in technology	5.795	0.61	0.00	1	0.487	0.00	(0.00)
Portfolio Entrepreneur	5.795	0.05	0.00	1	0.213	0.00	(0.00)
Restarter	5.795	0.04	0.00	1	0.186	0.00	(0.00)
Serial Entrepreneur	5.795	0.02	0.00	1	0.146	0.00	(0.00)
no qualification	5.795	0.03	0.00	1	0.176	0.387	(0.24)
Master Craftsman	5.795	0.26	0.00	1	0.437	0.135	(0.12)
University degree	5.795	0.39	0.00	1	0.488	0.153	(0.11)
Regional and Industry characteristics							
East Germany	5.795	0.18	0.00	1	0.385	0.00	(0.00)
Metropolitan areas and central cities	5.795	0.22	0.00	1	0.414	0.00	(0.00)
Urban areas	5.795	0.44	0.00	1	0.496	-0.008	(0.17)
Urban hinterland	5.795	0.13	0.00	1	0.337	0.082	(0.19)
Rural areas	5.795	0.14	0.00	1	0.343	-0.318	(0.20)
Firm age at panel entry 1 year	5.795	0.39	0.00	1	0.487	-0.341***	(0.10)
Firm age at panel entry 2 years	5.795	0.34	0.00	1	0.474	-1.452***	(0.13)
Cutting edge technology	5.795	0.06	0.00	1	0.243	-0.39	(0.27)
High-technology	5.795	0.04	0.00	1	0.206	0.603***	(0.22)
Software	5.795	0.08	0.00	1	0.273	0.424**	(0.17)
Non-tech manufacturing	5.795	0.12	0.00	1	0.328	0.119	(0.17)
Knowledge intensive services	5.795	0.07	0.00	1	0.257	-0.029	(0.19)
Industry related services	5.795	0.05	0.00	1	0.216	0.323	(0.20)
Conusmer related services	5.795	0.12	0.00	1	0.328	0.071	(0.16)
Construction	5.795	0.11	0.00	1	0.317	0.255	(0.18)
Trade	5.795	0.13	0.00	1	0.341	0.226	(0.15)
Constant						-0.948	(0.61)
log likelihood						-1992.93	

Table 4.10: Market exit - Descriptive statistics and probit results

Variable	Descriptive Statistics					Market Exit	
	N	Mean	Min	Max	SD	Coefficient	S.E.
LR Chi2						301	

Source: KfW/ZEW Start-up Panel and MUP (ZEW) 2012, author's own calculations.

Figure 4.3: Receiver Operator Characteristics of predicted market exit probability



Note: Comparison of observed market exit with predicted probability of market exit based on a probit regression of newly established firms in Germany using the KfW/ZEW Start-up Panel. Predicted probability that firms established in the years 2005 to 2007 exit the market within 3 years.

Source: KfW/ZEW Start-up Panel and MUP (ZEW) 2012, author's own calculation.

Table 4.11: Descriptive statistics for logit model

Variable	Mean	SD	Min	Max	Definition	Source
Prior personal bank relation	0.64	0.48	0	1	1 if at least one team member had private or business relation with the firms main bank	SuP
Multiple bank talks	0.54	0.50	0	1	1 if firm had multiple bank talks	SuP
Bank loan/service denied	0.13	0.34	0	1	1 if a bank denied account keeping, loans, provision of financial services	SuP
Criteria: Competence	0.10	0.29	0	1	1 if industry competence were considered as of utmost important for main bank selection	SuP
Criteria: Support in Crisis	0.36	0.48	0	1	1 if banks support in case of firm financial distress were considered as of utmost important for main bank selection.	SuP
Criteria: Specialized financial services	0.06	0.24	0	1	1 if spezialiszed financial services were considered as of utmost important for main bank selection.	SuP
Criteria: Favorable market conditions	0.29	0.46	0	1	1 if favorable market conditions were considered as vof utmost important for main bank selection	SuP
Criteria: Short distance to bank	0.43	0.50	0	1	1 if closeness to bank were considered as of utmost important for main bank selection	SuP
Market Exit Prob (3 years)	0.16	0.07	0.02	0.44	Predicted probability of market exit within 3 years	SuP/MUP
No. of bank relations	1.00	0.36	0	3	No of bank relations	MUP
Demand for bank finance	0.53	0.50	0	1	1 if firm either used and/or reported difficulties with bank finance	SuP
No demand for gov support	0.37	0.48	0	1	1 if firm either used and/or reported difficulties with governmental support	SuP
Demand for external equity	0.05	0.23	0	1	1 if firm either used and/or reported difficulties with external equity	SuP
Exporting	0.12	0.32	0	1	1 if firm sold products on foreign markets in its initial year	SuP
Sales	0.90	0.29	0	1	1 if firm with sales in intial year	SuP
Expected sales decline	0.15	0.35	0	1	1 if interview partner expected decline in sales for the second year	SuP
Proprietorship	0.43	0.50	0	1	1 if firm has a legal form of a limited liability	MUP
Firm size (employees)	2.74	6.64	1	242	Number of full-time equivalent employees including team members at startup	SuP
Management team	0.32	0.47	0	1	1 if firm was founded by a team.	SuP
Entrepreneurial record	0.17	0.38	0	1	1 if entrepreneur was a owner-manager of firms prior start-up of the observed firm	SuP
University degree	0.42	0.49	0	1	1 if at least one team member holds a university degree as highest level of education	SuP
Master craftsman	0.25	0.43	0	1	1 if at least one team member holds a certificate of master craftsman	SuP
Motivation: business idea	0.35	0.48	0	1	1 if implementation of a business idea was the main motivation of start-up	SuP
Motivation: higher expected salary	0.06	0.25	0	1	1 if implementation of a higher salary was the main motivation of start-up	SuP
Bank intensity (firm)	5.236	1.995	1.706	14.12	No of banks per 1,000 firms active in the district	MUP/BP
Bank intensity (employees)	0.52	0.30	0.0	2.0	No. Of banks per 1,000 people employed in the district	MUP/BP
Local banking market competition (district)	0.01	0.27	0.0	28.6	No of firms switched their main bank relation in proportion to the number of firms; per district	MUP/BP
Metropolises	0.08	0.26	0	1	District of cities $\geq$ 2,500 inhabitants/km	MUP/BBR
Major city	0.22	0.41	0	1	District of cities $\geq$ 100,000 inhabitants	MUP/BBR
Hinterland	0.12	0.33	0	1	Districts in urban area with population density of $<$ 150 inhabitants/km	MUP/BBR
Urban area	0.45	0.50	0	1	Districts in urban area with population density of $\geq$ 150 inhabitants/km	MUP/BBR
Rural area	0.14	0.34	0	1	Districts in rural areas	MUP/BBR
Year 2009	0.34	0.48	0	1	1 if Year of foundation is 2009	SuP
Year 2010	0.35	0.48	0	1	1 if Year of foundation is 2010	SuP
Year 2011	0.31	0.46	0	1	1 if Year of foundation is 2011	SuP
Cutting edge technology	0.08	0.27	0	1	1 if industry is Cutting edge technology	SuP
High-tech manufacturing	0.07	0.26	0	1	1 if industry is High-technology	SuP
Software	0.07	0.25	0	1	1 if industry is Software	SuP
Technology intensive services	0.21	0.41	0	1	1 if industry is technology intensive services	SuP
Low-tech manufacturing	0.11	0.32	0	1	1 if industry is Low-tech manufacturing	SuP
Knowledge intensive services	0.05	0.23	0	1	1 if industry is Knowledge intensive services	SuP
Business related services	0.06	0.24	0	1	1 if industry is Other business related services	SuP
Consumer related services	0.09	0.28	0	1	1 if industry is Consumer orientierted services	SuP
Construction	0.11	0.32	0	1	1 if industry is Construction	SuP
Trade	0.14	0.35	0	1	1 if industry is Trade	SuP

Definition of sources: SuP - KfW/ZEW Start-up Panel; MUP - Mannheim Enterprise Panel; BP - ZEW Bank Panel; BBR - Federal office for building and regional planing

Table 4.12: Characteristics of chosen main bank – Sample distribution

Bank type	Min	P25	P50	P75	P90	Max
Bank size (total)						
Public Banks	2	17	36	71	143	601
Cooperative Banks	0	4	8	15	24	160
Private Banks	0	1,439	3,273	4,747	4,957	4,957
Bank market share in district						
Public Banks	0.00	0.13	0.27	0.39	0.49	0.71
Cooperative Banks	0.00	0.02	0.07	0.11	0.16	0.30
Private Banks	0.00	0.04	0.13	0.21	0.27	0.43
Bank regional concentration						
Public Banks	0.10	0.42	0.72	0.83	0.89	0.95
Cooperative Banks	0.01	0.41	0.56	0.78	0.86	0.96
Private Banks	0.01	0.02	0.03	0.04	0.04	0.41
Bank industry specialization						
Public Banks	0.00	0.01	0.02	0.05	0.09	0.40
Cooperative Banks	0.00	0.01	0.02	0.07	0.12	0.50
Private Banks	0.00	0.01	0.02	0.04	0.07	0.28
Distance to bank branch in km						
Public Banks	0	1	3	8	18	610
Cooperative Banks	0	1	4	11	23	571
Private Banks	0	2	6	19	150	740
Distance to bank headquarter in km						
Public Banks	0	3	9	17	29	553
Cooperative Banks	0	4	10	19	32	574
Private Banks	0	151	243	379	444	757

Source: KfW/ZEW Start-up Panel and MUP (ZEW) 2012, author's own calculations.

Table 4.13: Descriptive statistics of the set of alternatives by sampling strategy

No. of observations			Closest Branch 13,992		Banks within 25 km 39,451		Client Structure 38,998	
	Min	Max	Mean	SD	Mean	SD	Mean	SD
Bank market share	0.000	0.697	0.069	0.108	0.027	0.072	0.020	0.063
Bank regional concentration	0.013	1	0.251	0.301	0.450	0.322	0.259	0.293
Bank size	0.000	11.271	7.263	1.731	6.414	1.886	6.403	1.492
Bank industry share	0	1	0.042	0.051	0.041	0.055	0.037	0.056
Distance to bank branch	0	757	16.0	28.3	32.7	73.1	102.2	130.1
Multiple bank talks	0	1	0.545	0.498	0.533	0.499	0.546	0.498
Prior personal bank relation	0	1	0.647	0.478	0.657	0.475	0.641	0.480
Bank loan/service denied	0	1	0.135	0.342	0.130	0.337	0.139	0.346
Criteria: Competence	0	1	0.091	0.288	0.074	0.262	0.087	0.282
Criteria: Support in Crisis	0	1	0.356	0.479	0.358	0.479	0.348	0.476
Criteria: Specialized financial services	0	1	0.056	0.230	0.055	0.227	0.057	0.231
Criteria: Favorable market conditions	0	1	0.291	0.454	0.278	0.448	0.285	0.451
Criteria: Short distance to bank	0	1	0.439	0.496	0.410	0.492	0.428	0.495
Sales	0	1	0.921	0.269	0.924	0.266	0.922	0.269
Demand for bank finance	0	1	0.527	0.499	0.527	0.499	0.518	0.500
No demand for gov support	0	1	0.355	0.479	0.365	0.481	0.362	0.481
Demand for external equity	0	1	0.054	0.227	0.059	0.236	0.055	0.227
Exporting	0	1	0.124	0.330	0.125	0.330	0.128	0.335
Market Exit Prob (3 years)	0.048	0.444	0.175	0.065	0.170	0.063	0.175	0.065
No. of bank relations	0	3	1.007	0.351	0.998	0.344	1.004	0.345
Proprietorship	0	1	0.425	0.494	0.444	0.497	0.431	0.495
Firm size (employees)	1	242	2.751	7.462	2.714	6.914	2.663	6.783
Management team	0	1	0.312	0.463	0.328	0.470	0.316	0.465
Entrepreneurial record	0	1	0.219	0.413	0.218	0.413	0.219	0.413
University degree	0	1	0.414	0.493	0.444	0.497	0.430	0.495
Master craftsman	0	1	0.248	0.432	0.244	0.430	0.240	0.427
Year 2009	0	1	0.270	0.444	0.251	0.433	0.263	0.440
Year 2010	0	1	0.333	0.471	0.320	0.466	0.330	0.470
Metropolises	0	1	0.072	0.259	0.053	0.224	0.116	0.321
Major city	0	1	0.211	0.408	0.290	0.454	0.214	0.410
Urban area	0	1	0.126	0.332	0.083	0.276	0.102	0.303
Rural area	0	1	0.131	0.338	0.080	0.272	0.105	0.307
Bank intensity (employees)	0.012	1.977	0.512	0.298	0.477	0.289	0.482	0.299
Local banking market competition (district)	0.002	0.022	0.007	0.003	0.007	0.003	0.007	0.003
Cutting edge technology	0	1	0.059	0.236	0.073	0.260	0.061	0.239
High-tech manufacturing	0	1	0.046	0.209	0.040	0.195	0.044	0.204
Software	0	1	0.079	0.269	0.075	0.264	0.080	0.271
Low-tech manufacturing	0	1	0.110	0.313	0.113	0.317	0.107	0.309
Knowledge intensive services	0	1	0.053	0.225	0.063	0.243	0.060	0.238
Business related services	0	1	0.064	0.244	0.060	0.238	0.064	0.244
Consumer related services	0	1	0.090	0.286	0.082	0.275	0.092	0.289
Construction	0	1	0.121	0.326	0.107	0.309	0.116	0.320
Trade	0	1	0.158	0.365	0.146	0.353	0.152	0.359

Source: KfW/ZEW Start-up Panel and MUP (ZEW) 2012, author's own calculations.

Table 4.14: Results of control variables – chosen main-bank relationship (nested logit model)

	Sampling: Branch network			Sampling: Client Structure		
	Base risk and risk aversion (1)	Bank Char risk aversion (2)	Distance risk and risk aversion (3)	Base risk and risk aversion (4)	Bank Char risk aversion risk aversion (5)	Distance risk and risk aversion (6)
Further control variables						
Demand for external equity	-0.551**	-0.429	-0.513*	-0.611**	-0.489*	-0.592**
	(0.28)	(0.28)	(0.29)	(0.29)	(0.28)	(0.29)
Competence important	0.065	0.199	0.116	0.04	0.214	0.075
	(0.28)	(0.28)	(0.29)	(0.28)	(0.28)	(0.29)
Sales	0.229	0.065	0.064	0.293	0.231	0.382*
	(0.22)	(0.21)	(0.23)	(0.22)	(0.21)	(0.22)
Proprietorship	-0.225	-0.321**	-0.374**	-0.143	-0.263	-0.11
	(0.18)	(0.16)	(0.19)	(0.18)	(0.16)	(0.19)
Firm size (employees)	0.053	0.037	0.048	0.058*	0.044	0.058*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Management team	0.094	0.105	0.081	0.075	0.066	0.067
	(0.16)	(0.16)	(0.17)	(0.17)	(0.17)	(0.17)
Entrepreneurial record	-0.195	-0.261	-0.17	-0.183	-0.172	-0.2
	(0.17)	(0.16)	(0.18)	(0.17)	(0.16)	(0.18)
University degree	-0.112	-0.147	-0.104	-0.136	-0.148	-0.121
	(0.18)	(0.17)	(0.18)	(0.18)	(0.17)	(0.18)
Master craftsman	0.208	0.192	0.194	0.187	0.163	0.181
	(0.21)	(0.21)	(0.22)	(0.22)	(0.21)	(0.22)
Local banking competition	-10.254	-12.668	-8.072	2.579	4.314	11.648
	(24.12)	(22.70)	(24.66)	(24.75)	(23.09)	(25.35)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
jahr2009	0.109	0.109	0.147	0.128	0.136	0.145
	(0.17)	(0.17)	(0.17)	(0.18)	(0.18)	(0.18)
jahr2010	0.016	0.016	0.03	0.037	0.038	0.048
	(0.16)	(0.16)	(0.16)	(0.17)	(0.17)	(0.17)
Cutting Edge Technology	-0.033	-0.033	-0.047	0.105	0.095	0.154
	(0.29)	(0.29)	(0.29)	(0.30)	(0.30)	(0.30)
High technology	0.315	0.315	0.362	0.412	0.404	0.444
	(0.33)	(0.33)	(0.33)	(0.34)	(0.34)	(0.34)
Software	-0.123	-0.123	-0.112	-0.03	-0.029	0.009
	(0.25)	(0.25)	(0.25)	(0.25)	(0.25)	(0.26)
Manufacturing	0.706**	0.706**	0.705**	0.792**	0.777**	0.786**
	(0.30)	(0.30)	(0.30)	(0.31)	(0.31)	(0.31)
Knowledge intensive services	0.276	0.276	0.27	0.192	0.232	0.303
	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)
Business oriented services	0.376	0.376	0.382	0.367	0.358	0.373
	(0.32)	(0.32)	(0.33)	(0.33)	(0.33)	(0.33)
Consumer oriented services	0.253	0.253	0.275	0.28	0.27	0.327
	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)	(0.29)
Construction	0.119	0.119	0.136	0.405	0.304	0.243
	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)	(0.30)
Trade	0.406*	0.406*	0.409*	0.532**	0.491**	0.528**
	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.25)

Note: This table presents the results of the Nested Logit model. The upper part presents estimated coefficients of the (bank) alternative varying variables. The lower part presents the figures of the individual specific variables that does not vary over alternatives. Previous estimation results suggested to use two nests: Public/cooperative vs. private banks. Private banks is used as base category in the lower part. Columns (1)-(3) refer to estimation results based on the sampling strategy "Bank branch structure". Each firm is assigned the nearest branch of each of the two nearest Sparkassen, cooperative banks and small private banks, as well as the nearest branch of the four large banks (Deutsche Bank, Commerzbank, Postbank, and HypoVereinsbank). Bank information is replaced with respect to bank type if the chosen bank is not initially sampled. Columns (4)-(6) refer to estimation results based on the sampling strategy "Bank client structure". A bank is assigned as an alternative of a firm if the bank is regional and active in the firms district, super-regional and active in the firms regional planing area, or national active. Regional (super-regional) banks are considered to be active in firms district (regional planing area) if the bank has a significant share of costumers (1 / count of districts (regional planing area)) in the firms district (regional planing area). Bank information is replaced with respect to bank type if the chosen bank is not initially sampled. Standard errors are presented in parentheses. *,**, and *** denote significance level on the 10, 5, and 1% levels of significance.
Source: KfW/ZEW Start-up Panel and MUP (ZEW) 2012, author's own calculations.

Table 4.15: Industry classification used by the KfW/ZEW Start-up Panel

No.	Industry	NACE Code Rev. 1
	high-tech industries	
1	cutting-edge technology manufacturing	23.30, 24.20, 24.41, 24.61, 29.11, 29.60, 30.02, 31.62, 32.10, 32.20, 33.20, 33.30, 35.30
2	high-technology manufacturing	22.33, 24.11, 24.12-4, 24.17, 24.30, 24.42, 24.62-4, 24.66, 29.12-4, 29.31-2, 29.40, 29.52-6, 30.01, 31.10, 31.40, 31.50, 32.30, 33.10, 33.40, 34.10, 34.30, 35.20
3	technology-intensive services	64.2, 72 (without 72.2), 73.1, 74.2, 74.3
4	software supply and consultancy	72.2
	non-high-tech industries	
5	non-high-tech manufacturing	15 37 (without sectors 1 + 2)
6	skill-intensive services (non-technical consulting services)	73.2, 74.11-4, 74.4
7	other business-oriented services	71.1, 71.2, 71.3, 74.5 74.8 (without 74.84.7), 90, 64.1, 61, 62, 60.3, 63.1, 63.2, 63.4
8	consumer-oriented services	55, 70, 71.4, 92, 93, 80.4, 65-67, 60.1, 60.2, 63.3
9	construction	45
10	wholesale and retail trade (without trade agents)	50 52 (without 51.1)

Note: Cutting-edge manufacturing technology: manufacturing industries with average R&D expenditure ¿ 8.5% of total sales. High-technology manufacturing: manufacturing industries with average R&D expenditure 3.5 8.5% of total sales.

Source: Grupp and Legler (2000), classification KfW/ZEW start-up Panel Fryges et al. (2010).

Bibliography

Aboody, D. and Lev, B. (2000), 'Information asymmetry, r&d, and insider gains', *Journal of Finance* **55**(6), 2747–2766.

Aerts, K. and Schmidt, T. (2008), 'Two for the price of one?: Additionality effects of r&d subsidies: A comparison between flanders and germany', *Research Policy* **37**(5), 806–822.

Aghion, P., Askenazy, P., Berman, N., Cette, G. and Eymard, L. (2012), 'Credit constraints and the cyclicality of r&d investment: Evidence from france', *Journal of the European Economic Association* **10**(5), 1001–1024. Working Paper 2007-4, Weatherhead Center for International Affairs, Harvard University.

Ahuja, G., Lampert, C. M. and Tandon, V. (2008), 'Chapter 1: Moving beyond schumpeter: Management research on the determinants of technological innovation', *Academy of Management Annals* **2**, 1–98.

Almus, M., Engel, D. and Prantl, S. (2000), 'The "mannheim foundation panels" of the centre for european economic research (zew)', Documantation 00-02, Centre for European Economic Research (ZEW), Zentrum fr Europische Wirtschaftsforschung GmbH, L7 1, 68161 Mannheim, Germany.

Amit, R., Glosten, L. and Muller, E. (1990), 'Entrepreneurial ability, venture investments and risk sharing', *Management Science* **36**(10), 1232–1245.

Angelini, P., Di Salvo, R. and Ferri, G. (1998), 'Availability and cost of credit for small businesses: Costumer relationships and credit cooperatives', *Journal of Banking & Finance* **22**, 925–954.

Audretsch, D. B. (1991), 'New-firm survival and the technological regime.', *Review of Economics & Statistics* **73**(3), 441–450.

Audretsch, D. B. and Lehmann, E. E. (2004), 'Financing high-tech growth: The role of banks and venture capitalists', *Schmalenbach Business Review* **56**(4), 340–357.

Audretsch, D. B. and Mahmood, T. (1995), 'New firm survival: New results using a hazard function', *Review of Economics and Statistics* pp. 97–103.

Bates, T. (2005), 'Analysis of young, small firms that have closed', *Journal of Business Venturing* **20**, 343–358.

Baum, J. A. C. and Oliver, C. (1991), 'Institutional linkages and organizational mortality', *Administrative Science Quarterly* **36**(2), 187–218.

Benfratello, L., Schiantarelli, F. and Sembenelli, A. (2008), 'Banks and innovation: Microeconometric evidence on italian firms', *Journal of Financial Economics* **90**, 197–217.

Berger, A. and Black, L. K. (2011), 'Bank size, lending technologies, and small business finance', *Journal of Banking & Finance* **35**, 724–735.

Berger, A. N., Goldberg, L. G. and White, L. J. (2001), 'The effects of dynamic changes in bank competition on the supply of small business credit', *European Finance Review* **5**, 115–139.

Berlin, M. and Mester, L. J. (1998), 'On the proftability and cost of relationship lending', *Journal of Banking & Finance* **22**, 873–897.

Boot, A. W. A. (2000), 'Relationship banking: What do we know?', *Journal of Financial Intermediation* **9**, 7–25.

Boot, A. W. A. and Thakor, A. V. (2000), 'Can relationship banking survive competition?', *Journal of Finance* **55**(2), 679–713.

Born, K. E. (1976), *Geld unf Banken im 19. und 20. Jahrhundert*, Vol. 1, Alfred Körner Verlag.

Bottazzi, L. and Da Rin, M. (2002), 'Venture capital in europe and the financing of innovative companies', *Economic Policy* **17**(34), 229.

Bozkaya, A. and De La Potterie, B. V. P. (2008), 'Who funds technology-based small firms? evidence from belgium', *Economics of Innovation & New Technology* **17**(1/2), 97–122.

Bris, A. and Welch, I. (2005), 'The optimal concentration of creditors', *Journal of Finance* **60**(5), 2193–2212.

Brown, M., Degryse, H., Höwer, D. and Penas, M. F. (2012), How do banks screen innovative firms? evidence from start-up panel data. ZEW Discussion Paper Series 12-032.

Brunner, A. and Krahnen, J. P. (2008), 'Multiple lenders and corporate distress: Evidence on debt restructuring', *Review of Economic Studies* **75**, 415–442.

Cameron, A. C. and Trivedi, P. K. (2005), *Microeconometrics, Methods and Applications*, Cambri, The Edinburgh Building, Cambridge CB2 2RU, UK.

Cameron, A. C. and Trivedi, P. K. (2009), *Microeconometrics using Stata*, Stata Press, College Station, Texas.

Chaddad, F. R. and Reuer, J. J. (2009), 'Investment dynamics and financial constraints in ipo firms', *Strategic Entrepreneurship Journal* **3**(1), 29–45.

Chatterjee, S. and Hadi, A. S. (2006), *Regression Analysis by Example*, John Wiley & Sons.

Chemmanur, T. J. and Fulghieri, P. (1994), 'Reputation, renegotiation, and the choice between bank loans and publicly traded debt', *Review of Financial Studies* **7**(3), 475–506.

Cohen, W. M. and Levinthal, D. A. (1989), 'Innovation and learning: The two faces of r & d', *Economic Journal* **99**(397), 569–596.

Cole, R. A. (1998), 'The importance of relationships to the availability of credit', *Journal of Banking & Finance* **22**(6-8), 959–977.

Colombo, M. and Grilli, L. (2007), 'Funding gaps? access to bank loans by High-Tech Start-Ups', *Small Business Economics* **29**(1), 25–46.

Cordella, T. and Yeyati, E. L. (2003), 'Bank bailouts: moral hazard vs. value effect', *Journal of Financial Intermediation* **12**(4), 300–330.

Cuervo-Cazurra, A. and Annique, U. C. (2010), 'Why some firms never invest in formal r&d', *Strategic Management Journal* **31**(7), 759–779.

Cuypers, I. R. P. and Martin, X. (2010), 'What makes and what does not make a real option? a study of equity shares in international joint ventures', *Journal of International Business Studies* **41**(1), 47–69.

Czarnitzki, D., Hottenrott, H. and Thorwarth, S. (2011), 'Industrial research versus development investment: the implications of financial constraints', *Cambridge Journal of Economics* **35**(3), 527–544.

Czarnitzki, D. and Toole, A. (2007), 'Business r&d and the interplay of r&d subsidies and product market uncertainty', *Review of Industrial Organization* **31**(3), 169–181.

Dahiya, S., Saunders, A. and Srunuvasani, A. (2003), 'Financial distress and bank lending relationships', *Journal of Finance* **58**(1), 375–399.

Degryse, H., Masschelein, N. and Mitchell, J. (2011), 'Staying, dropping, or switching: The impacts of bank mergers on small firms', *Review of Financial Studies* **24**(4), 1102–1140.

Degryse, H. and Ongena, S. (2001), 'Bank relationships and firm profitability', *Financial Management* **30**(1), 9.

Degryse, H. and Ongena, S. (2005), 'Distance, lending relationships, and competition?', *Journal of Finance* **60**, 231–266.

Degryse, H. and Ongena, S. (2008), Competition and regulation in the banking sector: A review of the empirical evidence on the sources of bank rents, *in* A. V. Thakor and A. W. A. Boot, eds, 'Handbook of Financial Intermediation and Banking', Elsevier, Amsterdam.

Deutsche Bundesbank (2012), Bankenstatistik, Technical report, Deutsche Bundesbank.

Diamond, D. W. (1984), 'Financial intermediation and delegated monitoring', *Review of Economic Studies* **51**, 393–414.

Diamond, D. W. and Dybvig, P. H. (1983), 'Bank runs, deposit insurance, and liquidity', *Journal of Political Economy* **91**, 401–419.

Dos Santos, B. L. and Peffers, K. (1995), 'Rewards to investors in innovative information technology applications: First movers and early followers in atms', *Organization Science* **6**(3), 241–259.

Dosi, G. (1982), 'Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change', *Research Policy* **11**(3), 147–162.

DSGV (2008), Fair. menschlich. nah. leitlinien der sparkassen fr eine nachhaltige geschftspolitik im interesse der kunden und der rtlichen gemeinschaft, Technical report, Deutscher Sparkassen- und Giroverband (DSGV).

Dussauge, P., Garrette, B. and Mitchell, W. (2000), 'Learning from competing partners: Outcomes and durations of scale and link alliances in europe', *Strategic Management Journal* **21**(2), 99.

Eckhardt, J. T., Shane, S. and Delmar, F. (2006), 'Multistage selection and the financing of new ventures', *Management Science* **52**(2), 220–232.

Egeln, J., Falk, U., Heger, D., Höwer, D. and Metzer, G. (2010), Ursachen fr das scheitern junger unternehmen in den ersten fünf jahren ihres bestehens, Technical report, Centre for European Economic Research (ZEW), Zentrum für Insolvenz und Sanierung, and Creditreform.

Elsas, R. and Krahnen, J. P. (1998), 'Is relationship lending special? evidence from credit-file data in germany', *Journal of Banking & Finance* **22**, 1283–1316.

Elsas, R. and Krahnen, J. P. (2002), 'Collateral, relationship lending and financial distress: An empirical study on financial contracting', *Center for Financial Studies* .

Elyasiani, E. and Goldberg, L. G. (2004), 'Relationship lending: a survey of the literature', *Journal of Economics and Business* **56**, 315–330.

Encaoua, D., Guellec, D. and Martínez, C. (2006), 'Patent systems for encouraging innovation: Lessons from economic analysis', *Research Policy* **35**(9), 1423–1440.

Engerer, H. (2006), 'Vom dreisulensystem zum baustein des europischen hauses - wandel vom eigentum und wettbewerb im deutschen banksektor', *DIW Vierteljehreshefte zur Wirtschaftsforschung* **75**(4), 11–32.

Engerer, H. and Schrooten, M. (2004), 'Deutscher bankensektor im umbruch - sparkassen und genossenschaftsbanken relativ gut positioniert', *DIW Wochenbericht* **71**(24), 345–349.

Fama, E. F. (1985), 'What's different about banks?', *Journal of Monetary Economics* **15**, 29–39.

Fischer, M., Hainz, C., Rocholl, J. and Steffen, S. (2011), 'Government guarantees and bank risk taking incentives', *SSRN eLibrary* .

Flannery, M. J. (1998), 'Using market information in prudential bank supervision: A review of the u.s. empirical evidence', *Journal of Money, Credit, and Banking* **30**, 273–305.

Folta, T. B. and O'Brien, J. P. (2004), 'Entry in the presence of dueling options', *Strategic Management Journal* **25**(2), 121–138.

Franks, J. and Sussman, O. (2005), 'Financial distress and bank restructuring of small to medium size UK companies', *Review of Finance* **9**(1), 65–96.

Fryges, H., Gottschalk, S. and Kohn, K. (2010), 'The kfw/zew start-up panel: Design and research potential', *Journal of Applied Social Sciences Studies, European Data Watch* **130**, 117–131.

Fryges, H., Gottschalk, S., Metzer, G., Mohr, B., Murrmann, M. and Ullrich, K. (2012), Gründungspanelreport, start mit strategie - beschftigungsfluktuation und finanzierungsverhalten junger unternehmen, Technical Report 5, KfW Banking Group, Centre for European Economic Research (ZEW) and Creditreform, Mannheim, Germany.

Fukuda, S.-i., Kasuya, M. and Akashi, K. (2009), 'Impaired bank health and default risk', *Pacific-Basin Finance Journal* **17**(2), 145–162.

Gompers, P. and Lerner, J. (2001), 'The venture capital revolution', *Journal of Economic Perspectives* **15**(2), 145–168.

Gourville, J. T. (2006), 'Eager sellers & stony buyers', *Harvard Business Review* **84**(6), 98–106.

Greenbaum, S. I., Kanatas, G. and Venezia, I. (1989), 'Equilibrium loan pricing under the bank-client relationship', *Journal of Banking & Finance* **13**, 221–235.

Grimpe, C. and Kaiser, U. (2010), 'Balancing internal and external knowledge acquisition: The gains and pains from r&d outsourcing c. grimpe and u. kaiser r&d outsourcing', *Journal of Management Studies* **47**(8), 1483–1509.

Gropp, R., Guettler, A. and Grndl, C. (2010), 'The impact of public guarantees on bank risk taking: Evidence from a natural experiment', *SSRN eLibrary* .

Gropp, R., Hakenes, H. and Schnabel, I. (2011), 'Competition, risk-shifting, and public bail-out policies', *Review of Financial Studies* **24**(6), 2084–2120.

Grunert, J. and Weber, M. (2009), 'Recovery rates of commercial lending: Empirical evidence for german companies', *Journal of Banking & Finance* **33**(3), 505–513.

Grupp, H. and Legler, H. (2000), Hochtechnologie 2000 - neudefinition der hochtechnologie fr die berichterstattung zur technologischen leistungsfähigkeit deutschlands. Karlsruhe/Hannover.

Hakenes, H. and Schnabel, I. (2010), 'The threat of capital drain: A rationale for public banks?', *Journal of Institutional and Theoretical Economics* **166(4)**, 662–689. Preprints of the Max Planck Institute for Research on Collective Goods Bonn 2006/11.

Hakenes, H. and Schnabel, I. (2011), 'Capital regulation, bank competition, and financial stability', *Economics Letters* **113**(3), 256–258.

Hall (2009), 'The financing of innovative firms', *EIB Papers* **14**, 8–29.

Hall, B. H. (2005), *Blackwell Handbook of Technology and Innovation Management*, Blackwell, chapter The Financing of Innovation, pp. 409–430.

Harhoff, D. and Koerting, T. (1998), 'Lending relationships in germany - empirical evidence from survey data', *Journal of Banking & Finance* **22**, 1317–1353.

Harhoff, D., Stahl, K. and Woywode, M. (1998), 'Legal form, growth and exit of west german firms - empirical results for mnufacturing, construction, trade and service industries', *Journal of Industrial Economics* **46**, 453–488.

Haselmann, R., Marsch, K. and Weder di Mauro, B. (2009), Real effects of bank governance: Bank ownership and corporate innovation. SSRN e-Libary 1507485.

Headd, B. (2000), Business success: Factors leading to surviving and closing successful. Office of Advocacy, U.S. Small Business Administration Working Paper.

Heckman, J. J. (1987), *Structural Analysis of Discrete Data with Econometric Applications*, MIT Press, Cambridge, MA., chapter The Incidental Parameters Problem and the Problem of Initial Conditions in Estimating a Discrete Time-Discrete Data Stochastic Process and Some Monte Carlo Evidence.

Hennart, J.-F. (1994), 'International financial capital transfers: A transaction cost framework', *Business History* **36**(1), 51–70.

Herrera, A. M. and Minetti, R. (2007), 'Informed finance and technological change: Evidence from credit relationships', *Journal of Financial Economics* **83**, 223–269.

Hosmer, D. W. and Lemeshow, S. (2000), *Applied Logistic Regression*, 2nd edn, John Wiley & Sons.

Höwer, D. (2009), From soft and hard-nosed bankers bank lending strategies and the survival of financially distressed firms. ZEW Discussion Paper No. 09-059.

Höwer, D., Schmidt, T. and J., S. W. E. (2011), An information economics perspective on main bank relationships and firm r&d. ZEW Discussion Paper 11-055.

Huyghebaert, N., Van De Gucht, L. and Van Hulle, C. (2007), 'The choice between bank debt and trace credit in business start-ups.', *Small Business Economics* **29**(4), 435 – 452.

Iannotta, G., Nocera, G. and Sironi, A. (2007), 'Ownership structure, risk and performance in the european banking industry', *Journal of Banking & Finance* **31**, 2127–2149.

James, C. (1987), 'Some evidence on the uniqueness of bank loans', *Journal of Financial Economics* **19**, 217–235.

Jimenez, G., Salas, V. and Saurina, J. (2009), 'Organizational distance and use of collateral for business loans', *Journal of Banking & Finance* **33**, 234–243.

Keeley, M. C. (1990), 'Deposit insurance, risk, and market power in banking', *American Economic Review* **80**(5), 1183–1200.

Kim, C.-S., Mauer, D. C. and Sherman, A. E. (1998), 'The determinants of corporate liquidity: Theory and evidence', *Journal of Financial & Quantitative Analysis* **33**(3), 335–359.

Kleer, R. (2010), 'Government r&d subsidies as a signal for private investors', *Research Policy* **39**(10), 1361–1374.

Koetter, M., Bos, J. W., Heid, F., Kool, C. J., Kolari, James, W. and Porath, D. (2007), 'Accounting for distress in bank mergers', *Journal of Banking & Finance* **31**(10), 3200–3217.

Krahnen, J. P. and Schmidt, R. H., eds (2004), *The German Financial System*, Oxford Univ. Press, Oxford, UK.

Laursen, K. and Salter, A. (2006), 'Open for innovation: the role of openness in explaining innovation performance among u.k. manufacturing firms', *Strategic Management Journal* **27**(2), 131–150.

Levitas, E. and McFadyen, M. A. (2009), 'Managing liquidity in research-intensive firms: signaling and cash flow effects of patents and alliance activities', *Strategic Management Journal* **30**(6), 659–678.

Lyons, R. K., Chatman, J. A. and Joyce, C. K. (2007), 'Innovation in services: Corporate culture and investment banking', *California Management Review* **50**(1), 174–191.

Main, A. (2006), 'Distance constraints: The limits of foreign lending in poor economies', *Journal of Finance* **61**, 1465–1505.

Markowitz, H. (1952), 'Portfolio selection', *Journal of Finance* **7**(1), 77–91.

Markowitz, H. M. (1991), 'Foundations of portfolio theory', *Journal of Finance* **46**(2), 469–477.

Matthey, A. (2010), 'Do public banks have a competitive advantage?', *European Journal of Finance* **16**(1), 45–55.

McFadden, D. (1973), *Frontiers in Econometrics*, Academic Press, New York, chapter Conditional logit analysis of qualitative choice behavior.

McFadden, D. (1978), *Spatial Interaction Theory and Planning Models*, Amsterdam, New York, North-Holland, chapter Modeling the Choice of Residential location, p. 75 96.

Merton, R. C. (1977), 'An analytic derivation of the cost of deposit insurance and loan guarantees an application of modern option pricing theory', *Journal of Banking & Finance* **1**, 3–11.

Modigliani, F. and Miller, M. H. (1958), 'The cost of capital, corporation finance and the theory of investment.', *American Economic Review* **48**(3), 261.

Ndofor, H. A. and Levitas, E. (2004), 'Signaling the strategic value of knowledge', *Journal of Management* **30**(5), 685–702.

Neyman, J. and Scott, E. L. (1948), 'Consistent estimates based on partially consistent observations', *Econometrica* **16**(1), 1–32.

OECD (2005), Oslo manual: Guidelines for collecting and interpreting innovation data, Technical Report 3, Organisation for Economic Co-operation and Development: Paris, Paris.

OECD (2008), Handbook on constructing composite indicators. Organization for Eonomic Co-operation and Development.

Ongena, S. and Smith, D. C. (1998), *Bank Relationship: A Review*, Cambridge University Press, chapter 2, pp. 221–258.

Ongena, S. and Smith, D. C. (2001), 'The duration of bank relationships', *Journal of Financial Economics* **61**, 449–475.

Pakes, A. and Schankerman, M. (1984), The rate of obsolescence of patents, research gestation lags, and the private rate of return of research resources, *in* U. of Chicago Press, ed., 'R & D, Patents, and Productivity', University of Chicago Press, pp. 73–88.

Peek, J. and Rosengren, E. S. (2005), 'Unnatural selection: Perverse incentives and the misallocation of creditr in japan', *American Economic Review* **95**(4), 1144–1166.

Petersen, M. A. and Rajan, R. G. (1994), 'The benefits of lending relationships: Evidence from small business data', *Journal of Finance* **44**, 3–37.

Petersen, M. A. and Rajan, R. G. (1995), 'The effect of credit market competition on lending relationships', *Quarterly Journal of Economics* pp. 407–443.

Petersen, M. A. and Rajan, R. G. (1997), 'Trade credit: Theories and evidence', *Review of Financial Studies* **10**(3), 661–691. ArticleType: primary_article / Full publication date: Autumn, 1997 / Copyright 1997 Oxford University Press.

Petersen, M. A. and Rajan, R. G. (2002), 'Does distance still matter? the information revolution in small business lending', *Journal of Finance* **57**(6), 2533–2570.

Phelps, E. S. and Tilman, L. M. (2010), 'Wanted: A first national bank of innovation', *Harvard Business Review* **88**(1/2), 102–103.

Porta, R. L., Lopez-de Silanes, F. and Shleifer, A. (2002), 'Government ownership of banks', *Journal of Finance* **57**, 265–301.

Rajan, R. G. (1992), 'Insiders and outsiders: The choice between informed and arm's-length debt', *Journal of Finance* **47**(4), 1367–1400.

Rajan, R. and Zingales, L. (2001), 'Financial systems, industrial structure, and growth', *Oxford Review of Economic Policy* **17**, 467–482.

Rao, H. (1994), 'The social construction of reputation: Certification contests, legitimation, and the survival of organizations in the american automobile industry: 1895–1912', *Strategic Management Journal* **15**, 29–44.

Rindova, V. P., Williamson, I. O., Petkova, A. P. and Sever, J. M. (2005), 'Being good or being known: An empirical examination of the dimensions, antecedents, and consequences of organizational reputation', *Academy of Management Journal* **48**(6), 1033–1049.

Santikian, L. (2011), The ties that bind: Bank relationships and small business lending. Discussion Paper USC Marhall School of Business and SSRN eLibary.

Sapienza, P. (2004), 'The effects of government ownership on bank lending', *Journal of Financial Economics* **72**(2), 357–384.

Schwartz, M. (2012), Kfw-mittelstandspanel 2012, Technical report, KfW.

Sharpe, S. A. (1990), 'Asymmetric information, bank lending, and impliocit contracts: A stylized moel of customer relationships', *Journal of Finance* **45**, 1069–1087.

Shimizu, K. (2012), 'Bankruptcies of small firms and lending relationship', *Journal of Banking & Finance* **36**(3), 857–870.

SpG (2005), 'Sparkassengesetz fr baden-wrttemberg (spg) in der fassung vom 19. juli 2005', *Gesetzblatt fr Baden-Wrttemberg* pp. 587–601.

Stein, J. C. (2002), 'Information production and capital allocation: Decentralized versus hierarchical firms', *Journal of Finance* **57**(5), 1891–1921.

Stiglitz, J. E. (2002), 'Information and the change in the paradigm in economics', *American Economic Review* **92**(3), 460–501.

Stiglitz, J. E. and Weiss, A. (1981), 'Credit rationing in markets with imperfect information', *American Economci Review* **71(3)**, 393–410.

Thakor, A. V. (1996), 'Capital requirements, monetary policy, and aggregate bank lending: Theory and empirical evidence', *Journal of Finance* **51**, 279–324.

Van de Ven, W. P. and Van Praag, B. (1981), 'The demand for deductibles in private health insurance', *Journal of Econometrics* **17**, 229–252.

Vincente-Lorente, J. D. (2001), 'Specificity and opacity as resource-based determinants of capital structure: Evidence for spanish manufacturing firms', *Strategic Management Journal* **22**(2), 157–177.

Williamson, O. E. (1973), 'Markets and hierachies: Some elementary considerations', *American Economci Review* **63**(2), 316–325.

Wilner, B. S. (2000), 'The exploitation of relationships in financial distress: The case of trade credit.', *Journal of Finance* **55**(1), 153–178.

LEBENSLAUF

Daniel Höwer

AUSBILDUNG

05/2008–06/2013	Promotion an der Universität Mannheim; Referent: Prof. Konrad Stahl, (Ph.D.), Universität Mannheim; Koreferent: Prof. Yossi Spiegel, (Ph.D.), Tel Aviv University
10/2005–09/2007	Master of Arts in Economics an der Universität Duisburg-Essen, Campus Essen
10/2002–09/2005	Diplom-Volkswirt an der Universität Hamburg
09/1999–06/2001	Friedrich-Dessauer-Schule Limburg/Lahn (Fachhochschulreife)
08/1990–07/1996	Anne-Frank-Realschule Montabaur

BERUFSERFAHRUNG

seit 05/2008	Wissenschaftlicher Mitarbeiter im Forschungsbereich Industrieökonomik und internationale Unternehmensführung am Zentrum fr Europäische Wirtschaftsforschung (ZEW), Mannheim
10/2007–04/2008	Investment Analyst bei der Investment Data Services GmbH (IDS), Allianz-Gruppe, München
08/1999–07/2001	Angestellter bei der Kreissparkasse Limburg, Limburg/Lahn
01/1999–07/1999	Angestellter bei der Kreissparkasse Westerwald, Westerburg
08/1996–01/1999	Ausbildung zum Bankkaufmann bei der Kreissparkasse Westerwald, Montabaur

Ehrenwörtliche Erklärung

Hiermit erkläre ich, dass ich die Dissertation selbständig angefertigt und mich anderer als der in ihr angegebenen Hilfsmittel nicht bedient habe, insbesondere, dass aus anderen Schriften Entlehnungen, soweit sie in der Dissertation nicht ausdrücklich als solche gekennzeichnet und mit Quellenangaben versehen sind, nicht stattgefunden haben.

Mannheim, den 04. April 2013

(Daniel Höwer)