# Government Ownership of Banks and Corporate Innovation *

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**ABSTRACT**

In this paper we analyze the impact of government and private ownership of banks on firms' probability innovating. We estimate firms' decision to innovate and their selection of a main lender for a sample of 9000 German manufacturing companies. Since these two decisions may be made simultaneously, we use the number of private and government bank branches located in close proximity to our sample firms as an instrument for the selection of each firm's main lender. We find that the probability that a firm will innovate is about 10 to 13 percent higher if the main lender is a private bank, compared to if it is a government bank (after controlling for firm characteristics and selectivity bias). Furthermore, we analyze whether the existence of state-owned banks impacts the aggregate level of corporate innovation. To do so, we focus on geographic regions that are covered by state-owned banks experiencing a distress event. Given that local politicians refrain from bailing out state-owned banks if the distress event occurs before an election, the timing of distress events over the electoral cycle provides us with exogenous variation in the future presence of state-owned banks in these regions. We document a higher level of corporate innovation in regions whose state-owned banks experienced a distress event right before an election as compared to regions whose state-owned banks experienced a distress event after the elections. Thus, extensive government involvement in the allocation of credit comes at the cost of lower corporate innovation and therefore of economic development.

JEL Codes: F34, F37, G21, G28, G33, K39.

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# 1. Introduction

During the current financial crisis governments have been forced to take over large parts of the banking system. Potentially this public sector involvement in the banking sector could have considerable effects in the long run, in all major industrialized countries. One of the most important functions of a financial system is that financial intermediaries select those entrepreneurs with the best chances of developing new products, which increases the rate of technological progress in an economy (King and Levine 1993; Levine and Zervos 1998; Beck, Levine, and Loayza 2000a; Levine 2005 for a survey).[1] Thus, banking development stimulates the introduction of innovations (Benfratello, Schiantarelli, and Sembenelli 2008). In this paper, we examine whether public or private financial intermediaries are better in selecting promising innovative projects and thus foster technological progress. More specifically, we analyze the impact of government-owned versus private-owned banks on the innovation ability of corporations.

Theory is ambivalent about the effect of government bank ownership on technological progress. On the one hand, government-owned banks might alleviate market failures in the process of innovation financing, thereby fostering growth. The most important market failures associated with financing innovations are asymmetric information and moral hazard (Carpenter and Petersen 2002; Hall 2002),[2] as well as the existence of positive externalities generated by the provision of external finance for

[1] Beck, Levine, and Loayza (2000b) find a positive correlation between financial development and TFP growth.

[2] A new technology is less understood by third parties, and during the development of the new technology few interim signals on its outcome can be verified (Goodacre and Tonks 1995). Furthermore, the salvage value from financing innovation is small, leaving the entrepreneur with stronger incentives to add risk, since a large proportion of the losses accrues to the outside financier (see also Herrera and Minetti 2007).

innovations.[3] The existence of such externalities might be a rationale for a subsidy in the form of government financing (e.g. Hainz and Hakenes 2012).[4]

On the other hand, government bankers' incentives can result in a misallocation of financial resources (La Porta, Lopez-De-Silanes, and Shleifer 2002; Sapienza 2004; Carvalho 2014). The causes of resource misallocation associated with government financing are manifold: e.g. politicians tend to influence their bankers' financing decisions for their personal goals, or government banks are reluctant to shut down unprofitable corporations to secure employment.[5] This political view of government bank ownership implies that government banks may not facilitate an efficient allocation of resources by preventing capital to be channeled to new innovative enterprises. Thus, there are diverging arguments about the effect of government ownership of banks on corporate innovation. It therefore remains an empirical question which is yet to be answered, as evidence on this issue for industrialized countries is rare.

Recent papers exist showing that credit relationships may affect corporate innovation. Herrera and Minetti (2007) find that a stronger relationship between lender and borrower, proxied by the duration of the credit relationship between the lender and the borrower, promotes innovation. Benfratello, Schiantarelli, and Sembenelli (2008) show that local banking development affects the probability of corporate innovations. For a sample of large publicly traded US firms, Atanassov, Nanda, and Seru (2007) document that more innovative firms actually prefer arm's length financing to relationship borrowing.

[3]Such externalities are first of all technology spill-overs, but can also take the form of regional employment prospects etc. See Romer (1990), Aghion and Howitt (1992) or Aghion and Howitt (1997) for an overview.

[4]According to Lin, Srinivasan, and Yamada (2015) and Coleman and Feler (2014) government-owned banks can help mitigate financial shocks suggesting that lending markets are likely to be characterized by market failures.

[5]Bertrand, Schoar, and Thesmar (2007) find that following government deregulation of the French banking sector, banks became less willing to bail out poorly performing firms and more likely to support restructuring activities. Consequently, they observe an improvement in allocative efficiency across firms following deregulation. Khwaja and Mian (2005) present empirical evidence for Pakistan. They find that government banks systematically favor politically-connected firms (i.e. firms whose director participates in an election) over non-connected firms, even though loans to connected firms have a 50 percent higher default rate. They estimate the economy-wide costs of the rents associated with connected lending being 0.3 to 1.9 percent of GDP every year.

Our paper differs in several dimensions from previous work in the field. Studies of bank governance mostly focus on developing countries (e.g. Khwaja and Mian 2005). In developing countries, it is difficult to differentiate between the particular institutional characteristics (e.g. corruption) of these economies and the consequences of government bank ownership. Therefore, these findings cannot be generalized for industrialized countries. The German corporate landscape provides a good laboratory for examining the link between bank ownership and firms' innovation decisions, and thereby fill this gap. First, because corruption is rather low, it is not the main driver of government bankers actions. Second, the German financial sector is bank-based: banks are the prevalent source of finance for German firms, and market-based financing is of secondary importance. Third, the existing government banking sector is about the same size as the private banking sector. Finally, the German economy is characterized as innovative.[6]

We construct a unique dataset that allows us to observe individual corporate lending relationships. For a sample of 9 000 German manufacturing enterprises, we determine their credit relationships for all loans exceeding 1.5 million euros through the Bundesbank credit register for the years 1993 to 2015. Combining this dataset with patent information from the European Patent Office allows us to identify firms' innovation activity, as well as the type of main lender.

Another novelty of our paper is that we model firms' selection of their main lender. A central concern for our study is a possible problem of endogeneity, namely that firms might choose a specific type of bank depending on their innovation activity. Thus, firms that plan to innovate in the future might choose a government-owned or private bank depending on the banks' willingness to finance new technologies. We overcome this endogeneity problem in two ways. First, we identifying all existing bank branches located near our sample firms. This measure is used as an instrument (as discussed at length in section 4.1), because previous research has shown that geographic distance plays an important role in relationship banking (e.g. Degryse and

[6]According to the OECD (2007) R&D spending in Germany is well above the OECD average in 2005.

Ongena 2005; Petersen and Rajan 2002).[7] Small firms in particular bear considerable costs if applying for external finance with non-regional banks.[8] Since private banks do not have branches in geographic proximity to all our sample firms, some firms have only government-owned banks in close geographic proximity. This allows us to identify whether the ownership type of a bank itself has a causal effect on the innovation activity of a firm.

Second, we focus on exogenous variation in the presence of state-owned banks of different geographic regions. To do so, we focus on different counties that are covered by state-owned banks experiencing a distress event. As shown by Bian, Haselmann, Kick, and Vig (2016) local politicians refrain from bailing out state-owned banks if the distress event occurs before an election. More specifically, the probability of bail-out by local politicians is more than 30 percent less likely if the distress event of a local bank occurs in the year before the election as compared to the years after the election. The involvement in the bail-out of the local politician has consequences on the future presence of the state-owned banks in the respective regions. If local politicians organize a bail-out the size of the regional bank remains basically the same. If local politicians do not organize the bail-out, a centralized institution is conducting a restructuring of the bank (that either results in a down sizing or a distress merger with a neighbouring state-owned bank). As a result the share of corporate lending provided by state-owned banks is drastically reduced in the respective counties following the distress event. We use the occurrence of distress events of state-owned banks over the electoral cycle as an instrument to obtain exogenous variation in the presence of state-owned banks in a given region. This allows us to analyze the impact of state-owned bank presence on the aggregate level of corporate innovation.

[7] There is also evidence that the emergence of local entrepreneurship depends on regional financial development. Michelacci and Silva (2007) have documented the importance of local financial development for local entrepreneurs.

[8] For large firms that have access to financial intermediaries nationwide as well as to national and international securities markets, local banking market development matters to a smaller extent (Benfratello, Schiantarelli, and Sembenelli 2008).

We find that a firm's probability to innovate is related to the ownership of its main lender. The probability of a firm innovating is about 10 to 13 percent higher if the main lender is a private as opposed to a government bank (after controlling for firm characteristics and selectivity bias). These findings are based on a bivariate probit model with full maximum likelihood estimation. The ownership type of the main lender is especially important for smaller firms, since their access to finance is more dependent on the local supply of lenders. Among innovating firms, those with a private main lender tend to produce more innovation compared to firms with a government main lender.

The presence of state-owned banks has an impact on the aggregate level of corporate innovation. Regions whose state-owned banks experience a distress event before an election (and thus tend to be not bail-out by local politicians) experience significant more corporate innovation as compared to regions whose state-owned banks experience a distress event following an election (and thus have a high probability to be bail-out by local politicians. Importantly, this finding implies that the presence of state-owned banks has a damping impact on corporate innovation.

A remaining question is why potential innovators do not simply switch from state-owned banks to private banks once they plan to innovate (e.g. private banks are better suited to finance new technologies). We argue that the type of lending relationship endogenously affects a firm's innovation activity. As mentioned before, asymmetric information and moral hazard are especially pronounced in the process of technology financing. A bank can moderate this moral hazard problem by gathering information on the new technology to be financed (Herrera and Minetti 2007). In this process, a firm's main lender generally functions as a delegated monitor for the other lenders (Diamond 1984) and is therefore the main producer of information concerning the borrower. Once a firm is stuck in a relationship with a main lender, it is difficult to switch to a new financier. The problem is that potential new financiers know that a firm's main lender has an informational advantage regarding the borrower. Consequently, switching main bank is likely to be very costly either because the new

lender lacks information or switching lender sends a bad signal (since the new lender may assume that a financing decision was refused by the old lender). This hold-up problem is especially pronounced for technology finance, since such projects tend to be informationally opaque.

The remainder of this paper is structured as follows: Section 2 describes the German banking system, explains the construction of our dataset, and provides descriptive statistics. In Section 3, we introduce the empirical analysis that we follow in this paper. Section 4 presents our results, and section 5 concludes.

# 2. Data and descriptives

## 2.1. The German banking sector

The German financial sector is bank-based, with a universal banking system. One of the particularities of the German banking sector is the so-called three pillar structure which refers to the three different legal ownership forms of German banks. The three forms are government-owned banks, private banks and credit cooperatives. While credit cooperatives mostly specialize in household and small business finance, private and government-owned banks compete for enterprise financing. In the following, we focus on the differences between government-owned banks and private banks. Together, these two groups hold 84.5% of the total assets of German banks (39% held by private banks and 45.5% by government-owned banks, see Table II).[9] While the market share of government-owned banks in Germany is relatively high by European standards (Hartmann, Heider, Papaioannou, and Duca 2007), a high share of government involvement in the banking sector is not uncommon else where. Porta, Lopez-De-Silanes, and Shleifer (2002) find, for a large sample of countries, that on average 30% of the banking sectors were controlled by governments in 1995.

[9]We restrict our analysis to these two groups, as credit cooperatives are underrepresented in our sample. The reason for this is that credit cooperatives are typically very small and therefore are generally not the main lenders of our sample firms.

The specific structure of the German banking sector has evolved over time. The first public saving banks were founded in the 18th/19th century in Germany in order to make savings accounts accessible, and the first joint stock banks were founded in the 19th century.[10] The structure of the government-owned banking sector is the result of laws implemented at the beginning of the twentieth century and after the second world war. This so-called 'Sparkassengesetz' gave rise to a country wide community banking sector. Nowadays, government-owned banks, also referred to as saving banks, are owned by local communities and state governments. The regional principle requires community banks to supply local finance and prevents competition between government-owned banks, by forbidding them to serve customers beyond their community. The objectives of government-owned banks as laid down in the respective laws (e.g. Sparkassengesetz 2008 and Sparkassengesetz 2005) are manifold: e.g. ensuring the availability of credit to enterprises and communities as well as facilitating individual savings.[11] The difference in objectives of government-owned and private bankers is the main difference between the two groups of banks.

The German banking sector consists of 2,277 banks and nearly 40,000 bank branches.[12] The legal framework, however, prohibits consolidation between private and government-owned banks. Consolidation can only take place within each of the pillars, so that competitive pressure through M&As is low for government-owned banks. A typical example for the local distribution of private and government-owned banks is shown in Figure 1 for the district of Karlsruhe. As can be seen in this graph, government-owned banks possess a dense branch network in rural as well as urban areas. The strong presence of government-owned banks in rural areas is a result of the aforementioned regional principle. As a consequence, rural areas have an especially

[10] See Hackethal (2004) and Brunner, Decressin, Hardy, and Kudela (2004) for more information on the German Banking market.

[11] Commonly this legal framework includes a statement that profit maximization is not the main objective of government-owned banks and that they have to serve common welfare. Other objectives are to provide a checking account to every private person, irrespective of their income, and the economic education of the youth (see the 'Sparkassengesetze', 'Sparkassenordnung' and 'Landesbankgesetz' of the Länder in Germany).

[12] Within Europe Germany is among the countries with the highest number of credit institutions, branches and bank employees, see European Central Bank (2007) for details.

high branch density, so private banks generally tend to concentrate their branches in urban areas.

## 2.2. Firm data and firm' innovation abilities

Time series information for the financial statements of German corporations is obtained from Bureau van Dyck's Amadeus database. As a starting point we take all German manufacturing firms and obtain 9,310 firms and 32,839 firm year observations (for the period 1993-2015). A detailed description of the underlying data sets and the matching strategies can be found in Appendix A.

In order to measure the innovation activity of firms, we collect data on successful patent applications for our sample firms. Patent applications have been used in several empirical studies to measure the innovation activity of firms (Seru 2014; Angrist and Krueger 1991) and have been found to be superior to accounting figures for measuring corporate innovation activity (Griliches and Mairesse 1991; Trajtenberg 1990a,b).[13] We collect patent information from the European patent office (EPO), extracted from the EP-CESPRI database. We have information on the number of patents per firm each year and information on the number of citations[14] per year from EPO (see Table III for a distribution of patent application and citations per industry). We use both the number of patents to measure innovation intensity and a binary variable classifying firms into innovators and non-innovators.[15]

We link the financial statement information for our sample firms to the German credit register of the Deutsche Bundesbank. This allows us to identify the lenders to a firm and provides us also with data for lending relationships from 1993 to 2015. The credit register includes information on each credit relationship if the total outstanding

[13]In addition, according the German accounting standards (HGB), R&D expenditures include expenditures to purchase patents and copyright rights, and are therefore not appropriate to measure the innovation activity of a firm (see Bessler and Bittelmeyer 2006, and Jeny and Stolowy 1999).

[14]In the patent application process, the relationship to other patents has to be clarified and in this process, precedent patents to which the new invention is related are cited. See Haeussler, Mueller, and Harhoff (2009) for a more detailed description.

[15]For the definition of the variables, see Table I.

amount of loans in a given quarter exceeds 1.5 million Euros.[16] We are therefore able to classify the firms based on their main lender (private or government-owned), defining the main lender as the bank granting the highest share of loans to the firm. Finally, in order to control for the different regional environments in which firms operate (government-owned banks tend to be better represented in rural areas), we also collect data on local community development (GDP per capita per region) and population density.

We have to control for the fact that the firm's choice of main lender may be endogenous, as will be discussed at length in Section 4.1. We therefore collect information on the ownership of banks and branches close to the firms in our sample (within a radius of 3 km around each firm, a surface area of about 28 $km^2$). As mentioned before distance matters in the relationship between firms and their lender. Our aim is to find a measure of local bank supply provided by private and government-owned banks in close geographic proximity to our sample firms. Thus, we count the number of banks and branches in proximity to the firms and the number of private (*share_private*) and government-owned banks. Our instrument will be the share of private banks (to the sum of private and government-owned banks). We also calculate the number of private and government-owned banks within a radius of 10 km (a surface of about 315 $km^2$).

All data sources are matched as described in Appendix A. We end up with a data set of 12,343 observations for 4,588 firms. About one third of all observations are from innovative firms (see Table IV), 1,362 of these observations have a government-owned bank as main lender and 2,860 a private bank. Our sample firms have, on average, total assets of 265 million Euros and a debt to assets ratio of 28%. Overall, private banks make up a 40% share.

In order to obtain initial insights into the relationship between firm innovation and bank ownership, we present descriptive statistics for firms having either a government-owned or a private bank as main lender. We find that firms having a private bank as main lender are more likely to be innovative, the difference being fairly high at 10%.

[16] Please refer to Schmieder (2006) for a detailed description of the credit register of the Bundesbank.

They furthermore apply on average for 1.5 patents more than customers of government-owned banks, supporting the hypothesis that these two groups differ substantially. On average, firms with a private main lender are somewhat larger and older. If a private bank serves as a main lender, the number of total lenders is generally larger. Private bank customers tend to be in regions with a higher population density, a higher output per capita and a larger supply of bank branches in geographic proximity. Finally, we can see evidence that geographic proximity affects the formation of a lending relationship. Firms that have a lending relationship with a private bank also have a higher number and share of private banks with a radius of 3 km.

We also compare innovative and uninnovative firms. The innovative firms in our sample are larger (measured by assets, sales or number of employees) and older than their not innovative counterparts (see column 4 of Table IV). Innovative firms have more bank branches, especially from private banks, in close geographic proximity, and are settled in more populated and more economically active regions.

## 2.3. Data on regional distress events by state-owned banks

The definition of state-owned bank distress events is based on Bian, Haselmann, Kick and Vig (2016). By statutes, savings banks do not compete one with the other as their operations are constrained to the municipalities that formally own them. The head of the respective municipal government, who is either a city mayor or a county administrator (referred to as local politician throughout the paper) acts as the chairman of the local savings bank's supervisory board.[17] Their position as a chairman of the board gives local politicians a strong influence on the operations of the bank (e.g., the appointment of bank management and the allocation of earnings).

While savings banks in distress will always be bailed out, there are two different ways in which the bailout can be organized. On the state level, a so-called saving bank

[17]The supervisory board of a savings bank has about 15 members. The members besides the chairman are representatives from local authorities (in most cases politicians from the local parliament who account for about two thirds of the board members).

association operates a safety net for these banks. The decision on support measures and restructuring plan is made by the board of the association, which consists of politicians and bank executives from other municipalities covered by the respective association. The board members have to rely on a broad perspective when deciding on support measures. Due to the distance between their own jurisdiction and the savings bank's municipality they do not derive any benefits from controlling the bank.

On the local level, the politicians who chair the supervisory board may step in by injecting taxpayers' money. Such interventions allow them to prevent the implementation of restructuring activities by the association. This could be efficient, since local politicians, compared with the board of the association, are much closer to the bank and thus have better information on the underlying causes of the distress event. Moreover, they might know better what a restructuring of the bank would mean for the local economy (which they govern in their function as city major or county administrator). However, decisions by local politicians could be distorted by personal considerations. Restructuring activities imposed by the association are likely to reduce the pecuniary and the non-pecuniary benefits that local politicians can derive from their position as a chairman. For example, their ability to influence the allocation of earnings—which gives them access to funds that are not controlled by the local parliament—is likely to be constrained. Such considerations might lead the politicians to intervene also in cases where tight restructuring (or even a distressed merger) would actually be the more efficient option.

Overall, we identify 148 distress events of German savings banks during our sample period from 1994 to 2010. Among these 148 distress event, more than one third was resolved by capital injections from the owner (55 cases). The remaining 93 events were dealt with by the association. Out of these 93 cases, 44 banks experienced a distressed merger in the year following the distress event.

Finally, we collect data on county level elections. The focus is on the elections in rural countries and urban municipalities, for which the laws are enacted at the state level. While the electoral cycle for county / city parliaments is five years in almost

all German states (with the exception of Bavaria and Bremen, that have a six year and a four year cycle, respectively), there are some differences in the elections of local heads of government. In many German states, mayors or district administrators are directly elected in separate elections that take place on the same day as the election of the local parliament. Our focus is on parliamentary elections at the county or city level. In most cases these election take place on the same day as the election of the mayor / county administrator. Data of the regional election dates is obtained from the respective state election offices.

# 3. Empirical analysis

## 3.1. Firm-level analysis

We assume that a firm ($i$) has a choice to innovate or use an existing technology. This choice can be modeled as follows:

$$y_i = \alpha \cdot X_i + \delta \cdot F_i + u_i \tag{1}$$

with $y$ as our measure of innovation that takes the value of one if firm $i$ decides on a new technology (gets a patent granted during our sample period) and zero otherwise. The decision to innovate is likely to depend on a series of firm-specific characteristics such as industry sector, firm size and firm age that are summarized by the vector $X_i$. Whether the main lender of a firm is a government or private bank is captured by $F_i$, which takes the value of one if a government-owned bank is the main lender and zero if the main lender is a private bank. Our coefficient of interest is $\delta$ which aims to measure the sensitivity of ownership of the main bank to a firm's decision to innovate. We refer to specification 1 as our 'outcome' equation.

This interpretation of $\delta$ is, however, problematic if the choice of the Financier $F_i$ and the decision to innovate are jointly determined. If a firm expects that one of the two types of banks will be better suited to finance innovation, it might choose

the bank that suits its preferences best. In this case, the average treatment effect $\delta$ would capture this choice by a firm and not an endogenous effect of the main bank's ownership type on innovation by the borrowing firm.

In order to control for this selectivity bias, we introduce a bivariate probit model (Heckman 1978) in which a firm's decision to innovate is jointly determined by a firm's choice of the ownership of its main bank. The selection equation is as follows:

$$F_i = \beta \cdot X_i + \gamma \cdot Z_i + v_i \tag{2}$$

with $Z_i$ being a vector of instruments. Equation 2 is referred to as our 'selection' equation.

Both decisions by the firm that we model (the innovation and the main bank selection) are binary, so that there are four states of the world. The likelihood function corresponding to this set of events is a bivariate probit model. A similar research design has been applied in several empirical studies, such as Evans and Schwab (1995).

In a second step, we examine the innovation intensity among the firms classified as innovators. We use the number of patents each innovator applies for as the dependent variable of the 'innovation' equation. In this case our two-equation system corresponds to a classical treatment model. This model can be either estimated by full maximum likelihood or a two-stage procedure (Imbens and Angrist 1994). We repeat these tests, replacing the number of patents with the number of citations. This test allows us to measure the relative importance of the granted patents. Furthermore, we reestimate our main model by applying alternative definitions for a firm's main lender and an alternative definition of our instrument.

## 3.2. Aggregate analysis

We aim at evaluating how aggregate future corporate innovations are affected in regions that are covered by state-owned banks that were bailed out by local politicians

with regions that are covered by state-owned banks that had been bail-out by the association. Our baseline specification for this comparison is as follows:

$$Y^{post}_{i,t_1-t_5} = \alpha_j + \alpha_t + \delta_1 BLP_{it} + B'_{it-1}\gamma + C'_{kt-1}\delta + \epsilon_{it}, \tag{3}$$

where $i$ denotes the individual bank, $j$ the association to which the bank belongs, $k$ the county or city of the bank, and $t$ the year in which the distress event occurred. The dependent variable is a the five year post performance measure of bank $i$ or the five year post performance measure of the macroeconomics situation of the county the bank is located in. With regards to the bank performance measures $Y^{post}_{i,t_1-t_5}$, we use the capital ratio, the non-performing loan ratio, the loan loss provision ratio and bank's ROA. The post performance macroeconomic measures comprise the aggregate share of state owned banks, overall loans to regional GDP, loans to the private sector to GDP,real GDP growth, and the share of employees in the population in the county the distress bank is located.

The explanatory variable of interest is $BLP_{it}$ that takes the value of one if the bank distress is resolved by the politician and the value of zero if the distress is resolved by the association.[18] Bank level control variables are denoted by the vector $B_{it-1}$ and include the bank's relative size to county / city GDP, the capital ratio, the return on assets, the non-performing loans ratio, the market share, and the deposit ratio. They are lagged by one year in order to obtain pre-event values. Regional control variables are also lagged by one year and include the level and the growth rate of county-level GDP per capita. They are summarized in the vector $C_{kt-1}$. In our most stringent specification, we include two sets of dummy variables, one of them indicating the association to which the bank belongs and the other one indicating time dummies. The specification further includes a random error term $\epsilon_{it}$. Standard errors are clustered by year and robust to heteroscedasticity in all our regressions.[19]

[18] Cases in which both the association and the owner inject money into the bank are classified as the category that contributed the larger amount of capital. See Section **??** for details.

[19] Alternatively we cluster standard errors by association. This results in lower standard errors.

Evaluating consequences of political bail-outs decisions is challenging due to inherent selection issues that arise from politician's decisions which type of banks to bail-out. If this selection decision by politicians is based on unobservables, post-performance of the affected banks might be affected by this selection rather than the treatment by politicians.

We circumvent this issue by taking advantage of the observation that local politicians tend to not bail-out banks in the year prior to the election (see Bian, Haselmann, Kick and Vig, 2016). Therefore, we can use the electoral cycle as an instrument. It is important to note that the estimates in the instrumental analysis is only coming from switchers (Imbens and Angrist 1991). Thus, our estimates are driven by those distress banks for which politicians would alter their bail-out decision if the distress event would have occurred at a different point in time during the electoral cycle.

To implement this instrumental variable approach, we estimate the following first-stage regression: [20]

$$BLP_{it} = \alpha_j + \alpha_t + \delta_2 Cycle_{kt} + B'_{it-1}\gamma + C'_{kt-1}\delta + \epsilon_{ijkt}, \tag{4}$$

with $Cycle_{kt}$ being the instrumental variable. The second-stage estimates the impact of a political bail-out on banks' future performance (or the future macroeconomic performance of the banks' bushiness area).

# 4. Firm-level Results

## 4.1. The choice between a government and a private main lender

We start with the estimation of our 'selection' equation. We use the number of private bank branches to all bank branches located in a radius of 3 km around each firm as an instrument. For our instrument to be valid, two conditions have to be met. First, it has

[20] Using a nonlinear logit model gives results that are very similar to the results from our linear specification (see Table **??**).

to be an important determinant of a firm's decision to select its main lender. Second, it must not be a determinant of a firm's decision to innovate. The first condition can be easily tested by simply estimating the selection equation 2 individually and testing for the explanatory power of the instrument.

The results are shown in Table V. In the first column, we add the relative number of private banks to all banks (*share_private*) and the total number of banks (*total_banks*) in a radius of 3 km around each firm as instruments. Further, we add firm size, and, age, as well as industry and year fixed effects as explanatory variables. Both of our instruments enter the probit model significantly. Firms that have a higher fraction of private banks and more branches in their surroundings are less likely to choose a government bank as their main bank. Furthermore, larger firms tend to have a relationship with a private bank and older firms with a government bank. Since government banks are more predominant in rural areas and private banks in urban areas (as can be seen for example in Figure 1), the latter finding could be driven by differences in the population density around the firm's location. Therefore, we include population density (*pop_density*) and regional development (*regional_GDP*) of the community in which a firm is located (see Panel B column 1'). Both factors have an impact on the main bank selection. In more heavily populated areas, more private banks exist, and therefore firms are less likely to have a government bank as a main lender.

Second, the location of private bank branches in close geographic proximity to a firm may not be a determinant of a firm's innovation decision. One way to test for this is to include our instrument *share_private* in the outcome equation. This does not constitute a formal test, since we have argued before that a bivariate probit is the correct specification. Nevertheless, this test allows us to analyze the correlation between the probability of innovating and the relative number of private branches in the proximity of a firm, once controlling for other firm characteristics. As shown in Table VI, the estimated coefficient of *share_private* is not statistically significant. Even

though this is not a formal test for the validity of our instrument, no direct relationship between the bank-firm location and the probability of innovating is detected.

For our instrument to be meaningful, it is also important that bank as well as firm location are not endogenously determined (e.g. a certain bank type does not choose location based on innovation activity of firms, and firms do not locate in proximity to a certain bank type based on their innovation activity). We are less concerned about endogeneity of bank branch location in Germany. As argued before, the regional principle demands that government-owned banks establish a dense branch network in order to provide an area-wide supply of finance (see Section 2.1). Thus, the locational choice of government banks is largely predetermined by law. The observed regional distribution of private and government-owned bank branches corresponds with these considerations (see Figure 1). Thus, while firms located in urban areas generally have a choice between private and government-owned lenders, firms located in rural areas often only find government-owned banks in geographic proximity.

Arguing that firm location is not chosen endogenously is more difficult. In our sample of manufacturing firms, moving is not frictionless, since it requires the relocation of manufacturing halls and machines. These frictions should be especially important for small firms and firms with a high fraction of tangible assets, since moving location is more costly. In order to see whether firm location is determined endogenously, we re-estimate our model only for firms with a fraction of tangible assets in the top quartile. The results are reported in the subsequent section.

Larger firms are likely to have better access to nationwide banking markets and therefore rely less on the conditions of their local banking market. Furthermore, larger firms may alternatively access market-based finance. Consequently, our instrument should be more relevant for smaller firms. To test for this presumption, we stepwise remove large firms from our sample and re-estimate our selection equation for the remaining sample. Results are reported in Table V, columns 2 to 5. In column 2, the largest $75^{th}$ percentile of firms are excluded from the sample. The coefficient *share_private* increases in magnitude. If we only estimate the selection model for

the smallest $50^{th}$, $25^{th}$ and $10^{th}$ percentiles of firms, this effect becomes more drastic. Therefore, we conclude that our instrument is more relevant for medium-sized and smaller firms. The coefficient is significant for all groups, but increases in magnitude, if we estimate the selection model for the smallest $50^{th}$, $25^{th}$ and $10^{th}$ percentiles of firms.

## 4.2. Government ownership and innovation

Table VII presents coefficients of the outcome equation from the bivariate probit model. In column 1, we exclude community controls (*pop_density* and *regional_GDP*) from the selection equation, while these controls are included in the system presented in column 2. Having instrumented for the selection of a bank's choice of its main lender, the ownership type of the banker ($F_i$) has a significant impact on a firm's probability to innovate. The probability of innovating is about 13 percent higher for firms with a private as compared to a government main lender (see marginal effects reported beside the coefficients).[21] The coefficients of the firm characteristics suggest that older and larger firms are more likely to innovate. The correlation between the error terms of the outcome and selection equation is denoted by $\rho$. As reported in the lower part of the table, we can reject the hypothesis that $\rho$ is equal to zero, establishing the need for a bivariate estimation technique of our model.

Results for firms with a high fraction of tangible assets and thus high moving costs are reported in Table VII, column 3. Results are robust for estimation of this subsample. The probability of innovating for a firm that is in a lending relationship with a government-owned bank is actually even smaller.

Estimation of the full maximum likelihood model does not provide estimates for all subsamples of our dataset. Therefore, we also present a different econometric model. If we ignore the bivariate nature of our endogenous variable, we can estimate our system with a two-stage procedure. The estimation technique is less demanding

[21] Marginal effects have been calculated following Greene (1996).

than the full maximum likelihood estimation of our bivariate model. Angrist (1991) has shown that instrumental variable estimation is a viable alternative to the bivariate probit model, since the IV estimates of the average treatment effect $\delta$ are very close to the estimates obtained by a bivariate probit model. We choose the two-stage conditional maximum likelihood ($2SCML$) technique, as proposed by Rivers and Vuong (1988). Thus, we estimate the selection equation by OLS and save the corresponding fitted residuals. In the second stage, we estimate a probit model of the outcome equation in which we include the fitted residuals as an additional regressor. An appealing feature of the $2SCML$ procedure is that the t-statistic of the fitted residuals provides a valid test of the null hypotheses that the selection of the main lender is exogenous (Wooldridge 2001). The results of the corresponding second-stage equation are presented in the first column of Table VIII. Our main finding also holds for the two-stage procedure: if the main lender is a government bank as opposed to a private bank, a firm's probability of innovating is reduced. Since the coefficients of the fitted residuals from the first-stage regression are statistically significant, we can reject the null hypotheses that the selection of the main lender's ownership is exogenous. This result establishes the need for a bivariate (or two-stage) estimation technique.

Next, we use the two-stage estimation technique to test whether the impact of the main lender's ownership on a firm's probability of innovating varies according to firm size. Therefore, we stepwise reduce our sample by dropping the largest firms measured by total assets. In column 2 of Table VIII, we estimate the same model as before, but drop the largest $25^{th}$ percentile of firms from the sample. Here, the results remain unaffected. If we further drop the largest firms from the sample (see columns 3 to 5) the coefficient of the *Financier* variable increases by magnitude. Thus, the negative effect of government bankers on a firm's innovation probability is larger for small firms. A rationale for this finding is that larger firms can also access financial markets nationwide, whereas smaller firms are more dependent on local banks.

Finally, we test for the impact of the main lender's ownership on the number of innovations among innovating firms. In the previous analysis, we modeled a firm's

decision to innovate by a binary variable. In our underlying dataset, we have coded the number of patents each innovating firm has successfully applied for. Thus, we have a measure for the number of innovations for our sample firms. We estimate the same two-equation system as before using the number of patents each innovator has been granted during our sample period as the outcome variable. Since in this system the outcome variable is not binary, we can estimate the system with a treatment-effects model by using a two-step consistent estimator. The treatment-effects model considers the effect of an endogenously chosen binary treatment on another endogenous continuous variable. The results are reported in Table IX. Among innovating firms, those firms with a private main lender tend to apply for more patents, after controlling for firm characteristics and selectivity bias. This result is significant at the 99% hurdle. Thus, bank ownership not only has an effect on a firm's innovation decision, but also on the innovation intensity of a firm.

Furthermore, we use information on citations as the dependent variable in our analysis. The advantage of using citations instead of patent filings is that citations convey information about the economic value of patents (see Harhoff, Narin, Scherer, and Vopel (1999)). Patents which are more often cited have a higher economic value and can therefore be seen as a measure of the quality of the invention. The results are shown in column 2 of Table IX. A lending relationship with a government-owned bank has a negative significant impact on the quality-weighted amount of innovations that a firm produces.

## 4.3. Robustness tests

So far, we have chosen each firm's largest lender as the main bank. Our definition of the main lender is based on Diamond (1984) who argued that the largest lender for a firm generally functions as a delegated monitor of the other lenders. In the relationship banking literature, various alternative definitions for the main lender are used. Memmel, Schmieder, and Stein (2007) require a bank to lend at least 80% of all outstanding loans to a firm in order to be considered its main lender. We test for the

robustness of our findings by re-estimating the bivariate probit model for alternative definitions of the main lender in Table X. In column 1, we require a bank to lend at least 80%, and in column 2 at least 60% of all outstanding loans to be a firm's main lender. Results remain unaffected. A main government lender has a highly significant negative impact on a firm's innovation probability. The marginal effect is about 11 percent.

In all previous estimations, we have chosen a radius of 3 km around each firm to define local banking supply. We replicated the analysis allowing for a wider radius of 10 km. Results remain unaffected by using this alternative definition of our instrument (see Table XI).

# 5. Aggregate Results

**[Section not finished yet]**

## 5.1. Distress events, the electoral cycle and subsequent share of state-owned banks

In this section we focus on exogenous variation in the presence of state-owned banks of different geographic regions. To do so, we focus on different counties that are covered by state-owned banks experiencing a distress event. In the data section we have shown that there have been 148 distress events of local state-owned banks during our sample period. As has been argued by Bian, Haselmann, Kick and Vig (2016) local politicians refrain from bailing out state-owned banks if the distress event occurs before an election. We, therefore, use the occurrence of bank distress events as an instrument to obtain exogenous variation in the share of state owned banks in a given region.

To learn about relevance of our instrument, we first present the first stage regressions (see Bian, Haselmann, Kick and Vig (2016) for more details). We use a linear probability model in order to assess the relative likelihood of the two possible outcomes: bailout by the politician and support measures by association. We use the 148 distress cases in our sample to estimate the following equation:

$$Event\ Type_{ijkt} = association_j + time_t + POL'_{kt}\beta + B'_{it-1}\gamma + C'_{kt-1}\delta + \epsilon_{ijkt}, \quad (5)$$

where $i$ denotes the individual bank, $j$ the association to which the bank belongs, $k$ the county or city of the bank, and $t$ the year in which the distress event occurred. The dependent variable is a dummy called $Event\ Type_{ijkt}$ and takes the value of one if the bank distress is resolved by the politician and the value of zero if the distress is resolved by the association. The political variables include dummy variables for the electoral cycle, the political competition within the county and the ideology of the politician. They are summarized in the vector $POL_{kt}$. Bank level control variables are denoted by the vector $B_{it-1}$ and include the bank's relative size to county / city GDP, the capital ratio, the return on assets, the non-performing loans ratio, the market share, and the deposit ratio. They are lagged by one year in order to obtain pre-event values. Regional control variables are also lagged by one year and include the level and the growth rate of county-level GDP per capita. They are summarized in the vector $C_{kt-1}$. In our most stringent specification, we include two sets of dummy variables, one of them indicating the association to which the bank belongs and the other one indicating time dummies. The specification further includes a random error term $\epsilon_{ijkt}$. Standard errors are clustered by year and robust to heteroscedasticity in all our regressions.[22] The primary variables of interest are the dummies for the electoral cycle in the vector $POL_{kt}$.

Table XII presents estimation results for Equation (5). We start with a benchmark specification without any political variables in column 1. The regression shows that larger banks or banks with a higher deposit ratio are less likely to receive capital injections from the owner. The opposite is true for banks with a higher local market

[22] Alternatively we cluster standard errors by association. This results in lower standard errors.

share. One could argue that these banks are more important for regional development within the county and therefore the owner has a greater interest in keeping control of the bank and wants to avoid a painful restructuring plan or even a distressed merger. Finally, the regression shows that counties or cities with higher GDP per capita growth are less likely to use taxpayers' money in order to bail out a savings bank in distress.

The electoral cycle seems to have a strong influence on the type of the bailout for a savings bank in distress. In the twelve months before an election, the probability that a politician resolves a distressed bank is 23 to 36 percent lower as compared to the other years in the electoral cycle (column 2). This finding is remarkable as it suggests that decisions on bank bailouts by local politicians are distorted by personal considerations about their probability to be re-elected.

Politicians are about 15 percent less likely to support a distressed bank if political competition within the county or city of the bank is relatively high (column 3). The more intense the political competition, the more severe the threat of punishment. Further, column 3 shows that capital injections from the owner are about 18 percent less likely if the bank chairman is a member of the conservative party, which is in line with the conservative ideology of limited state interventions. The results hold when we run a horse-race of all political variables in column 4. The explanatory power of the model significantly improves when the political variables are included: The $R^2$ increases from 0.240 in the benchmark case to 0.341. The results are further robust to the inclusion of association dummies (column 5).

In a second step, we show that the involvement in the bail-out of the local politician has consequences on the future presence of the state-owned banks in the respective regions. If local politicians organize a bail-out the size of the regional bank remains basically the same. If local politicians do not organize the bail-out, a centralized institution is conducting a restructuring of the bank (that either results in a down sizing or a distress merger with a neighbouring state-owned bank). As a result the share of corporate lending provided by state-owned banks is drastically reduced in the respective counties following the distress event. In Figure 2 the red line represents areas

affected by bank distress events resolved by owner bailout and the blue line represents the areas affected by bank distress events resolved by the association. The percentage of firms with state banks as their main lender (receiving more than 50% of their loans from state banks) reduces considerably in the areas that have not been treated by a political bail-out.

This observation can also be illustrated by estimating OLS regressions evaluating how the bailout type affect lending by state banks in several post-event years (see Table ). The sample used in specification (1) to (5) is $T = 0$ (event year), $T = 2$, $T = 4$, $T = 6$, $T = 8$, respectively. In Panel A, the dependent variable is *state_share*, which equals to the share of loans granted by government owned state banks. The dependent variables are the change ($\Delta$) from pre-event three year ($T = -1$ to $T = -3$) average values. *Owner Bailout* is a dummy variable which equals to 1 if the bailout involves capital injection from the owner, and 0 if the resolution is related to the association. No matter which time horizon is considered, we observe a significantly lower share of state bank funding in those regions that have not been bailed out by local politicians. More specifically, the share of loans granted by state owned banks 8 percent lower in these regions in the four years following the distress event of the bank. These findings are confirmed once replacing the left-hand side variable by the fraction of local firms who have state banks as the main lender (receiving more than 50% of their loans from state banks) in Panel B of the table.

One might be concerned that local politicians chose the respective banks they bail out based on the future lending projects a saving bank has available. We address this selection concern by replicating the analysis of the previous table using the electoral cycle as an instrument in TableXIV. The table reports estimates of two-stage least squares regressions using local electoral cycle as an instrument. In the first stage we regress the dummy variable *Owner Bailout* on the electoral cycle (see Table XII). In the second stage, predicted probabilities of owner bailout in the first stage are used to predict the dependent variables, which are specified in row 3. These results confirm our previous finding, that the occurrence of a state-bank distress event provides exogenous

variation in the presence of state-owned banks in a given region. This allows us to analyze the impact of state-owned bank presence on the aggregate level of corporate innovation in the subsequent section.

## 5.2. Bailout type and corporate innovation

Before presenting our instrumental variable model, we start with reporting evidence of relationship between the bail-out type and future corporate innovation (see Table XV). The table reports estimates from OLS regressions evaluating how the bailout type affect local innovation activities in several post-event years. The sample used in specification (1) to (5) is $T = 0$ (event year), $T = 2$, $T = 4$, $T = 6$, $T = 8$, respectively. In Panel A, the dependent variable is $ln.N\_cit\_gr$, which equals to log of the number of citation weighted patents granted to firms operating in the corresponding local area. We observe that the total number of patents applied for (weighted by citations) increase significantly in those regions that have experienced a decrease in the share of state-bank funding (since the distress event has been resolved by the association). Once we move from the aggregate number of patents applied for in a given region towards the number of firms involved in patenting activities in the local area (Panel B) we find very similar patterns.

As in the previous section, we rule out that these findings are driven by the selection of banks bailed out by local politicians. To do so, we replicate the previous analysis instrumenting the right-hand side variable by the electorial cycle. Estimates of the two-stage least squares regressions are presented in Table XVI. Again, the first stage is as reported previously in Table XII. In the second stage, predicted probabilities of owner bailout in the first stage are used to predict the dependent variables, which are specified in row 3. The dependent variable in specification (1) is $ln.N\_cit\_gr$, which equals to log of the number of citation-weighted patents granted to firms operating in the corresponding local area. The dependent variable in specification (2) is $ln.N\_firms\_pt$, which equals to the number of firms involved in patenting activities in the local area. In specification (3) the dependent variable is $ln.N\_scaled\_year\_ipc$,

which counts the citation-weighted number of patents scaled by the average citation in the corresponding technology class (IPC or International Patent Class) and year. In specification (4) the dependent variable is $ln.N\_scaled\_year$, which counts the citation-weighted number of patents scaled by the average citation in the corresponding year. In specification (5) the dependent variable is $ln.N\_top5\%$, which counts the number of patents with top% citation in the corresponding year. All the dependent variables are the change ($\Delta$) from pre-event three year ($T = -1$ to $T = -3$) average values.

No matter which outcome variable we apply as a measure for corporate innovation, we find a significant relationship between the type of bail out that is associated with the share of state-owned banks and future innovation activities. In regions in which the share of state owned banks drops after the bailouts the aggregate level of patenting activities is significantly higher as compared to regions in which the share of state-owned banks remains constant as a consequence of a political bailout.

# 6. Conclusion

Providing external finance for corporate innovation is a key mechanism through which banks affect economic growth. We find that ownership (government-owned versus private) of financial intermediaries has an impact on firms' innovation activity. Firms that have a government-owned bank as a main lender are less likely to develop innovations compared to firms that have a lending relationship with a private bank. This finding is especially pronounced for smaller /medium-sized firms with limited access to nationwide financial markets. Among the innovators, firms that have their main lending relationship with a private bank apply for more patents compared to those that have a government-owned bank as main lender.

Furthermore, we document that the share of state-owned banks in a given region has a negative impact on the aggregate level of corporate innovation activities. Using the timing of state-owned bank distress events over the electoral cycle as an instrument,

we show that more firms involve in patenting activities after the share of private banks has increased in these regions.

These findings suggest that private banks are superior to government-owned banks in selecting successful innovative projects. One reason why the private sector appears to be better at stimulating innovation could be that private bankers have incentives to maximize shareholder value. Government bankers' incentives are manifold and, thereby may be less likely to support restructuring activities and more willing to allocate resources to old, often less innovative firms. These findings have important policy implications for government ownership of banks. While a high degree of government involvement in banking is inevitable, in view of the financial crises to stabilize the system, the present study suggests that government involvement in the allocation of credit to firms comes at the cost of lower innovation and thus lower growth.

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# Appendix A. Description and construction of the data set

**Amadeus database** We use data from Bureau van Dyck, the Amadeus database for German firms. This database provides standardized annual account data and financial ratios. We restrain our sample to unconsolidated (in order to prevent double counting) annual account information of manufacturing firms.[23] We drop observations with turnover or assets reported as to be zero and firms with implausible financial data (negative values for debt). We therefore end up with an unbalanced panel of 9,309 German firms in the period from 1994 to 2007.

**German credit register** The Deutsche Bundesbank collects for regulatory purpose information for every credit granted in Germany when the sum of outstanding loans of a creditor exceed 1.5 Mio Euro. Information are collected on a quarterly basis and every credit exceeding the threshold once in the respective quarter has to be reported, thus entries in the credit register may be smaller than 1.5 Mio Euro. The credit register provides information about the borrower (name and address), the lender (name of the bank) and a classification of the credit. We focus on credits being on balance sheet positions in the years 1993 to 2006, taking the respective entry of the quarter in which balance sheet data in the Amadeus database is reported.

Our matching procedure gives reasonable results. We find a median of 0.957 for this coverage ratio which is generally in line with those found by other studies using the German credit register (Memmel, Schmieder, and Stein 2007; Ongena, Tuemer-Alkan, and Westernhagen 2012) .

**Innovation data** The information on patents are part of the EP-CESPRI database, provided by Gianluca Tarasconi. This database is based on the information published by the European Patent Office (EPO) in Espace Bulletin and REFI. It covers all patents granted to German firms by the EPO from 1978-2006. The database includes a count of the patents granted and a count of citations of the patents by priority year[24] together with the firm name and address. Patents are assigned to the firm the innovator is working for at the moment of the patent application.

**Bank branches data and geocoding procedure** We collected data from the Banken-Verlag Medien GmbH about the branch network of German banks in 2007. This database provides us the addresses of all banks and bank branches (of German and foreign banks) in Germany.

For the calculation of the distance between bank branches and firms, we use geocodes (degrees of latitude and longitude). We add geocodes to our observations from the Amadeus database and to the addresses of the banks and their branches using the website MyGeoposition[25] and control the results via googlemaps. We use these geocodes to calculate the distance between firms and banks (using the great-circle-distance-method) and count the

[23] The three-digit US SIC codes from 200 to 399.

[24] Date of first application of the patent to any patent office, not the application date at the EPO.

[25] www.mygeoposition.com

number of private and government-owned banks in a certain distance to the firms. We used 3 km and 10 km as a radius around each firm, this equals an area of about $28km^2$ and $314km^2$.

**Regional data** We use data on the regional development (GDP, GDP per capita) and population density for German administrative districts (Landkreis)[26] from the statistical offices of the Federation and the Länder.

**Matching procedure** We link information from different data set that do not have a unique numeric identifier. Therefore, we matched these different data sources by the name, address and legal form of the respective firms.

For this procedure we apply the reclink-ado for STATA (Blasnik, 2007). It uses record linkage methods to match observations when no unique common identifier exists and gives a probability of matching correctness. Reclink uses a bigram string comparator to assess fuzzy matches of string variables and allows to match over more than one variable.

In order to improve the results of the matching procedure, we unify the spelling of the firm names. We drop all special characters use only uppercase letters. In a first step we match only those observations being in the same zip code area (we define zip code regions by the first two numbers of the zip code in case one data base reports the street zip code and the other post office box zip code. Then we group zip codes by steps of 5000, e.g. all observations with zip codes from 10000 to 15000 form one region). We manually control the results of the matching procedure to ensure the correctness of the matching results. In a second step, we further shorten the names by dropping common words and abbreviations and then match by the first letters of the firm-names and by zip code areas. We again inspect the results. In a last step we try to match all observations from the credit register not reporting any zip codes to the firms in the Amadeus database by only matching on the names. The data on innovation (patents) are matched to the Amadeus database in the same manner.

[26] As we use end-of-year-data for 2007, Germany was divided into 429 districts .

# Appendix B. Regional distribution of private and government-owned bank branches

**Figure 1.** Distribution of private and government-owned bank branches in the community Karlsruhe

Notes: Data on bank branches from Banken-Verlag Medien GmbH for begin of 2007. The large map shows the district of Karlsruhe (Stadtkreis and Landkreis) in the south-west of Germany and the private and government-owned banks and their branches in this area. Grey-shaded areas illustrate larger cities (more than 25,000 inhabitants) and their surface. All other cities displayed have more than 5,000 inhabitants. The small map in the down right corner shows Germany, the black area displays the district of Karlsruhe.

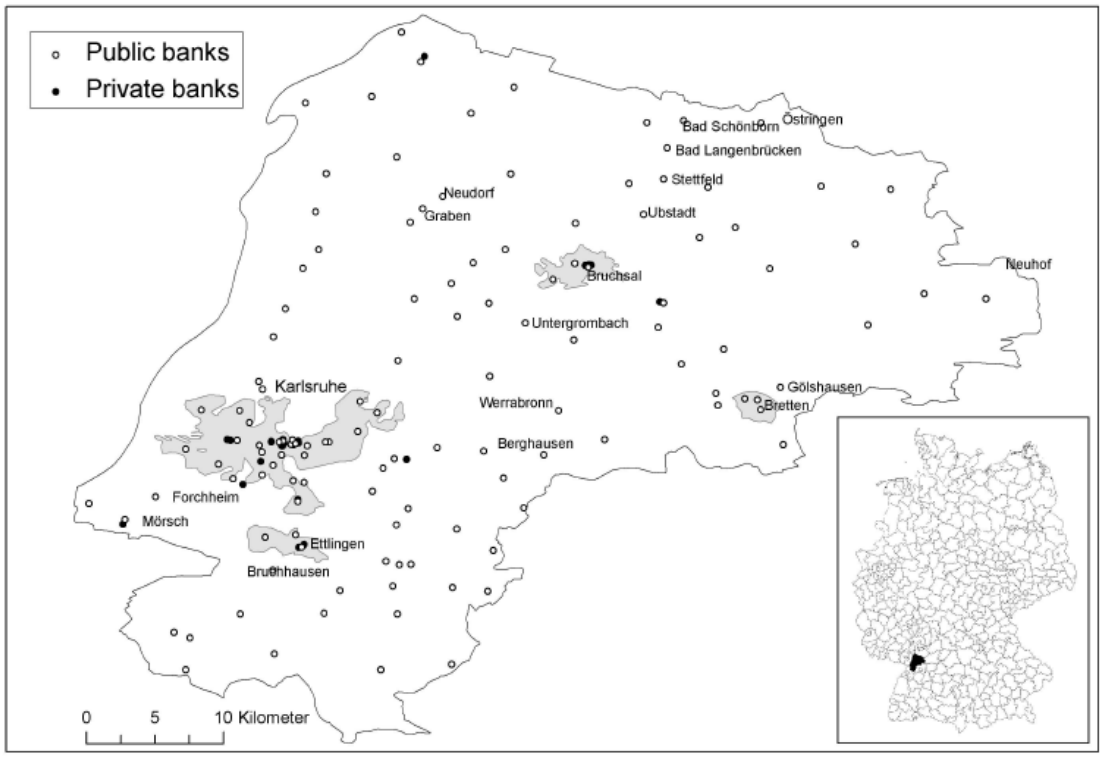
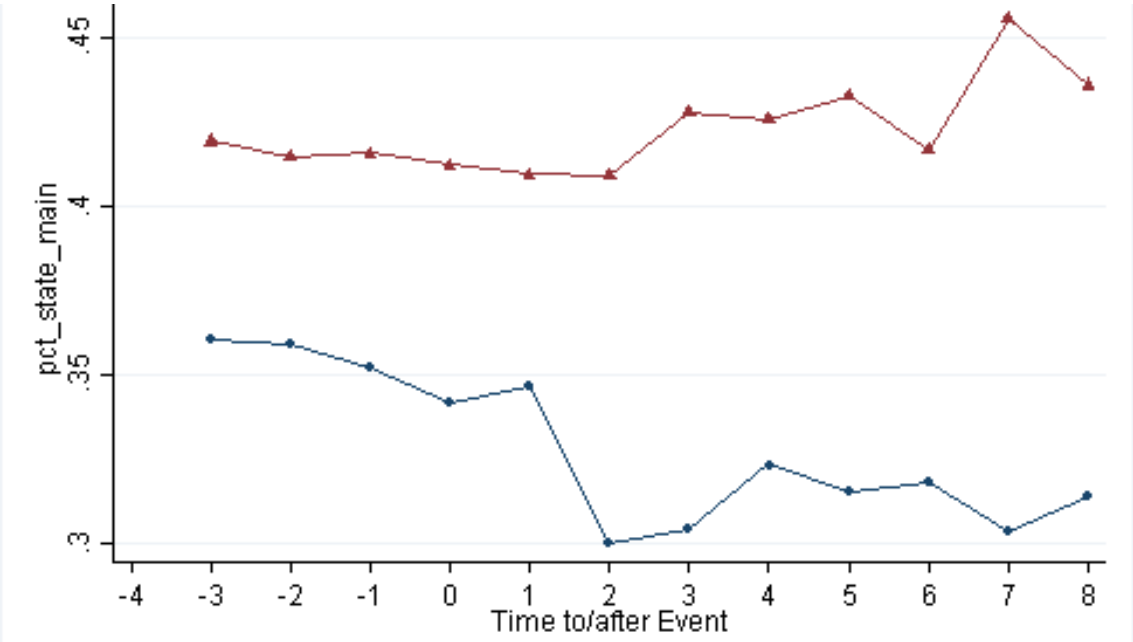


**Figure 2. Bailout Type of Bank Distress and Lending by State Banks**

Notes: This figure shows how the local lending activities of state banks change after different types of distress bank bailout. The above(red) line represents areas affected by bank distress events resolved by owner bailout. The below (blue) line represents the areas affected by bank distress events resolved by the association. The y-axis shows the percentage of firms with state banks as their main lender (receiving more than 50% of their loans from state banks). The x-axis shows the year to/after the bailout event.



## Table I
## Description of Variables

| Name | Description |
|---|---|
| Innovative | Dummy variable, 1 if firm applied at least once successfully for a patent at the EPO in the observation period (1996-2006), 0 else |
| Patents | Number of patent applications per year and firm (European Patent Office) |
| Patents_DPMA | Number of patent applications per year and firm (German Patent Office) |
| Citations | Number of citations of a patent |
| Total_banks | Number of all banks within a radius of 3 km for each firm |
| share_private | Share of private banks of all private and government-owned banks within a radius of 3 km for each firm |
| Financier | Dummy variable, 1 if the main lender (highest amount of loans) is a government-owned bank, 0 if main lender is private bank |
| Pop_density | Number of inhabitants per $km^2$ |
| Regional_GDP | Regional GDP (in thousand) per capita |
| N_lender | Number of lenders of a firm reporting to the credit register |
| Share_main | Share of credit granted by the main lender, total credit taken from the credit register |
| Assets | Total Assets of the firm (in million Euro) |
| Age | Age of the firm |
| Employees | Number of employees of a firm |
| Sales | Sales of a firm (in million Euro) |
| ROA | Return on total assets (%) |
| Tangibility | Fixed assets over total assets |
| Debt | Total debt over total assets |

## Table II
## Structure of the German banking market (2007)

Notes: Data from Bundesbank 2008

| | Number of Institutes | Number of Branches | Share of Total assets |
|---|---|---|---|
| All Banks | 2,277 | 39,833 | 100 % |
| Private banks | 278 | 11,286 | 39.0 % |
| Government banks | 458 | 14,109 | 45.5 % |
| Credit cooperatives | 1,236 | 12,488 | 15.5 % |

## Table III
## Number of patents and citations per industry

Notes: Number of patents and citations from the European Patent Office (EPO). *Innovative* is a dummy variable that takes the value of 1 if firm applied at least once successfully for a patent during the sample period and 0 otherwise. Industries grouped by two-digit SIC-codes, classification in high-tech and low-tech according to Parisi, Schiantarelli, and Sembenelli (2006). The number of observations (N) are reported in the last column.

| | Patents Mean | Innovative Mean | Citations Mean | N |
|---|---|---|---|---|
| **Low-tech industries** | | | | |
| Food and kindred products | 0.010 | 0.054 | 0.006 | 1,082 |
| Tobacco products | 0.586 | 0.207 | 0.138 | 29 |
| Textile mill products | 0.050 | 0.166 | 0.003 | 319 |
| Apparel and other finished products made from fabrics and similar materials | 0.055 | 0.105 | 0.036 | 275 |
| Lumber and wood products, except furniture | 0.117 | 0.297 | 0.011 | 273 |
| Furniture and fixtures | 0.449 | 0.340 | 0.109 | 156 |
| Paper and allied products | 0.290 | 0.338 | 0.059 | 390 |
| Printing, publishing and allied industries | 1.078 | 0.087 | 0.124 | 460 |
| Petroleum refining and related industries | 0.211 | 0.232 | 0.011 | 95 |
| Rubber and miscellaneous plastics products | 1.293 | 0.383 | 0.409 | 699 |
| Leather and leather products | 0.000 | 0.125 | 0.000 | 16 |
| Stone, clay, glass and concrete products | 0.357 | 0.347 | .120 | 499 |
| Primary metal industries | 0.427 | 0.289 | 0.033 | 838 |
| Fabricated metal products, except machinery and transportation equipment | 0.438 | 0.272 | 0.058 | 1,471 |
| Miscellaneous manufacturing industries | 0.226 | 0.290 | 0.048 | 186 |
| **High-tech industries** | | | | |
| Chemicals and allied products | 10.947 | 0.452 | 6.189 | 957 |
| Industrial and commercial machinery and computer equipment | 1.841 | 0.446 | 0.220 | 2,226 |
| Electronic and other electrical equipment an components, except computer equipment | 2.031 | 0.476 | 0.281 | 1,085 |
| Transportation equipment | 10.162 | 0.496 | 2.863 | 815 |
| Measuring, analyzing and controlling instruments; photographic, medical and optical goods; watches and clocks | 1.909 | 0.557 | 0.081 | 472 |
| **All firms** | 2.340 | 0.342 | 0.784 | 12,343 |

# Table IV: Descriptive statistics

Notes: Means for firm characteristics by firms' innovation activity and main lending relationship. See Table I for definitions. Column 2 presents results for all firms, column (2) and (3) for innovative and not innovative firms (*Innovative*) and columns (5) and (6) for firms having as main lender a private or a government-owned bank (*Financier*). The number of observations (N) of each variable is reported in parentheses below the respective mean values. Columns (4) and (7) present results of t-test for differences in means between the groups of firms, p-value below in parentheses.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Variable | All firms Mean (N) | No innovations Mean (N) | Innovators Mean (N) | (2)-(3) Difference (p-value) | Private Mean (N) | Government Mean (N) | (5)-(6) Difference (p-value) |
| **Part I: Firm characteristics** | | | | | | | |
| Patents | 2.339 | 0 | 6.839 | -6.839 | 2.983 | 1.361 | 1.622 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.000) |
| Innovative | 0.342 | 0 | 1 | | 0.384 | 0.278 | 0.106 |
| | (12,343) | (8,121) | (4,222) | | (7,444) | (4,899) | (0.000) |
| Citations | 0.784 | 0 | 2.292 | -2.292 | 1.121 | 0.273 | 0.848 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.001) |
| Assets | 265.455 | 98.540 | 586.515 | -487.974 | 356.435 | 127.211 | 229.225 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.000) |
| Age | 39.794 | 36.852 | 45.452 | - 8.599 | 40.374 | 38.913 | 1.461 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.066) |
| Employees | 1,687.341 | 764.822 | 2,788.211 | - 2,023.390 | 2,010.801 | 986.714 | 1024.087 |
| | (5,854) | (3,185) | (2,669) | (0.000) | (4,005) | (1,849) | (0.000) |
| ROA | 6.137 | 6.173 | 6.068 | 0.104 | 6.364 | 5.793 | 0.571 |
| | (12,334) | (8,114) | (4,220) | (0.692) | (7,436) | (4,898) | (0.025) |
| Sales | 313.741 | 141.032 | 645.946 | -504.914 | 421.217 | 150.431 | 270.786 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.000) |
| Tangibility | 0.384 | 0.387 | 0.378 | 0.008 | 0.388 | 0.377 | 0.011 |
| | (12,342) | (8,120) | (4,222) | (0.043) | (7,443) | (4,899) | (0.006) |
| Debt | 0.280 | 0.325 | 0.204 | 0.121 | 0.237 | 0.347 | -0.110 |
| | (8,214) | (5,165) | (3,049) | (0.000) | (5,020) | (3,194) | (0.000) |
| **Part II: Lending relationship and regional data** | | | | | | | |
| share_private | 0.405 | 0.393 | 0.427 | - 0.034 | 0.438 | 0.355 | 0.082 |
| | (11,116) | (7,190) | (3,926) | (0.000) | (6,758) | (4,358) | (0.000) |
| N_lender | 2.647 | 2.031 | 3.833 | - 1.802 | 2.829 | 2.370 | 0.458 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.000) |
| Share_main | 0.795 | 0.833 | 0.722 | 0.111 | 0.779 | 0.820 | -0.040 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.000) |
| Pop_density | 831.446 | 752.599 | 983.108 | - 230.510 | 951.528 | 648.982 | 302.547 |
| | (12,343) | (8,121) | (4,222) | (0.000) | (7,444) | (4,899) | (0.000) |
| Regional_GDP | 21.444 | 20.243 | 23.693 | - 3.450 | 21.973 | 20.642 | 1.331 |
| | (12,060) | (7,862) | (4,198) | (0.000) | (7,268) | (4,792) | (0.000) |

## Table V
## Determinants of the main bank relationship

Notes: The table reports estimates of the probit model $F_{it} = \beta \cdot X_{it} + \gamma \cdot Z_{it} + v_{it}$, where $i$ indexes for firm and $t$ for year. The dependent variable $F_{it}$ is a dummy variable that takes the value of 1 if the main lender is a government-owned bank and 0 if the main lender is a private bank. Firm specific characteristics are summarized by the vector $X_{it}$. A vector of instruments is denoted by $Z_{it}$. All variables are defined as in Table I. Standard errors are reported in parentheses. All regressions include year and industry fixed effects. The bottom line of the table states the number of observations of each estimation. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| **Panel A** | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Sample | All | $75^{th}$ percentile | $50^{th}$ percentile | $25^{th}$ percentile | $10^{th}$ percentile |
| *Instrumental variables* | | | | | |
| share_private | -0.290*** | -0.438*** | -0.615*** | -0.826*** | -0.853* |
| | [0.040] | [0.051] | [0.073] | [0.173] | [0.499] |
| total_banks | -0.002** | -0.005*** | -0.007*** | -0.004 | -0.016 |
| | [0.001] | [0.001] | [0.003] | [0.005] | [0.014] |
| *Exogenous variables* | | | | | |
| log(age) | 0.092*** | 0.122*** | 0.099*** | 0.049 | 0.031 |
| | [0.014] | [0.018] | [0.029] | [0.073] | [0.237] |
| log(assets) | -0.200*** | -0.317*** | -0.260*** | 0.013 | 0.297 |
| | [0.008] | [0.017] | [0.033] | [0.081] | [0.201] |
| Year fixed effects | yes | yes | yes | yes | yes |
| Industry fixed effects | yes | yes | yes | yes | yes |
| Observations | 11418 | 7007 | 3246 | 703 | 144 |
| Pseudo $R^2$ | 8.87% | 8.13% | 8.22% | 13.18% | 40.56% |

| **Panel B** | (1') | (2') | (3') | (4') | (5') |
|---|---|---|---|---|---|
| Sample | All | $75^{th}$ percentile | $50^{th}$ percentile | $25^{th}$ percentile | $10^{th}$ percentile |
| *Instrumental variables* | | | | | |
| share_private | -0.159*** | -0.232*** | -0.388*** | -0.545*** | -1.153* |
| | [0.045] | [0.058] | [0.084] | [0.202] | [0.675] |
| total_banks | -0.002** | -0.003** | -0.004 | 0.003 | -0.021 |
| | [0.001] | [0.002] | [0.003] | [0.007] | [0.016] |
| pop_density | -0.177*** | -0.270*** | -0.325*** | -0.341*** | 0.155 |
| | [0.019] | [0.026] | [0.039] | [0.092] | [0.331] |
| regional_GDP | 0.017*** | 0.020*** | 0.023*** | 0.014 | 0.008 |
| | [0.002] | [0.002] | [0.004] | [0.009] | [0.042] |
| *Exogenous variables* | | | | | |
| log(age) | 0.069*** | 0.083*** | 0.043 | 0.032 | 0.053 |
| | [0.014] | [0.019] | [0.031] | [0.076] | [0.250] |
| log(assets) | -0.211*** | -0.335*** | -0.258*** | -0.026 | 0.304 |
| | [0.009] | [0.018] | [0.034] | [0.083] | [0.208] |
| Year fixed effects | yes | yes | yes | yes | yes |
| Industry fixed effects | yes | yes | yes | yes | yes |
| Observations | 11171 | 6789 | 3127 | 663 | 125 |
| Pseudo $R^2$ | 9.84% | 9.59% | 10.29% | 14.93% | 40.37% |

## Table VI
## Testing for instrument viability

Notes: The table reports estimates of the probit model $y_{it} = \alpha \cdot X_{it} + \delta \cdot F_{it} + \gamma \cdot Z_{it} + u_{it}$, where $i$ indexes for firm and $t$ for year. The dependent variable $y_{it}$ is a dummy variable that takes the value of 1 if firm has been innovative during our sample period and 0 otherwise. Firm specific characteristics are summarized by the vector $X_{it}$. $F_{it}$ is a dummy variable that takes the value of 1 if the main lender is a government-owned bank and 0 if the main lender is a private bank. A vector of instruments is denoted by $Z_{it}$. All variables are defined as in Table I. Standard errors are reported in parentheses. All regressions include year and industry fixed effects. The bottom line of the table states the number of observations of each estimation. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | (2) |
|---|---|---|
| Financier | -0.203*** | -0.214*** |
| | [0.027] | [0.028] |
| share_private | 0.051 | 0.019 |
| | [0.041] | [0.046] |
| total_banks | 0.005*** | 0.001 |
| | [0.001] | [0.001] |
| pop_density | | -0.024 |
| | | [0.018] |
| regional_GDP | | 0.019*** |
| | | [0.002] |
| log(age) | 0.170*** | 0.139*** |
| | [0.014] | [0.014] |
| log(assets) | 0.024*** | 0.021*** |
| | [0.005] | [0.005] |
| | 0.006 | -0.007 |
| Year fixed effects | yes | yes |
| Industry fixed effects | yes | yes |
| Observations | 11418 | 11171 |
| Pseudo $R^2$ | 11.84% | 12.63% |

## Table VII: Government banks and innovation progress - Bivariate probit estimations

Notes: The table reports estimates of the bivariate probit model described in Section 3. Coefficients are shown for the 'outcome' equation $y_{it} = \alpha \cdot X_{it} + \delta \cdot F_{it} + u_{it}$, where $i$ indexes for firm and $t$ for year. The dependent variable $y_{it}$ is a dummy variable that takes the value of 1 if firm has been innovative during our sample period and 0 otherwise. Firm specific characteristics are summarized by the vector $X_{it}$. $F_{it}$ is a dummy variable that takes the value of 1 if the main lender is a government-owned bank and 0 if the main lender is a private bank. The 'outcome' equation is simultaneously estimated with the 'selection' equation $F_{it} = \beta \cdot X_{it} + \gamma \cdot Z_{it} + v_{it}$ by full maximum likelihood estimation. The vector of instruments is denoted by $Z_{it}$. All variables are defined as in Table I. Standard errors are reported in parentheses. All regressions include year and industry fixed effects. Marginal effects at the means (and the effect of a change from zero to one for dummy variables) are reported besides the coefficients. In column 1 control variables for the community each firm operates in are included in the 'selection' equation. The correlation between the error terms of the 'outcome' and 'selection' equation is denoted by $\rho$. The bottom line of the table states the value of the likelihood function and the number of observations of each estimation. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
| Sample | all | | all | | tangibility > 0.5 | |
| | coefficients | marginal effects | coefficients | marginal effects | coefficients | marginal effects |
| Financier | -1.107906*** | -0.187 | -0.8320775*** | -0.133 | -1.302*** | -0.238 |
| | [0.077] | | [0.141] | | [0.071] | |
| log(age) | 0.1216965*** | 0.0356784 | 0.1105342*** | 0.029 | 0.127*** | 0.043 |
| | [0.014] | | [0.014] | | [0.024] | |
| log(assets) | 0.186813*** | 0.0025921 | 0.230398*** | 0.007 | 0.184*** | 0.016 |
| | [0.015] | | [0.021] | | [0.019] | |
| rho | 0.688 | | 0.516 | | 0.868 | |
| chi(rho=0) | 49.156 | | 14.769 | | 39.974 | |
| Year fixed effects | yes | | yes | | yes | |
| Industry fixed effects | yes | | yes | | yes | |
| Pop density | no | | yes | | no | |
| Observations | 11418 | | 11171 | | 3463 | |

## Table VIII
## Government banks and innovation progress - 2*SCML* estimations

Notes: The table reports estimates of a two-stage conditional maximum likelihood model. Coefficients are shown for the 'outcome' equation $y_{it} = \alpha \cdot X_{it} + \delta \cdot F_{it} + \eta \cdot Residuals + u_{it}$, where $i$ indexes for firm and $t$ for year. The dependent variable $y_{it}$ is a dummy variable that takes the value of 1 if firm has been innovative during our sample period and 0 otherwise. Firm specific characteristics are summarized by the vector $X_{it}$. $F_{it}$ is a dummy variable that takes the value of 1 if the main lender is a government-owned bank and 0 if the main lender is a private bank. *Residuals* are fitted residuals obtain from on OLS estimation of the 'selection' equation $F_{it} = \beta \cdot X_{it} + \gamma \cdot Z_{it} + v_{it}$. The vector of instruments is denoted by $Z_{it}$. All variables are defined as in Table I. Standard errors are reported in parentheses. All regressions include year and industry fixed effects. The bottom line of the table states the number of observations of each estimation. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Sample | All coefficients | 75th percentile coefficients | 50th percentile coefficients | 25th percentile coefficients | 10th percentile coefficients |
| Financier | -0.074 | -0.609** | -1.683*** | -2.312** | -2.906 |
| | [0.354] | [0.292] | [0.359] | [0.991] | [2.911] |
| Residuals | 0.080 | 0.498* | 1.493*** | 1.591 | 2.494 |
| | [0.355] | [0.295] | [0.365] | [1.010] | [2.994] |
| log(assets) | 0.307*** | 0.290*** | 0.025 | -0.196** | -0.373 |
| | [0.027] | [0.041] | [0.052] | [0.097] | [0.314] |
| log(age) | 0.103*** | 0.096*** | 0.080** | 0.046 | -0.369 |
| | [0.019] | [0.025] | [0.040] | [0.117] | [0.323] |
| Constant | -6.854*** | -4.852*** | -2.661*** | -0.572 | 7.850* |
| | [0.735] | [0.685] | [1.032] | [1.395] | [4.102] |
| Year fixed effects | yes | yes | yes | yes | yes |
| Industry fixed effects | yes | yes | yes | yes | yes |
| Observations | 11418 | 7007 | 2985 | 537 | 86 |
| Pseudo $R^2$ | 20.20% | 14.39% | 9.07% | 20.56% | 42.65% |

## Table IX
## Government banks and the number of innovations - treatment-effects model

Notes: The table reports estimates of a treatment-effects model using a two-step consistent estimator for the innovative sample firms. Coefficients are shown for the 'outcome' equation $y_{it} = \alpha \cdot X_{it} + \delta \cdot F_{it} + u_{it}$, where $i$ indexes for firm and $t$ for year. The dependent variable $y_{it}$ is the sum of all patents each innovative firm has been granted during the sample period. Firm specific characteristics are summarized by the vector $X_{it}$. $F_{it}$ is a dummy variable that takes the value of 1 if the main lender is a government-owned bank and 0 if the main lender is a private bank. The binary endogenous variable $F_{it}$ is instrumented by $Z_{it}$. All variables are defined as in Table I. Standard errors are reported in parentheses. All regressions include year and industry fixed effects. The bottom line of the table states the number of observations of each estimation. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | | (2) | |
|---|---|---|---|---|
| Dependent | log(Nr. of patents) | | log(Nr. of citations) | |
| Sample | innovators | | innovators | |
| | coefficients | marginal effects | coefficients | marginal effects |
| Financier | -2.407*** | -0.910 | -3.222** | -0.960 |
| | [0.709] | | [1.351] | |
| log(age) | 0.181*** | | 0.198*** | |
| | [0.181] | | [0.048] | |
| log(assets) | 0.574*** | | 0.551*** | |
| | [0.035] | | [0.037] | |
| $\rho$ | 0.860 | | 0.880 | |
| $\sigma$ | 1.690 | | 1.879 | |
| $\lambda$ | 1.454 | | 1.944 | |
| $\chi^2(\lambda{=}0)$ | 3.41 | | 2.40 | |
| Year fixed effects | yes | | yes | |
| Industry fixed effects | yes | | yes | |
| Observations | 4027 | | 2103 | |

## Table X
## Relationship banks and innovations - Bivariate probit estimations

Notes: The table reports estimates of the bivariate probit model described in Section 3. Coefficients are shown for the 'outcome' equation $y_{it} = \alpha \cdot X_{it} + \delta \cdot F_{it} + u_{it}$, where $i$ indexes for firm and $t$ for year. The dependent variable $y_{it}$ is a dummy variable that takes the value of 1 if firm has been innovative during our sample period and 0 otherwise. Firm specific characteristics are summarized by the vector $X_{it}$. In column 1 (2), $F_{it}$ is a dummy variable that takes the value of 1 if a government-owned bank provides at least 80 (60) percent of a firm's outstanding loans and 0 if a private bank provides at least 80 (60) percent of a firm's outstanding loans (and missing otherwise). The 'outcome' equation is simultaneously estimated with the 'selection' equation $F_{it} = \beta \cdot X_{it} + \gamma \cdot Z_{it} + v_{it}$ by full maximum likelihood estimation. The vector of instruments is denoted by $Z_{it}$. All variables are defined as in Table I. Standard errors are reported in parentheses. All regressions include year and industry fixed effects. Marginal effects at the means (and the effect of a change from zero to one for dummy variables) are reported besides the coefficients. The correlation between the error terms of the 'outcome' and 'selection' equation is denoted by $\rho$. The bottom line of the table states the value of the likelihood function and the number of observations of each estimation. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | | (2) | |
|---|---|---|---|---|
| Relationship lender if | > 80% of loans | | > 60% of loans | |
| | coefficients | marginal effects | coefficients | marginal effects |
| Financier | -0.761*** | -0.116 | -0.736*** | -0.112 |
| | [0.184] | | [0.168] | |
| log(age) | 0.113*** | 0.027 | 0.114*** | 0.027 |
| | [0.020] | | [0.018] | |
| log(assets) | 0.227*** | 0.008 | 0.227*** | 0.007 |
| | [0.030] | | [0.026] | |
| $\rho$ | 0.409 | | 0.420 | |
| $\chi^2(\rho = 0)$ | 8.698 | | 10.386 | |
| Year fixed effects | yes | | yes | |
| Industry fixed effects | yes | | yes | |
| Community controls | no | | no | |
| Log Likelihood | -7300.494 | | -8923.812 | |
| Observations | 6812 | | 8207 | |

## Table XI
## Effect of a government lending relationship - Alternative definition of instrument 10 km radius

Notes: The table reports estimates of a treatment-effects model using a two-step consistent estimator for the innovative sample firms. Coefficients are shown for the 'outcome' equation $y_{it} = \alpha \cdot X_{it} + \delta \cdot F_{it} + u_{it}$, where $i$ indexes for firm and $t$ for year. The dependent variable $y_{it}$ is the sum of all patents each innovative firm has been granted during the sample period. Firm specific characteristics are summarized by the vector $X_{it}$. $F_{it}$ is a dummy variable that takes the value of 1 if the main lender is a government-owned bank and 0 if the main lender is a private bank. The binary endogenous variable $F_{it}$ is instrumented by $Z_{it}$. All variables are defined as in Table I. Standard errors are reported in parentheses. All regressions include year and industry fixed effects. The bottom line of the table states the number of observations of each estimation. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | | (2) | |
|---|---|---|---|---|
| | coefficients | marginal effects | coefficients | marginal effects |
| Financier | -1.038*** | -0.177 | -0.721*** | -0.115 |
| | [0.086] | | [0.163] | |
| log(age) | 0.121*** | 0.035 | 0.109*** | 0.028 |
| | [0.013] | | [0.014] | |
| log(assets) | 0.202*** | 0.008 | 0.248*** | 0.012 |
| | [0.016] | | [0.022] | |
| $\rho$ | 0.656 | | 0.458 | |
| $\chi^2(\rho{=}0)$ | 40.07 | | 9.75 | |
| Log Likelihood | -14138 | | -13823 | |
| Observations | 12623 | | 12344 | |

## Table XII
## First Stage: Bail-out Decisions and the Electoral Cycle

Notes: The table shows results for an OLS estimation of the following equation:

$$Event\ Type_{ijkt} = association_j + time_t + POL'_{kt}\beta + B'_{it-1}\gamma + C'_{kt-1}\delta + \epsilon_{ijkt},$$

where $i$ denotes the individual bank, $j$ the association, $k$ the county or city where the bank is located, and $t$ the year of the event. The dummy $Event\ Type_{ijkt}$ equals one if the bank received capital injections from the owner and zero if the bank received support measures from the association. The vector of political variables is denoted by $POL_{kt}$, $B_{it-1}$ includes bank-level control variables, and $C_{kt-1}$ is the vector of regional control variables. All columns include time dummies for the four election cycles in our sample (1994-1998, 1999-2003, 2004-2008, 2009-end of sample), and column 5 additionally includes a set of dummy variables that indicate the association of the bank. Standard errors adjusted for clustering at the yearly level are denoted in parentheses. * indicates statistical significance at the 10 %-level, ** at the 5 %-level, and *** at the 1 %-level.

| | Dependent Variable: Event Type | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Total Assets / GDP (t-1) | -0.138** | -0.177*** | -0.116* | -0.160** | -0.157** |
| | (0.056) | (0.048) | (0.060) | (0.055) | (0.059) |
| Capital Ratio (t-1) | -0.034 | -0.042 | -0.019 | -0.034 | -0.065 |
| | (0.037) | (0.045) | (0.037) | (0.044) | (0.052) |
| ROA (t-1) | 0.067 | 0.071 | 0.039 | 0.046 | -0.017 |
| | (0.071) | (0.058) | (0.079) | (0.063) | (0.055) |
| NPL Ratio (t-1) | -0.022* | -0.021 | -0.023* | -0.022* | -0.019* |
| | (0.012) | (0.012) | (0.011) | (0.011) | (0.010) |
| Market Share (t-1) | 0.009*** | 0.010*** | 0.009** | 0.009*** | 0.008** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.004) |
| Deposit Ratio (t-1) | -0.007 | -0.007 | -0.005 | -0.005 | -0.004 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.005) |
| GDPPC Growth (t-1) | -0.020* | -0.025** | -0.019* | -0.023** | -0.021** |
| | (0.010) | (0.009) | (0.010) | (0.010) | (0.009) |
| Log(GDPPC) (t-1) | 0.030 | 0.040 | -0.049 | -0.051 | 0.016 |
| | (0.095) | (0.113) | (0.092) | (0.114) | (0.110) |
| D(0-12 months after) | | 0.286*** | | 0.301*** | 0.265** |
| | | (0.082) | | (0.080) | (0.102) |
| D(12-24 months after) | | 0.390*** | | 0.384*** | 0.413*** |
| | | (0.092) | | (0.088) | (0.098) |
| D(24-36 months after) | | 0.230** | | 0.222** | 0.233** |
| | | (0.090) | | (0.100) | (0.088) |
| D(12-24 months before) | | 0.296** | | 0.310** | 0.275* |
| | | (0.137) | | (0.129) | (0.139) |
| Competitive County | | | -0.150** | -0.118 | -0.166** |
| | | | (0.068) | (0.070) | (0.077) |
| Cons. Bank Chairman | | | -0.181** | -0.200** | -0.141 |
| | | | (0.080) | (0.086) | (0.081) |
| Time Dummies | YES | YES | YES | YES | YES |
| Association Dummies | NO | NO | NO | NO | YES |
| Observations | 148 | 148 | 148 | 148 | 148 |
| R-squared | 0.240 | 0.305 | 0.277 | 0.341 | 0.490 |

## Table XIII
## OLS: Bailout Type of Bank Distress and Lending by State Banks

Notes: The table reports estimates from OLS regressions evaluating how the bailout type affect lending by state banks in several post-event years. The sample used in specification (1) to (5) is $T = 0$ (event year), $T = 2$, $T = 4$, $T = 6$, $T = 8$, respectively. *Owner Bailout* is a dummy variable which equals to 1 if the bailout involves capital injection from the owner, and 0 if the resolution is related to the association. The dependent variable in panel A is *state_share*, which equals to the share of loans granted by government owned state banks. The dependent variable in panel B is *pct_state_main*, which equals to the fraction of local firms who have state banks as the main lender (receiving more than 50% of their loans from state banks). The dependent variables are the change ($\Delta$) from pre-event three year ($T = -1$ to $T = -3$) average values. Standard errors are reported in parentheses. All regressions include year fixed effects and local macro economics controls. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| Panel A: Bank Bailout Type and State Loan Share | | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Post-event year | T=0 | T=2 | T=4 | T=6 | T=8 |
| Dependent ($\Delta$) | | | *state_share* | | |
| *Owner Bailout* | 0.042*** | 0.071*** | 0.080*** | 0.077*** | 0.080** |
| | (0.007) | (0.019) | (0.019) | (0.025) | (0.031) |
| $\Delta$ *total loans* | -0.005*** | -0.005** | -0.007*** | -0.000 | 0.002 |
| | (0.001) | (0.002) | (0.002) | (0.003) | (0.003) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes |
| Observations | 2592 | 1675 | 1464 | 1027 | 965 |
| Adjusted R-squared | 0.042 | 0.053 | 0.036 | 0.033 | 0.038 |

| Panel B: Bank Bailout Type and Main Lender of Firms | | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Post-event year | T=0 | T=2 | T=4 | T=6 | T=8 |
| Dependent ($\Delta$) | | | *pct_state_main* | | |
| *Owner Bailout* | 0.018** | 0.075*** | 0.068*** | 0.110*** | 0.151*** |
| | (0.009) | (0.018) | (0.017) | (0.022) | (0.030) |
| $\Delta$ *total loans* | -0.002 | -0.001 | -0.005** | -0.002 | 0.001 |
| | (0.001) | (0.002) | (0.002) | (0.003) | (0.003) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes |
| Observations | 2627 | 1703 | 1484 | 1046 | 976 |
| Adjusted R-squared | 0.019 | 0.016 | 0.014 | 0.033 | 0.044 |

## Table XIV
## IV: Bailout Type of Bank Distress and Lending by State Banks

Notes: The table reports estimates of two-stage least squares regressions using local electoral cycle as an instrument. The sample includes eight post event years from $T = 1$ to $T = 8$. In the first stage we regress the dummy variable *Owner Bailout* on the dummy for the electoral cycle (which equals to 1 if the bank distress is 0-12 months before the election). In the second stage, predicted probabilities of owner bailout in the first stage are used to predict the dependent variables, which are specified in row 3. *OwnerBailout* is a dummy variable which equals to 1 if the bailout involves capital injection from the owner, and 0 if the resolution is related to the association. The dependent variable in specification (1) is *state_share*, which equals to the share of loans granted by government owned state banks. The dependent variable in specification (2) is *pct_state_main*, which equals to the fraction of local firms who have state banks as the main lender (receiving more than 50% of their loans from state banks). In specification (3) the dependent variable is $ln(N\_state)$, which equals to log of the number of firms receiving loans from state banks. In specification (4) the dependent variable is $ln(N\_state\_main)$, which equals to log of the number of firms having state banks as the main lender. In specification (5) the dependent variable is $ln(N\_state\_top)$, which equals to log of the number of firms having a state bank as their top lender. All the dependent variables are the change ($\Delta$) from pre-event three year ($T = -1$ to $T = -3$) average values. Standard errors are reported in parentheses. All regressions include year fixed effects and local macro economics controls. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post-event year | | | T=1 to T=8 | | |
| Dependent ($\Delta$) | *state_share* | *pct_state_main* | $ln(N\_state)$ | $ln(N\_state\_main)$ | $ln(N\_state\_top)$ |
| *Owner Bailout* | 0.022** | 0.030*** | 0.221*** | 0.049** | 0.043** |
| | (0.010) | (0.008) | (0.018) | (0.019) | (0.020) |
| $\Delta$ *total loans* | -0.002*** | -0.001 | 0.033*** | 0.026*** | 0.031*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes |
| Observations | 10929 | 11100 | 11100 | 11100 | 11100 |
| Adjusted R-squared | 0.020 | 0.010 | 0.047 | 0.081 | 0.059 |

## Table XV
## OLS: Bailout Type of Bank Distress and Innovation Activities

Notes: The table reports estimates from OLS regressions evaluating how the bailout type affect local innovation activities in several post-event years. The sample used in specification (1) to (5) is $T = 0$ (event year), $T = 2$, $T = 4$, $T = 6$, $T = 8$, respectively. *Owner Bailout* is a dummy variable which equals to 1 if the bailout involves capital injection from the owner, and 0 if the resolution is related to the association. The dependent variable in panel A is $ln.N\_cit\_gr$, which equals to log of the number of citation weighted patents granted to firms operating in the corresponding local area. The dependent variable in panel B is $ln.N\_firms\_pt$, which equals to the number of firms involved in patenting activities in the local area. The dependent variables are the change ($\Delta$) from pre-event three year ($T = -1$ to $T = -3$) average values. Standard errors are reported in parentheses. All regressions include year fixed effects and local macro economics controls. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| Panel A: Bank Bailout Type and Citation Weighted Patents | | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Post-event year | T=0 | T=2 | T=4 | T=6 | T=8 |
| Dependent ($\Delta$) | | | $ln.N\_cit\_gr$ | | |
| Owner Bailout | -0.089** | -0.288*** | -0.188*** | -0.226*** | -0.314*** |
| | (0.035) | (0.059) | (0.055) | (0.060) | (0.068) |
| $\Delta$ *total loans* | -0.011* | -0.007 | 0.002 | 0.029*** | -0.011 |
| | (0.006) | (0.007) | (0.007) | (0.008) | (0.007) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes |
| Observations | 2592 | 1675 | 1464 | 1027 | 965 |
| Adjusted R-squared | 0.013 | 0.043 | 0.049 | 0.065 | 0.062 |

| Panel B: Bank Bailout Type and Number of Patenting Firms | | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Post-event year | T=0 | T=2 | T=4 | T=6 | T=8 |
| Dependent ($\Delta$) | | | $ln.N\_firms\_pt$ | | |
| Owner Bailout | 0.015 | -0.117*** | -0.037 | -0.164*** | -0.069 |
| | (0.018) | (0.028) | (0.029) | (0.036) | (0.044) |
| $\Delta$ *total loans* | 0.002 | 0.006* | 0.005 | 0.015*** | 0.006 |
| | (0.003) | (0.003) | (0.004) | (0.005) | (0.005) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes |
| Observations | 2592 | 1675 | 1464 | 1027 | 965 |
| Adjusted R-squared | 0.010 | 0.051 | 0.007 | 0.072 | 0.029 |

## Table XVI
## IV: Bailout Type of Bank Distress and Innovation Activities

Notes: The table reports estimates of two-stage least squares regressions using local electoral cycle as an instrument. The sample includes eight post event years from $T = 1$ to $T = 8$. In the first stage we regress the dummy variable *Owner Bailout* on the dummy for the electoral cycle (which equals to 1 if the bank distress is 0-12 months before the election). In the second stage, predicted probabilities of owner bailout in the first stage are used to predict the dependent variables, which are specified in row 3. *OwnerBailout* is a dummy variable which equals to 1 if the bailout involves capital injection from the owner, and 0 if the resolution is related to the association. The dependent variable in specification (1) is *ln.N_cit_gr*, which equals to log of the number of citation-weighted patents granted to firms operating in the corresponding local area. The dependent variable in specification (2) is *ln.N_firms_pt*, which equals to the number of firms involved in patenting activities in the local area. In specification (3) the dependent variable is *ln.N_scaled_year_ipc*, which counts the citation-weighted number of patents scaled by the average citation in the corresponding technology class (IPC or International Patent Class) and year. In specification (4) the dependent variable is *ln.N_scaled_year*, which counts the citation-weighted number of patents scaled by the average citation in the corresponding year. In specification (5) the dependent variable is *ln.N_top*5%, which counts the number of patents with top% citation in the corresponding year. All the dependent variables are the change ($\Delta$) from pre-event three year ($T = -1$ to $T = -3$) average values. Standard errors are reported in parentheses. All regressions include year fixed effects and local macro economics controls. *,**,*** indicates significance at the 10%, 5%, and 1%, respectively.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Post-event year | | | T=1 to T=8 | | |
| Dependent ($\Delta$) | *ln.N_cit_gr* | *ln.N_firms_pt* | *ln.N_scaled_year_ipc* | *ln.N_scaled_year* | *ln.N_top*5% |
| Owner Bailout | -0.076** | -0.064*** | -0.092** | -0.077** | -0.021*** |
| | (0.031) | (0.021) | (0.044) | (0.038) | (0.007) |
| $\Delta$ *total loans* | -0.000 | 0.008*** | -0.000 | 0.004 | -0.001 |
| | (0.006) | (0.003) | (0.006) | (0.006) | (0.002) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Macro Controls | Yes | Yes | Yes | Yes | Yes |
| Observations | 10929 | 10929 | 10929 | 10929 | 10929 |
| Adjusted R-squared | 0.013 | 0.013 | 0.010 | 0.009 | 0.001 |