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Anders Sørensen

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Address:
The ROCKWOOL Foundation Research Unit
Ny Kongensgade 6
1472 Copenhagen, Denmark

Telephone +45 33 34 48 00
E-mail: kontakt@rff.dk
en.rockwoolfonden.dk/research/

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How Much do Financial Constraints Limit Investments: Evidence from the 2007–2008 Financial Crisis*

Anders Sørensen†

Abstract

Were nonfinancial firms affected by a contraction in credit supply from troubled banks at the onset of the financial crisis of 2007–2008? This question is explored via a dataset that encompasses all accounts of Danish banks, along with detailed information about nonfinancial firms. Banks that were affected by the financial crisis curtailed their lending more than banks that were not affected. This decrease in lending resulted in a notable decline in borrowing among both small and medium-sized firms. Borrowing remained low in the years after the crisis. Specifically, for medium-sized firms, investments, profitability, and value-added growth remained low, while for small firms, employment growth and value-added growth remained low.

Keywords: Financing, Investments, Performance, Financial Crisis

JEL codes: E44, G20, D25, L25

1. Introduction

A credit crunch took place in many countries during the financial crisis of 2007. This was also the case for the Danish economy. Bank lending to nonfinancial firms contracted significantly during the crisis, and the economy experienced the sharpest decline in economic activity in decades. This paper investigates the link between a reduction in credit, investments and employment in Danish nonfinancial firms. Specifically, changes in the supply of financial capital by banks to nonfinancial firms are studied, and a group of firms that have banks that experienced a large decrease in their lending after the onset of the financial crisis are compared to another group of firms that use banks that were not affected to the same extent by the financial crisis. These two groups of banks are referred to as exposed and nonexposed banks, i.e., exposed to the financial crisis, which follows the terminology of Jensen and Johannesen (2017). Using this identification strategy, it is possible to study whether limited financial resources are a source of firm failure if firms are unable to invest capital or employ workers. The role of banks' credit supply is used to study the dynamics of bank loans, investments, employment, and returns to firms.

Financing constraints are often argued to be of major importance for the success of a firm, and the sharp fall in investments during a financial crisis is often argued to be caused by a sharp fall in bank loans; see Brunnermeier (2009) and Shleifer and Vishny (2010). The purpose of the present paper is to

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† The Rockwool Roundation and Copenhagen Business School, Department of Economics, as.eco@cbs.dk

evaluate whether firms that unexpectedly have access to fewer financial resources experience lower economic success. The focus is on small and medium-sized firms and their founders. We ask if firms that use banks that experience a credit crunch are affected by the extent of their bank loans, the development of primary production factors, their profitability, and their performance. To the best of my knowledge, no studies have shown that shocks to bank financing have a negative and causal effect on investments for medium–sized firms. Amiti and Weinstein (2018) found that the idiosyncratic supply side to bank loans has a large effect on the investments of listed Japanese firms' investments, and Kahle and Stulz (2013) studied companies listed on major U.S. stock exchanges and found that the economic significance of a causal link between falling borrowing because of the financial crisis and falling investments is tenuous.

The results of this paper are listed as follows. 1) Bank loans were lower for nonfinancial firms with exposed banks from the onset of the financial crisis than for nonfinancial firms with nonexposed banks. The effect was greater for medium-sized firms. 2) The investment rate decreased in medium-sized firms with exposed banks compared with medium-sized firms with nonexposed banks. 3) Small firms with exposed banks did not experience a reduction in their investments. However, these firms saw a decrease in employment growth compared with small firms with nonexposed banks. 4) Firms with exposed banks experienced lower value-added growth than did those with nonexposed banks. Additionally, medium-sized firms with exposed banks showed reduced profitability, as indicated by lower return on equity (ROE) and return on assets (ROA), compared to medium-sized firms with nonexposed banks. The established effects are persistent over time, and the measured effects described above remain lower in the postcrisis years.

The distinction by firm size is based on a literature suggesting that smaller, less transparent borrowers are more sensitive to credit constraints due to greater asymmetric information and smaller savings buffers (Chodorow-Reich, 2014; Duygan-Bump, Levkov, and Montoriol-Garriga, 2015). This study incorporates this direction by distinguishing firms based on size. However, the sample is restricted to private LLCs, resulting in only few large firms being included. Consequently, the sample predominantly consists of small and medium-sized firms, with the latter group considered small and the former very small. In the Danish context, medium-sized firms are expected to be more sensitive to credit constraints, while small firms are less affected. This is because small firms often struggle to establish strong relationships with banks, making it difficult for them to secure reasonably sized loans. Therefore, the sample is divided by firm size, with the expectation that medium-sized firms – that are small firms in other contexts – will experience the most significant impact on financial capital from banks.

The finding of differential effects at medium-sized and small firms is important because it can serve as a specification check for the validity of the research design. The existence of heterogeneous effects in the difference-in-differences estimation supports causal effects because it highlights how different groups of firms within the treatment and control groups respond differently to the treatment or intervention.

The applied method relies on three prerequisites. These prerequisites are that exposed banks should experience a larger supply shock to lending than nonexposed banks during the financial crisis, that bank–borrower relationships are sticky, and that the selection of bank relationships is unrelated to whether nonfinancial firms are weak or strong such that the financial crisis resulted in a credit crush that was exogenous to nonfinancial firms. We investigate whether these conditions can be claimed to be satisfied.

The analysis relies on a credit crunch that took place for some banks and not others. It is found that exposed banks experienced a larger drop in supply of loans than nonexposed banks after the onset of the financial crisis.

Moreover, the identification strategy relies the persistence of bank–borrower relationships. This means that firms that borrowed before the crisis from banks that did less lending during the crisis would have greater difficulty obtaining bank financing after the onset of the financial crisis, compared to firms that borrowed from less affected banks. Alternatively, firms could change banks from exposed to nonexposed banks to secure loans more easily. However, changing banks can be challenging, leading firms to maintain their existing bank-borrower relationships. We investigate this by evaluating the extent of bank changes among firms in the two groups before and after the financial crisis. Our findings indicate that bank changes were infrequent and that the probability of switching banks did not significantly differ between firms with exposed and nonexposed banks.

Finally, the health of banks must be uncorrelated with the unobserved characteristics of their borrowers that affect the loan market, investment, or employment outcomes. Therefore, it is important to investigate whether weak firms (or other characteristics) match exposed banks to a greater extent than nonexposed banks do. To investigate whether this is the case, two steps are performed. First, difference-in-differences regressions with and without fixed effects are compared. The regression results are virtually similar, suggesting that unobserved firm characteristics do not play a crucial role in borrower–bank relationships. Second, instrument regressions are performed on the difference-in-differences setup using the bank–founder relationship as an instrument for the bank–firm relationship. Two-stage least squares (2SLS) with fixed effects (FE) estimates are found to have similar magnitudes as the difference-in-differences estimates. These regressions support the interpretation of causal effects of the credit crunch on lower access to financial capital and real effects on physical capital investments and performance measures.

An important aspect of this paper should be mentioned. The data contain information on lending in banks of firms and lending banks. Moreover, the data contain yearly accounting data from annual reports and register data on other aspects, such as industry and geographical area. Finally, data on founders and owners are available from the Danish Business Register. Together with the financial crisis, these data enable difference-in-differences analysis with fixed effects and instrumental variable analysis.

The remainder of the paper is organized as follows. Section 2 describes the shock to the supply of financing. Section 3 details the data, while Section 4 investigates bank borrower relationships. Section 5 outlines the methodology, Sections 6 and 7 present the results of the analysis, and Section 8 concludes the paper.

2. Shock to Supply of Finance

In this section, the hypothesis that the financial shock from the financial crisis affected banks asymmetrically, resulting in a greater reduction in loans by banks exposed to the financial crisis (i.e., negative supply shock of bank finance), is investigated.

1. Background

It has often been argued that the onset of the financial crisis in Denmark started in the summer of 2008, when a relatively large bank, Roskilde Bank, went bankrupt; see, for example, Rangvid (2012). However, the international financial crisis began in 2007. In this paper, relatively small corporations are studied, i.e., private limited liability companies (LLCs), which may well have been influenced by the financial crisis, for example, through lower bank lending prior to the large events of bank cracks. Because of this, a conservative choice is made to use 2007 as the first year of the financial crisis.

In Figure 1, aggregate results are presented for credit from banks to the nonfinancial private sector. Lending decreased from late 2007 onward. At the same time, production in the nonfinancial part of the economy is shown to have decreased. This presents an indication of a relationship between financial loans from banks and real economic effects that reduce economic activity. The two curves follow each other. The most important observation from the figure is that both production and bank loans fall from the beginning of the financial crisis and forward.

There were 161 Danish banks in Denmark in 2006; the year before the financial crisis hit[1]. Of these, few banks accounted for the majority of all lending. The remaining banks were smaller regional or local banks. In the analysis below, 122 banks are used. In the analysis, the lending of ordinary bank loans is applied. This means that priority loans from banks and mortgages from mortgage credit institutions are specifically excluded from the analysis. Ordinary bank loans are considered to constitute marginal external financing for firms. The focus is therefore on the role of banks' credit supply of ordinary loans in shaping credit, affecting investments and firm performance.

2. Bank-Level Analysis

The main hypothesis in this paper is that the financial shock from the financial crisis affected banks asymmetrically. Specifically, unhealthy banks are expected to have been hit harder than healthy banks in the sense that they were forced to reduce credit more to nonfinancial firms. The health status of banks is measured by the loan-to-deposit ratio (LTD ratio) of the bank the year before the financial crisis, i.e., in 2006. Specifically, the loan-to-deposit ratio (LTD ratio) for a bank is calculated by comparing the total amount of ordinary loans that the bank provided to firms and households with the total deposits that firms and households had in that bank.

We calculate LTD ratios all using reported loans and deposits for firms and households from Danish banks and categorize banks into two groups, namely, those with an LTD ratio above the median value in 2006 and those below. Banks with a high LTD ratio are considered unhealthy banks in the sense that they were very exposed to the financial crisis, whereas banks with a low LTD ratio are considered healthy in the sense that they were not as exposed—or nonexposed—to the financial crisis. Specifically, banks that have ratios above the median, i.e., banks with a high LTD ratio, are categorized as banks exposed to the financial crisis, i.e., exposed banks, and banks that have ratios below the median are categorized as banks not exposed to the financial crisis, i.e., nonexposed banks. The hypothesis is that exposed banks were influenced more than nonexposed banks in the sense that their lending growth decreased relatively more for this group of banks.[2]

[1] See https://finansdanmark.dk/tal-og-data/institutter-filialer-ansatte/

[2] In the appendix results based on a continuous treatment variable, i.e., $ltd_{2006,i}$, are presented. The dummy and the continuous treatment lead to similar results.

In Figure 2, we present bank lending to nonfinancial firms for the two groups of banks over time, including the 6 years before the financial crisis and 6 years during and after the financial crisis. The growth rates in lending before and after the financial crisis are compared for exposed and nonexposed banks. In the upper panel, the development in lending is determined via unweighted log changes in lending, which implies that small banks are weighted as much as large banks are. In the lower panel, log changes in lending are weighted according to loans in 2006, which corresponds to the aggregate growth rate for a group. In the latter panel, the lending growth rate of large banks is greater than that of small banks. While the two groups of banks have similar growth rates in lending during the 2000–2006 period, there was a sharp divergence over the 2007–2012 period. In other words, there has been less new lending in exposed banks than in nonexposed banks from 2007 onward.

The relative growth rates in loans for both exposed and nonexposed banks followed a similar trend from 2001 to either 2006 or 2007. However, after this period, the growth rates diverged, with loans declining more significantly in exposed banks than in nonexposed banks. This finding supports the hypothesis that banks with a high LTD ratio are more vulnerable to the financial crisis, leading them to reduce their credit granting more than nonexposed banks do. This finding echoes the result for households presented in Jensen and Johannesen (2017).

In Table 1, a similar analysis is presented with difference-in-differences analyses using both unweighted and weighted regressions with bank loans from 2006 as weights. The results in Figure 2 are supported by the regressions in Table 1, which presents fixed effect estimations:

$$\Delta \log(loans_{i,t}) = \alpha_0 + \alpha \times TB_i + \beta \times Post_t + \gamma \times Post_t \times TB_i + \mu_i + \varepsilon_{i,t}$$

$$\Delta \log(loans_{i,t}) = \alpha_0 + \alpha \times LTDB_{2006,i} + \beta \times Post_t + \gamma \times Post_t \times LTDB_{2006,i} + \mu_i + \varepsilon_{i,t}$$

where TB_i is a dummy variable equal to 1 if a bank is exposed to the financial crisis and 0 otherwise; $LTDB_{2006,i}$ is the LTD ratio of bank i; $Post_t$ is a dummy variable that is equal to 1 in 2007, i.e., during the financial crisis, and 0 after; μ_i is a bank fixed effect; and $\varepsilon_{i,t}$ is an error term.

[Table 1 about here]

Loans in exposed banks decreased by 10–12% compared with those in nonexposed banks after the onset of the financial crisis.

The results are similar to the findings of Jensen and Johannesen (2017), Ivashina and Scharfstein (2010) for large borrowers and banks and Cornett et al. (2011), who studied bank lending during the financial crisis.

In conclusion, exposed banks reduced their credit granting to nonfinancial firms more significantly than nonexposed banks did. This raises the question of whether this reduction impacted nonfinancial firms, particularly those connected to exposed banks, by causing a negative financial shock to the firms. If such a shock occurred, we must also consider whether it has had real economic effects on these firms. We will now turn to the study of the hypothesis that the resulting lower supply of financial capital transmits to nonfinancial firms, having financial and real economic effects that are more severe for firms in relationships with banks, especially those exposed to the financial crisis.

3. Data Sources, Samples, and Summary Statistics

Before performing the empirical analysis (Section 6), the data sources, sample and summary statistics are presented (Section 3), whether bank and firm relationships are sticky is studied (Section 4), and the empirical strategy is presented (Section 5).

1 Data Sources

The dataset applied in this paper combines numerous sources of datasets. Data on lending and deposits of firms in Danish banks with a link between firms and their bank relations are obtained from tax records. The Danish Tax Authorities receives information on loans and deposits for corporations at the end of each year. This information is reported by financial institutions and is compulsory. The link between firms and banks comes from Jensen and Johannesen (2017), who have obtained information on branches of banks. Since each loan and deposit entry has information on the bank branch where the firm has its bank activities, the specific bank ID can be merged onto the database. The data show that there were 122 banks in 2006 (the remaining 39 banks, as there were a total of 161 banks in Denmark in 2006, were very small local banks).

Each firm is identified by a firm ID, and each bank is identified by a bank ID. Because of this identification, we can merge information of each firm with loan and deposit data. Accounting data from annual reports are also merged into the data. This includes information on investments, employment, financial costs, results, etc. Thus, these data comprise a collection of all the external annual reports of Danish corporations that are collected and delivered by Experian.

In addition to accounting data from annual reports, administrative records from Statistics Denmark are merged with firm IDs. Specifically, we obtain information on sales, industry, the location of the firm by municipality, the founding date of the firm, and the legal form of the firm. Finally, data from the Danish Business Register is merged with the data. This register includes information on the founders and owners of the firms.

Given the available data on lending and deposits of individuals in Danish banks with a link between persons and their bank relations from tax records, it is possible to identify founders' and owners' bank connections. This relationship can be used to develop an instrumental variable for the bank-borrower relationships for founders and owners. The specific instrumental variable is a dummy variable that is equal to 1 if the founder(s) or owner(s) had an exposed bank as private bank connection in 2006 and 0 otherwise. The instrument variable analysis is performed in Section 7.

Given the available data on lending and deposits of individuals in Danish banks, along with a link between persons and their bank relationships from tax records, it is possible to identify founders' and owners' bank connections. This relationship can be used to develop an instrumental variable for the bank-borrower relationships of founders and owners. The specific instrumental variable is a dummy variable that equals 1 if the founder(s) or owner(s) had an exposed bank as a private bank connection in 2006, and 0 otherwise. The instrumental variable analysis is performed in Section 7.

The dataset covers the 2003–2012 period. A key relationship between accounts information and Danish banks is applied, and background information obtained from accounting data, register data, and the Danish business register are used to enrich the database.

2 Sample

Before conducting the empirical analysis, we restrict the sample in several ways. First, we remove self-employed individuals since it is not possible to separate borrowing for business and borrowing for private purposes by those operating a firm in their own name. Thus, sole proprietors and other unincorporated firms are removed from the analysis. Second, only private limited liability companies (LLCs) are included. This is the most common type of corporation in the Danish economy. In addition, there is the legal form of public LLCs. This type of corporation tends to be much larger than a private LLC and is the legal form taken by the largest Danish firms, which often have access to external financing from other sources through their Danish bank connections. For this reason, the private LLC is the only legal form studied in this paper.

Firms in the financial and insurance activities industry are excluded from the sample, as are firms with unknown industries.

A principal bank is defined for each firm in 2006 via the following method. For firms that made loans to only one bank in 2006, this is their principal bank. For firms that had multiple bank relationships in 2006 but only made a loan to one of those banks, this is their principal bank. For firms that made loans in multiple banks in 2006, the bank for which the loan balance was largest is the principal bank.

3 Summary Statistics

The descriptive statistics of the sample are presented in Table 2. Firms are grouped according to the LTD ratio of their principal bank in 2006, as described in Section 2. The sample is split at the median firm so that the number of firms with exposed and nonexposed banks should be a fifty-fifty split. This is, however, not the case because the firms below and above the median may have the same principal bank and will therefore be assigned to the same group. It is seen that 41% of firms have relationships with exposed banks, and 59% of firms have relationships with nonexposed banks. All variables measured in the DKK are winsorized at the two and a half percentiles and the ninety-seven and a half percentiles to reduce the influence of extreme observations. It is seen that the firms across the two groups are relatively similar.

[Table 2 about here]

4 Sticky Bank-borrower Relationships

If bank–borrower relationships are sticky, then there is credit market friction. When these relationships are sticky, borrowers are less likely to switch banks even if better terms are available elsewhere. This can lead to inefficiencies in the credit market, such as limited access to credit if firms have to stay with exposed banks that especially reduce their credit. Therefore, there may be an inefficient allocation of resources because financial resources might not flow to the most productive uses if borrowers stick with their current banks regardless of better opportunities. This can hinder the overall efficiency and effectiveness of the financial system.

Before answering the questions of whether the credit crunch in banks transferred to nonfinancial firms, we have to address whether bank–borrower relationships are sticky. To do this, we provide descriptive statistics for how often nonfinancial firms shift banks. Table 3 shows that out of 279,900 firm × year observations, bank shifts take place 4.25% of the time. The share of bank shifts is greater

after the onset of the financial crisis than before; i.e., the share of bank shifts was 5.51% after and 2.76% before. Interestingly, bank shifts take place more often for firms with nonexposed banks than for those with exposed banks. Specifically, the share of bank shifts is almost twice as large for firms with nonexposed banks than for those with exposed banks, and the differences are significantly different from 0 at the 1% significance level.

When we focus on firms, we find that out of the 49,033 firms in the sample, 23% change their main bank connections during the 10-year study period. For firms with exposed banks, the share is 16%, whereas it is 28% for firms with nonexposed banks.

[Table 3 about here]

The overall impression is that bank–borrower relationships are sticky, as a relatively low share of firms replace their banks from year to year. Interestingly, firms with nonexposed banks change bank connections more often than firms with exposed banks do. One concern in this respect is that this result could be due to selection. Weak firms team up with exposed banks that are much more willing to give loans than nonexposed banks are, whereas strong firms team up with nonexposed banks that are less willing to give loans. A more rigorous assessment of creditworthiness in nonexposed banks may serve as a stamp of the quality of the firms that they have as customers. This is a concern because it may reflect selection into the two groups that takes place. This may indicate that firms with exposed banks may be in a deadlock and face difficulties in changing banks. We return to this aspect later in Section 7.

The results from the estimation of the following equation are presented in Figure 3:

$$Pr\left(bank\ change_{i,j,m,t}\right) = \alpha_0 + \gamma \times Year_t \times T_i + \lambda_t + \mu_j + \nu_m + \alpha_i + \varepsilon_{i,j,m,t} \quad (1)$$

where $bank\ change_{i,j,m,t}$ is a dummy variable equal to 1 if firm i located in industry j and municipality m change their bank relationship at time t. T_i is a dummy variable equal to 1 if firm i's bank connection is an exposed bank, and $Year_t$ is a dummy variable equal to 1 for year t. λ_t, μ_j, ν_m and α_i denote a full set of year fixed effects, industry fixed effects, municipality fixed effects, and firm fixed effects, respectively. Firm fixed effects take bank fixed effects into account. $\varepsilon_{i,j,m,t}$ denotes an iid error term.

Figure 3 shows that there is no difference in trends in bank changes across the two groups before 2007. In 2007, firms in the exposed group change banks to a lower degree than do firms with nonexposed banks. This effect equals almost -5 percentage points and is significantly different from that at the 10% significance level. This coefficient implies that firms with nonexposed banks change their bank connections 5 percentage points more than do firms with exposed banks. Moreover, the coefficients for 2010 and 2012 are also negative at approximately -0.02–0.03 and significantly different from zero.

[Figure 3 about here]

Table 4 present results similar to those of Figure 3. There are, however, two differences. First, before and after the financial crisis are distinguished only via $Post_t$, which is a dummy that equals 1 during the financial crisis and 0 after. Moreover, heterogeneous effects across firm sizes are investigated. Specifically, the dummy variable $Size_i$ is introduced that equals 1 if a firm has total assets equal to or larger than the medium value in 2006. In other words, the following equation is estimated:

$$Pr\left(bank\ change_{i,j,m,t}\right) = \alpha_0 + \gamma \times Size_i \times Post_t \times T_i + \lambda_t + \mu_j + \nu_m + \alpha_i + \varepsilon_{i,j,m,t} \qquad (2)$$

Column 1 is estimated without the size variable, and it is found that firms with exposed banks shift banks to an extent that is 3 percentage points lower than for firms with nonexposed banks. This reproduces the results of Figure 3. However, when firms are distinguished after size, as is the case in Column 2, it is found that medium-sized firms have a smaller difference in bank shifts between firms with exposed banks and firms with nonexposed banks than small firms do. Specifically, the difference is -0.03 (=-0.04+0.01) for large firms and -0.04 for small firms. When estimated separately for large and small firms, it is found that there are differences in only bank shifts for the treatment and control firms for the group of small firms at the 5% significance level.

[Table 4 about here]

In conclusion, we find that bank–borrower relationships are sticky. Even when the financial crisis strikes, the relationships remain sticky. If anything, it is firms with nonexposed banks that change banks to some extent. When distinguishing between small and medium-sized firms, small firms with exposed banks shift banks to a lower degree than do small banks with nonexposed banks. Moreover, the effect for medium-sized firms with exposed banks is lower and is nonsignificant when it is estimated for medium-sized firms alone.

As a final remark, in the analysis, our measure of bank changes covers potential bank merges in the data, implying that when banks merge or are acquired, this may lead to an involuntary bank change. It is unclear how important such changes are in the data because information on mergers and acquisitions is not available. Therefore, the results presented in this section represent an upper limit of the bank changes in the data.

Sticky borrower–bank relationships are also documented in Chodorow-Reich (2014), who focused on loans to large corporations in the syndicate loan market. A bank that served as the prior lead lender of a private borrower has a 71 percentage point greater likelihood of serving as the new lead lender.

5. Empirical Strategy

In Sections 2 and 4, it has been documented that the credit crush created during the financial crisis was more pronounced in exposed banks with large LTD ratios. Moreover, it has been documented that borrower–bank relationships are sticky. Because of this, the current analysis turns to the study of whether firms that use exposed banks are affected by their borrowing and other financial measures to a greater extent than are firms that use nonexposed banks. In addition, we study whether the expected financial effects have real economic effects on firms through negative effects on primary production factors and ultimately on profitability and sales.

1 Regression Framework

A difference-in-differences estimation strategy is applied. To do this, we have to define control and treatment effects and pre- and postintervention periods. Firms are divided into treatment and control groups according to their bank connection in 2006. If firms had an exposed bank in 2006, they are placed in the treatment group, whereas if they had a nonexposed bank connection in 2006, then they are placed in the control group. The following equations are applied:

$$outcome_{i,j,m,t} = \alpha_0 + \sum_{t_0}^{T} \gamma_t \times Year_t \times T_i + \lambda_t + \mu_j + \nu_m + \alpha_i + \varepsilon_{i,j,m,t} \quad (3)$$

$$outcome_{i,j,m,t} = \alpha_0 + \gamma \times Post_t \times T_i + \lambda_t + \mu_j + \nu_m + \alpha_i + \varepsilon_{i,j,m,t} \quad (4)$$

$$outcome_{i,j,m,t} = \alpha_0 + \gamma \times Size_i \times Post_t \times T_i + \lambda_t + \mu_j + \nu_m + \alpha_i + \varepsilon_{i,j,m,t} \quad (5)$$

where $outcome_{it}$ is a financial or economic outcome of firm i at time t; α_i represents firm fixed effects; $year_t$ is a vector of year dummies (2006 is the omitted category); and $exposed_i$ is a dummy variable indicating whether the primary bank of individual i in 2006 had a loan–deposit ratio above the population median.

The three abovementioned estimated equations differ with respect to the difference-in-differences estimator. Equation 3 estimates a more nonparametric functional form regression, letting γ_t vary and has its own value for each year t, estimating approximately 10 values for γ_t. The T_i representing firms with exposed banks remains the same across years. Equation 4 is the standard difference-in-differences estimator that estimates the mean effect of the financial crisis for firms with exposed banks compared to those with nonexposed banks. Finally, Equation 5 estimates heterogeneous effects for subpopulations of the treatment and control groups. The applied heterogeneous effect is for medium-sized firms.

The following set of financial outcomes is applied: the yearly change in $\log(debt)$ of firm i. Specifically, it is hypothesized that firms with exposed banks obtained lower levels of new loans or paid off more on existing loans after the onset of the financial crisis. Moreover, we apply a variable for the overall financial (net) costs of firms where we expect that firms with exposed banks tended to have higher financial costs than firms with nonexposed banks. Finally, we study the effective interest rate of loans, where we expect that firms with exposed banks faced higher interest rates after the onset of the financial crisis.

Two sets of economic variables are applied. First, variables related to the build-up of firms' primary production factors are applied. Gross-investments in firms are investigated because investments in fixed assets are often financed through bank loans. Because firms with exposed banks are expected to have access to fewer bank loans than are firms with nonexposed banks, it is hypothesized that firms with exposed banks had relatively low investments after the onset of the financial crisis. That is, a mechanism from lower bank loans to lower investments should be uncovered, which is expected to have real economic effects on firms. This is our main hypothesis concerning primary production factors. An additional effect may be that firms with exposed banks will lower employment growth more compared with nonexposed banks if firms have to spend more of the firm's cash flow on investments or other costs.

Second, we apply variables related to firm performance. Specifically, we investigate $\Delta \log(value\ added)$, return on assets (ROA), return on equity (ROE), and firm exit. The hypothesis is that financial means improve performance because firms can make optimal investment and employment decisions. On the other hand, when firms are restricted by poorer access to bank lending, their performance will also be weaker. Therefore, firms with exposed banks are expected to have weaker performance than firms with nonexposed banks after the onset of the financial crisis. As described above, the difference-in-differences Equations 1–3 include firm fixed effects. For this reason, we do not include invariant firm variables or initial firm characteristics. Moreover, heterogeneous effects are investigated, as was the case when previously examining bank shifts.

2 The “Small versus Large” Hypothesis

The distinction by firm size is based on the literature suggesting that smaller, less transparent borrowers are more sensitive to credit constraints because of greater asymmetric information and smaller savings buffers (Chodorow-Reich, 2014; Duygan-Bump, Levkov, and Montoriol-Garriga 2015). However, there are only a few large firms in the applied sample because the sample is restricted to include private LLCs only. This implies that there are many very small firms. Consequently, it is expected that the group containing medium-sized firms will experience the largest impact on financial capital from banks. The reason that the small group is expected not to be affected to a large extent is that it is difficult for small firms to have a serious relationship with their bank and are thus not able to obtain loans of reasonable size. The size of firms is defined according to total assets, where one group is above the median and the other is below the median. In this respect, it is expected that the group of small firms is so small that they do not have access to much external funding from commercial banks. Consequently, small firms are not expected to be as affected by having worse access to external financing from bank loans during the financial crisis to the same extent as medium-sized firms.

In addition to distinguishing between firms by size, firms are also distinguished by firm age. This division of firms is applied in the robustness analysis of Section 8.

6 Results

In this section, the main results are presented. As outlined in Section 2, the financial shock from the financial crisis impacted banks unevenly, leading to a more significant reduction in loans by those banks that were exposed to the crisis. This section presents findings supporting the hypothesis that a decreased supply of financial capital extended to nonfinancial firms, resulting in more severe financial and economic effects for firms associated with exposed banks. In the analysis, the treatment group consists of firms with connections to exposed banks in 2006, whereas the control group consists of firms with connections to nonexposed banks in 2006.

1. Financial Outcomes - Bank Loans and Financial costs

The financial crisis is expected to have influenced the financial situation of firms through two channels. First, it is expected that firms with exposed banks will have had more difficulty obtaining new bank loans. Second, it is expected that financial costs will have increased more in these firms because exposed banks have to raise the financing costs more than nonexposed banks do and because firms with exposed banks have to accept higher financial costs for external financial capital obtained through sources other than their bank(s). Below, three financial outcome measures are presented. These are the log change in the bank debt of the firm; the net financial expense ratio, which is defined as net financing costs in relation to sales; and the interest rate on external finance, which is defined as the financial costs in relation to total debt.

Figure 4, Panel a, presents the development in bank loans for firms with exposed banks compared with that for firms with nonexposed banks. More precisely, Equation 3 is estimated with $outcome_{i,j,m,,t} = \Delta \log\left(Bank\ debt_{i,j.m,t}\right)$, where $Bank\ debt_{i,j.m,t}$ is the loan of firm i in industry j and municipality m in year t. The developments for the two groups follow similar trends for years before the onset of the financial crisis. When the financial crisis struck in 2007, firms with exposed banks experienced a decrease in the log change of their debt compared with firms with nonexposed banks. This was either

because the firms were repaying existing debt or were taking out less debt than were firms with nonexposed banks. The relative growth rate of loans in exposed banks fell by approximately 5 log points in 2007 and onward, with significantly lower growth rates in all years except 2009. The picture that emerges is that the credit crunch affected firms with exposed banks more than firms with nonexposed banks.

[Figure 4 about here]

Figure 4, Panel b, presents the net financial expense ratio. These costs developed similarly across control and treatment in the years up to the financial crisis. This cost share increased in the firms with exposed banks compared with firms with nonexposed banks between 2007 and 2008. The magnitude of the effect is that financing costs increased by approximately 4–6 percentage points during the postcrisis years. This implies that the net financial costs in relation to sales increased more in firms with exposed banks than in those with nonexposed banks. The interpretation is that firms with exposed banks had more difficulty financing their fixed assets at this time. The ratio increased until 2010, where it peaked at 6 percentage points and then decreased gradually to almost 2 percentage points in 2012.

Figure 4, Panel c, presents the last measure, namely, the interest rate on the external financing of firms with exposed banks compared with nonexposed banks. For the net financial expense ratio, the interest rate followed similar trends for firms with and without exposed banks before the financial crisis. The difference in interest rates was up to 0.5 percentage points greater in firms with exposed banks than in those with nonexposed banks in the postcrisis years.

In conclusion, we find that nonfinancial firms with exposed banks experienced a tougher period starting at the onset of the financial crisis than did nonfinancial firms with nonexposed banks. Specifically, those firms with exposed banks had lower ordinary bank loans, higher net financial expense ratios and higher interest rates than their counterparts with nonexposed banks. This development is attributed to the negative supply shock on ordinary bank loans in exposed banks generated by the financial crisis. In this sense, a lower supply of ordinary bank loans is found to have had a causal effect on the log change in ordinary bank debt, as well as financial costs, in firms with exposed banks than in those with nonexposed banks.

The results presented motivates an investigation of heterogeneous effects, where small and medium-sized firms as measured by total assets are distinguished. If a firm had total assets below the median value among firms in 2006, it is categorized as a small firm, whereas if the firm's total assets were above the median value, it is categorized as a medium-sized firms.

[Table 5 about here]

The heterogeneous effects are estimated and presented below in Table 5. The heterogeneous effect is pronounced. The log change in debt is -8 log points lower for firms with exposed banks than for those with nonexposed banks. For medium-sized firms with exposed banks, the effect is -6 log points lower than that for small firms with exposed banks, as shown in Column 2. In Columns 3 and 4, the difference-in-differences estimator is -0.10 and strongly significant for medium–sized firms, whereas it is -0.03 and significant at the 10% significance level for small firms. For the net financial expenses

ratio and the interest rate, heterogeneous effects are also documented where the expense ratio increases more for medium-sized firms than for small firms.[3]

2. Primary Input Factors – Changes in Physical Capital and Employment

It is expected that firms will reduce their investments because of less available and more expensive external financing. Because of these expectations, the investment rate, defined as gross investments in relation to fixed assets measured at the beginning of the year, will be investigated in the following.

Figure 5, Panel a, presents the investment rate. The investment rate developed similarly across the two groups from 2003 to 2006. After 2006, the investment rate decreased, and this decrease becomes significantly differed from zero for 2009 and 2010. In 2011 and 2012, the effect on the investment rate was nonsignificant.

[Figure 5 about here]

In Table 6, the difference-in-differences estimator implies that gross investments as a share of total assets decreased by -0.017 percentage points in firms with exposed banks compared with those in firms with nonexposed banks after the financial crisis. As the mean value of the variable in 2006 is 0.640, the additional decrease in investment intensity is approximately 2.7% lower in firms with exposed banks than in those with nonexposed banks.

[Table 6 about here]

When investigating heterogeneous effects, we find that the negative difference-in-differences estimator equals -0.035 percentage points for medium-sized firms, whereas the mean value of the investment intensity equals 0.341. This implies that medium-sized firms with exposed banks experienced a decrease in their investment intensity that is 10% smaller than that of medium-sized firms with exposed banks.

The results show that medium-sized firms with exposed banks had lower investment rates than did medium-sized firms with nonexposed banks. In contrast, small firms with exposed banks did not experience effects on their investment rates from the credit crunch different than those experienced by small firms with nonexposed banks.

Next, the analysis turns to the log change in employment. Firms may also adjust their number of employees because of less access to financial capital. This effect is unclear since two opposite effects can influence the choice. First, firms may substitute capital for labor because they change their capital labor ratio as a consequence of changed relative input prices because of less available and more expensive external financing. Second, they may reduce production all together and thereby reduce employment. Consequently, it is theoretically unclear which of these opposite effects dominate; therefore, it is unclear whether employment will increase or decrease in firms with exposed banks compared with nonexposed banks. We present the results for employment for the number of employees in firms with the dependent outcome variable $\Delta \log(employees_{i,j.m,t})$.

[3] Differences in effects for subgroups defined after industries or firm age turns out to be insignificant. Hence, the only heterogeneous effect that is found is after firm size. In Appendix Tables A1, the results for such regressions are presented.

Figure 5, Panel b, shows that the number of employees was not affected in firms with exposed banks after the onset of the financial crisis. There is a relative decrease in the log change of employees from 2007 to 2010 for the treatment group compared with the control group, and the estimated effect is significantly different from zero at least at the 10% significance level for these years except for 2008.

In Table 5, heterogeneous effects are documented where small firms with exposed banks experienced a greater reduction in the log change in employment than did small firms with nonexposed banks. The effect is found to be nonsignificant for medium-sized firms.

In summary, we conclude that lower access to financial capital in the form of bank loans reduces investments in physical capital more for medium-sized treatment firms than for control firms. In this sense, medium-sized firms become limited in their ability to invest in capital and thereby choose to reduce the level of physical capital. For small firms, such an effect is not established.

On the other hand, the log change in employees remains unchanged for medium-sized firms. For small firms, however, the log change in employees decreases more in small firms with exposed banks than in small firms with nonexposed banks.

The conclusion of this subsection is that in response to supply shocks to ordinary loans in banks, medium-sized firms reduce their investments, whereas small firms reduce their employment growth.

3 Performance and Profitability

Thus far, we have traced causal effects from the bank credit crunch to financial measures and primary production factors. Now, we turn to measures of success. The measures that we apply here are the log change in value added, two profitability measures, and the probability of exit of firms.

The change in log value added is applied as a measure of performance. The log change in value added is expected to decrease for both small and medium-sized firms because the changes in primary factors have fallen for both small and medium-sized firms with lower employment growth rates and lower investment rates.

The two profitability measures are return on assets (ROA) and return on equity (ROE). ROA measures net income divided by total assets, whereas ROE measures net income divided by private equity (or shareholder equity). The difference in interpretations of the two measures is related to the different measures in the denominator, or more precisely, the financial metrics from the balance sheet in the financial statements to which an income measure is compared. The difference-in-differences estimators for ROA and ROE are expected to be negative since the returns are calculated after the deduction of financial costs that we have seen to increase in Subsection 6.2 on financial outcomes.

This is exactly what we find. Table 7 shows that firms with exposed banks had a log change in value-added growth that is 1.9 log points lower than that of firms with nonexposed banks after the onset of the financial crisis. Moreover, the two firm types in the treatment group – small firms and medium-sized firms – did not experience differences in growth rates. This is seen from Column 2, as the difference-in-differences estimator does not vary significantly across small and medium-sized firms.

[Table 7 about here]

Next, the results for profitability are presented via ROE and ROA. When we apply these earnings measures, we find that medium-sized firms with exposed banks experienced more of a decrease in the two profitability measures compared with medium-sized firms with nonexposed banks. For ROE, the difference-in-differences estimator implies that the measure decreases by -2.1 percentage points in relative terms for firms with exposed banks. For medium-sized firms, the ROE decreases by 3.3 percentage points in relative terms. Since the mean value of ROE for medium-sized firms in 2006 was equal to 0.43, ROE decreases by 8% more in medium-sized firms with exposed banks after the onset of the financial crisis than in medium-sized firms with nonexposed banks. When profitability is measured by ROA, the qualitative results are the same.

The question is whether ROE and ROA decrease for medium-sized firms because higher financial costs reduce the net income or whether earnings before interest and taxes (EBIT) also decrease because of the relatively low accumulation of primary production factors documented above in Subsection 6.2. To answer this question, regressions are run using the adjusted ROE and ROA, where EBIT is used as an income measure. ROE with EBIT decreases significantly for medium-sized firms with exposed banks compared with that for medium-sized firms with nonexposed banks after the onset of the financial crisis.

This result is not recreated for ROA based on EBIT, where difference-in-differences estimators are found to be nonsignificant. When we move from ROE to ROA, liabilities are added to private equity in the denominator. The explanation for the insignificance of the difference-in-differences estimator is

that the relative decrease in liabilities is greater than the relative decrease in private equity such that the ROA based on EBIT is more stable across the treatment and control groups.

Finally, we investigate firm exit. Exits are defined as liquidation, forced closures or bankruptcies. Table 8 shows that the probability of exit for firms with exposed banks in 2006 increases by 0.6 percentage points compared to an exit share of 0.016 for firms with nonexposed banks. Therefore, the probability of exit increases by 40% in firms with exposed banks compared with firms with nonexposed banks. There are heterogeneous effects, such that the effect is significant for only small firms. The coefficient equals 0.8 percentage points, which should be compared to a 2006 value of 0.004, corresponding to an increase of approximately 200%.

[Table 8 about here]

The conclusion of this section is that the decreased supply of financial capital from banks exposed to the financial crisis extended to nonfinancial firms, resulting in more severe financial and economic effects for firms with exposed banks than for those with nonexposed banks. The effects are especially pronounced for medium-sized firms where lower access to external financing reduces investments and thereby profitability and performance. However, small firms are also affected, although with a different transmission mechanism where borrowing and employment growth were lower for firms with exposed banks during the postcrisis years.

7. Instrumental Variable Analysis

The purpose of this section is to perform an instrumental variable analysis that investigates whether it can be ruled out that the above results are a consequence of firms' (unobserved and time variant) characteristics differing across the treatment and control groups and thus not founded only on having exposed or nonexposed banks.

Until now, the banks that firms use has been treated as exogenous such that it has been assumed that firms select banks randomly. This rules out that weak (or fragile) firms that have relatively large challenges coping with the financial crisis are choosing exposed banks (for whatever reason) in the precrisis period. If weak firm characteristics play a role, then these characteristics (partly) generate the weak performance of firms with exposed banks. The concern is that firms may not select banks randomly but instead that a certain group of firms, e.g., weak firms, select banks with high LTD ratios, for example, with the expectation that it will be easier to obtain more and larger bank loans. If weak firms choose exposed banks, then the estimated effects in Section 6 may be a consequence of this selection, i.e., firms in the treatment group have a hard time coping with the financial crisis. Thus, this group is compared to a control group of strong firms that are better at facing this challenge.

To investigate whether the weak firm hypothesis is a concern, we perform an instrumental variable analysis that is based on the idea that founders' or owners' personal bank connections are essential for a firm's bank connections. Of course, weak founders may choose exposed banks and open weak firms. This would imply that it is the weak founders that essentially drive the results. Nevertheless, this outcome is considered less likely.

Using data from the Danish Business Register, the founders' and owners' personal bank connections are identified, and this information is used to predict the firms' bank connections. More precisely, we

identify the founder private bank connection for their private loans and use the LTD ratio for the private bank as an instrument for the loans and deposits ratio for the firm's bank.

The instrumental variables analysis is performed using the same regressions as those described in the analysis above. In this analysis, however, we introduce an additional equation, namely, a first-stage regression for the selection of the bank. In this regression, we apply an instrument that represents the bank of the owner(s) or founder(s). The idea is that a founder or an owner of a firm may well choose the same bank for his firm that he has for himself:

$$outcome_{i,j,m,t} = \alpha_0 + \gamma \times \widehat{D_{it}} + \lambda_t + \mu_j + \nu_m + \alpha_i + \varepsilon_{i,j,m,t}$$

$$D_{it} = P_t \times T_i = P_t \times F_i + \lambda_t^F + \mu_j^F + \nu_m^F + \alpha_i^F + \varepsilon_{i,j,m,t}^F$$

The analysis is performed by weighting the regressions using the inverse number of founders/owners in firms, i.e., if a firm has two founders, it will enter the regressions with two observations, and each of these will have a weight of one half. In this way, firms enter with equal weights in the analysis.

The empirical results are presented in Table 9. First, the results for the financial outcomes are presented. The results are presented for medium–sized firms, as it is for this subgroup of firms for which the largest difference-in-differences estimates were established. The first column presents the estimates for the fixed effects regression of the new sample, i.e., this regression is the same as that presented in Table 5, Column 4. However, the sample is smaller as it contains only the observations for which founders and/or owners can be identified. The estimates are of the same magnitude as those described in Table 5. The estimate equals -0.07 log points, which is significantly different from zero. In Column 2, the reduced-form regression where the instrument is substituted for the interaction term into the second-stage regression. The point estimate for the reduced form is slightly smaller than that for the fixed effects regression and equals 0.04. Nevertheless, the coefficient is significant at the 5% level. Finally, the fixed effect IV regression is presented in Column 3; it is found that the causal effect of having an exposed bank has the same effect on the log change in loans. The results for financial costs are also presented in the table; they show that the causal effect on financial costs of the financial crisis is of the same magnitude as for the fixed effect regression.

[Table 9 about here]

Next, we turn to the development of primary production factors. In the first three regressions, we present the results for the gross investment rate for medium–sized firms. The first is for the fixed effect estimation, the second is for the reduced form, and the third is for the fixed effect IV regression. The difference-in-differences gross investment rates are affected similarly across the three estimation methods, implying that the effects of the financial crisis on the investment rate are causal. The estimation results do not survive, for the employment regressions that is estimated using the full sample. Even when the sample is split into the two groups consisting of small and medium-sized firms, respectively, the results are not significant.

Finally, we investigate performance measures such as the log change in sales and ROE. The results for ROE are similar across estimation methods, and the results presented in Section 6 are reconstructed. However, for log change in value added, the results from Section 6 cannot be recreated. The main reason for this is that the sample size is reduced.

In this subsection, an instrumental variable analysis is performed using founders' and owners' personal bank connections. For this subsample, the results are similar to those found for the full

sample presented in Section 6. We conclude that firms tend to choose their founders' and owners' bank connections and that firms with exposed banks obtain fewer loans, have higher financial costs, invest less, and have weaker performance throughout the financial crisis than do firms with nonexposed banks.

8 Conclusion

In conclusion, this paper provides robust evidence that the credit crunch that occurred during the financial crisis of 2007 had significant and lasting impacts on Danish nonfinancial firms. The findings demonstrate that firms with banks that experienced a substantial reduction in lending faced more severe constraints in accessing financial capital, which in turn negatively affected their investment rates, employment growth, and overall economic performance. Medium-sized firms were particularly impacted, showing a marked decline in both investment and profitability, whereas small firms primarily experienced reduced employment growth.

The study's methodology, which leverages differences in bank exposure to the crisis, underscores the causal relationship between reduced credit supply and negative firm outcomes. This research contributes to the literature by establishing, for the first time, a direct causal link between external financial constraints and reduced investments in medium–sized firms. Furthermore, the persistence of these effects into the postcrisis years highlights the long-term implications of financial shocks for firm performance.

Overall, the paper emphasizes the critical role of stable bank–firm relationships and the broader economic consequences when these relationships are disrupted. The differential impacts on small versus medium-sized firms provide valuable insights into the heterogeneous effects of financial crises, reinforcing the importance of tailored policy responses to support firms of varying sizes during economic downturns.

The existence of heterogeneous effects in the difference-in-differences estimation supports the interpretation of causal effects because it highlights how different groups of firms within the treatment and control groups respond differently to the treatment. This variation across groups supports a causal mechanism because heterogeneity in difference-in-differences estimation can emerge for multiple reasons, such as exposure to the intervention. Identifying and understanding these differences help support the existence of a causal mechanism because interventions are often predicted to affect subpopulations differently (e.g., small vs. large firms, younger vs. older firms). When the observed heterogeneity matches theoretical expectations, it strengthens the case that the difference-in-differences estimates capture causal effects.

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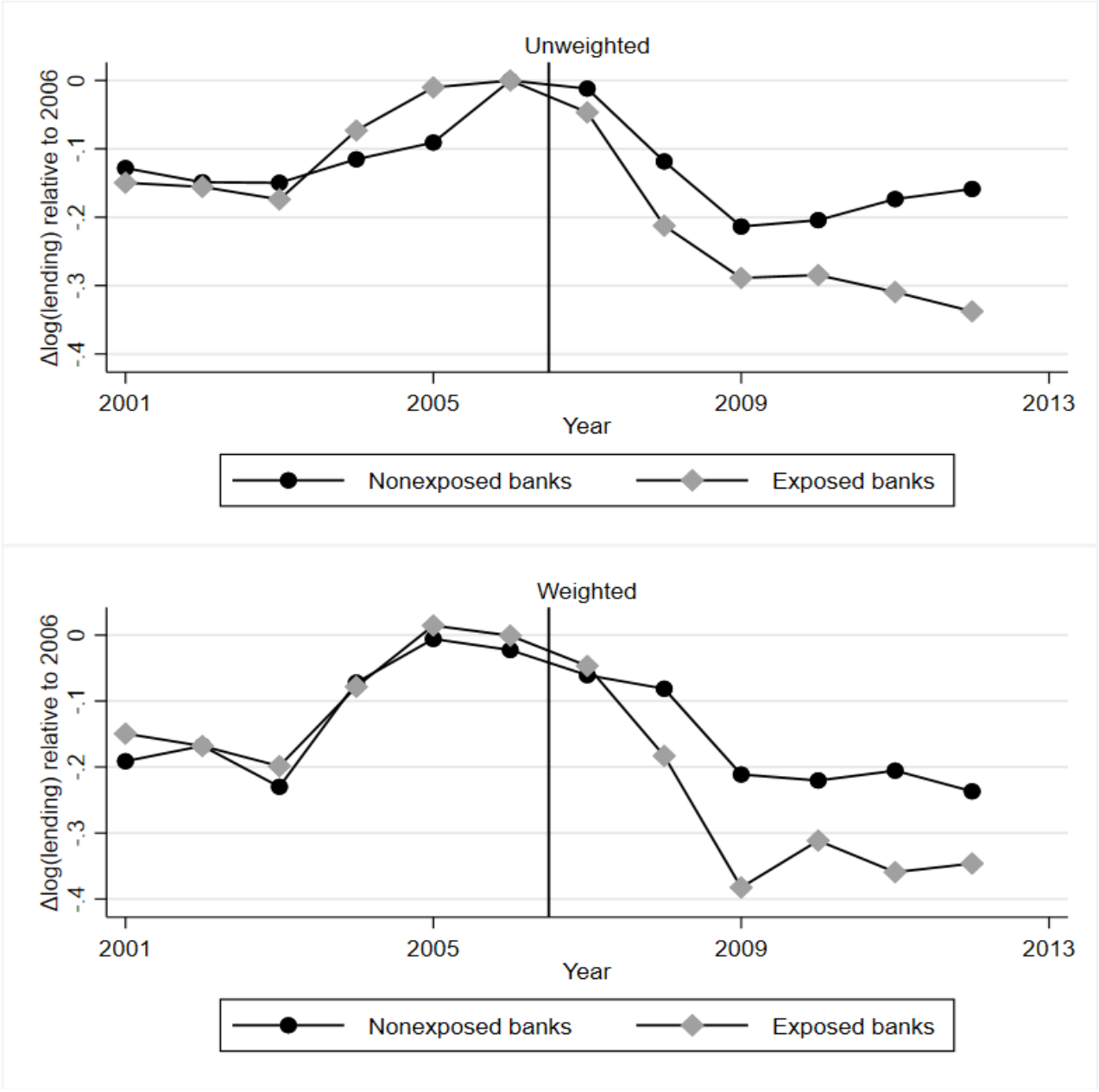
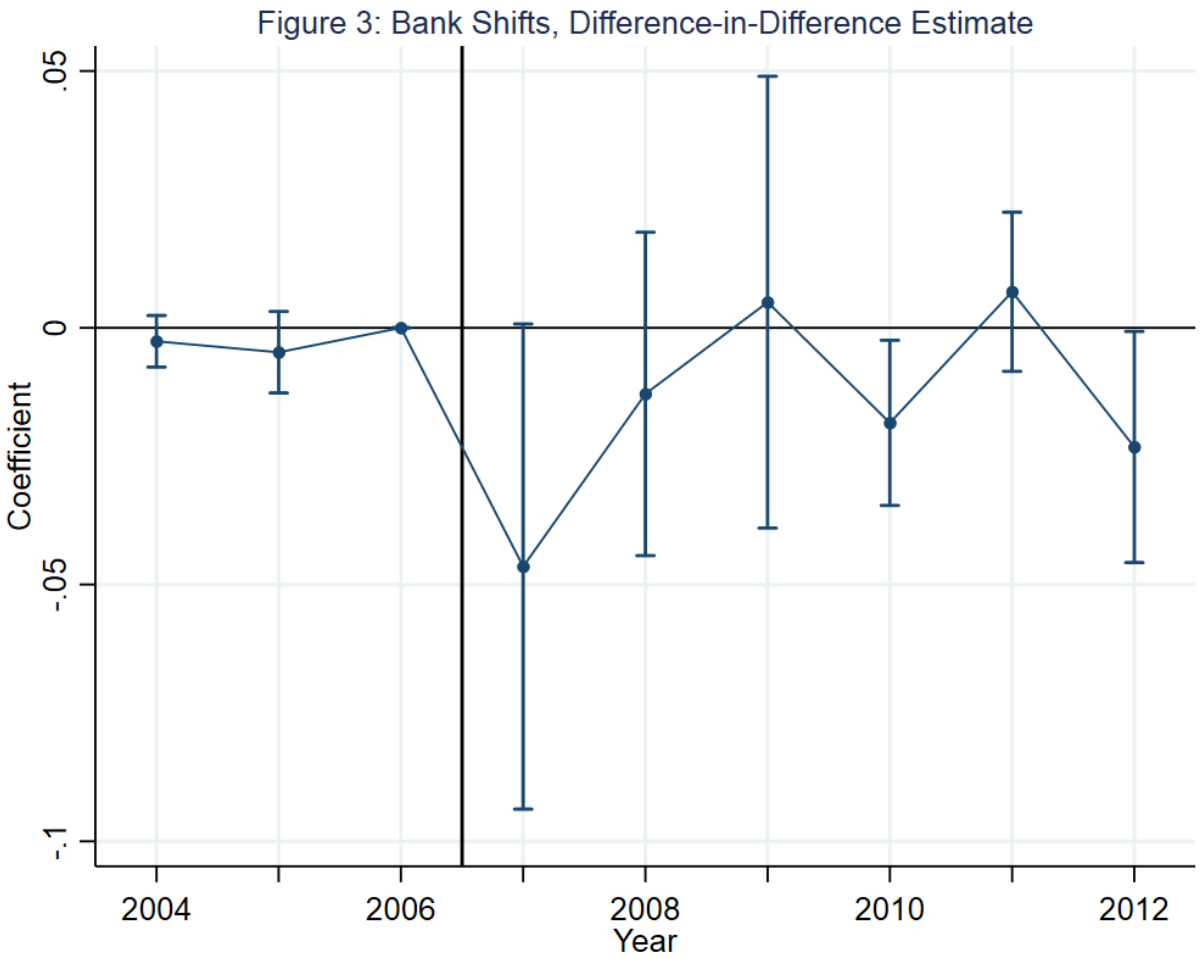
Figure 1: Production in Nonfinancial Sector an Bank Credit

Source: Statistics Denmark, NKBP10: 1-2.1.1 Production and generation of income by transaction, industry, price unit and seasonal adjustment; DNPUD: Loans in total from banks by data type, sector, country, currency and maturity (original maturity); DNPIN: Deposits in total in banks by instrument, data type, sector domestic and foreign, country and currency.

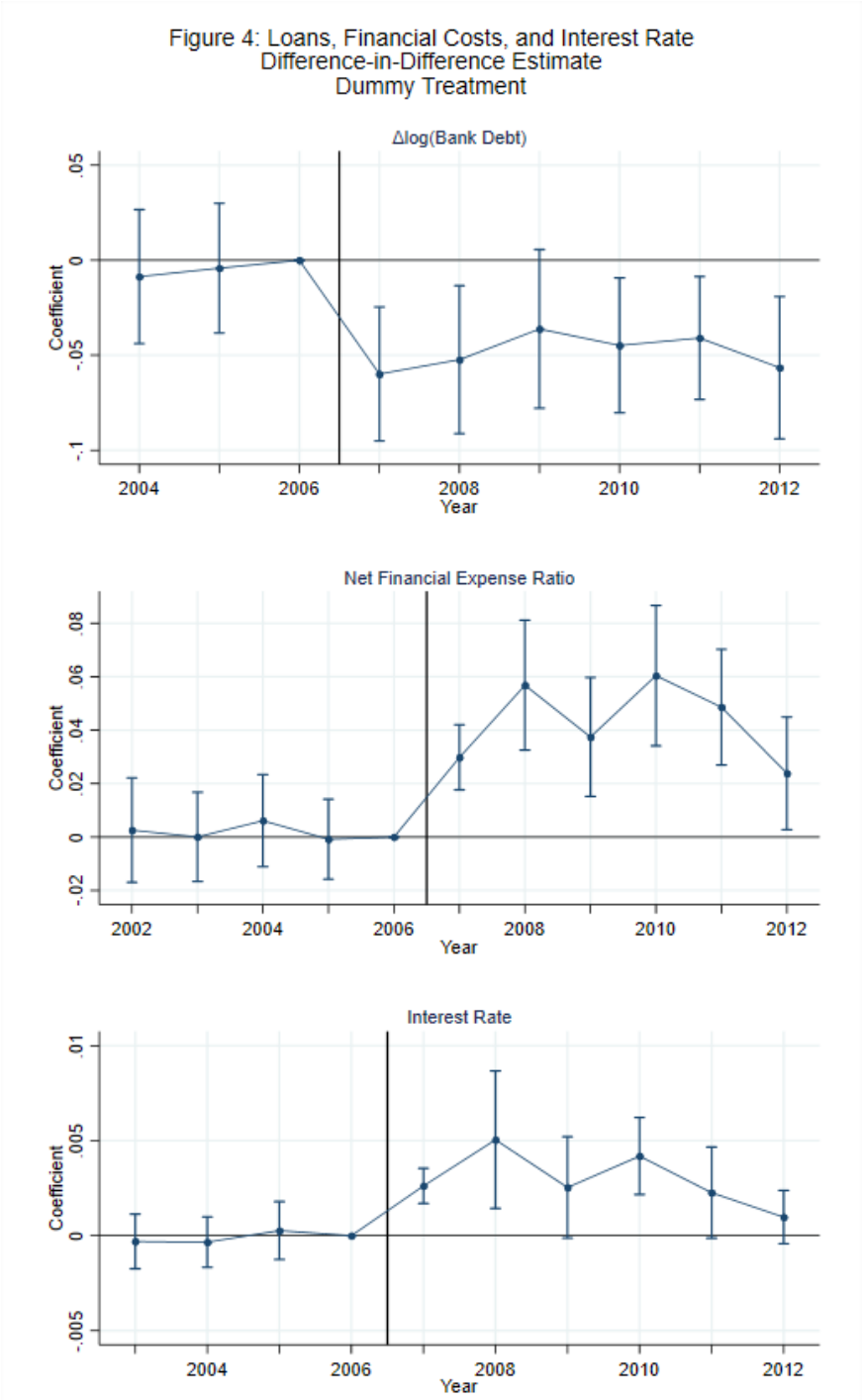
Figure 2: Bank Lending and Exposure to the Financial Crisis
Dummy Treatment



Note: Δlog $(lending)$ relative to 2006 is defined as the log change in loans minus the log change in loans in 2006 for the group of firms. In the upper panel, the treatment and control group are defined after the median of the number of banks, whereas the treatment and control group is defined after the median weighted with loans in 2006. Source: Statistics Denmark and own calculations

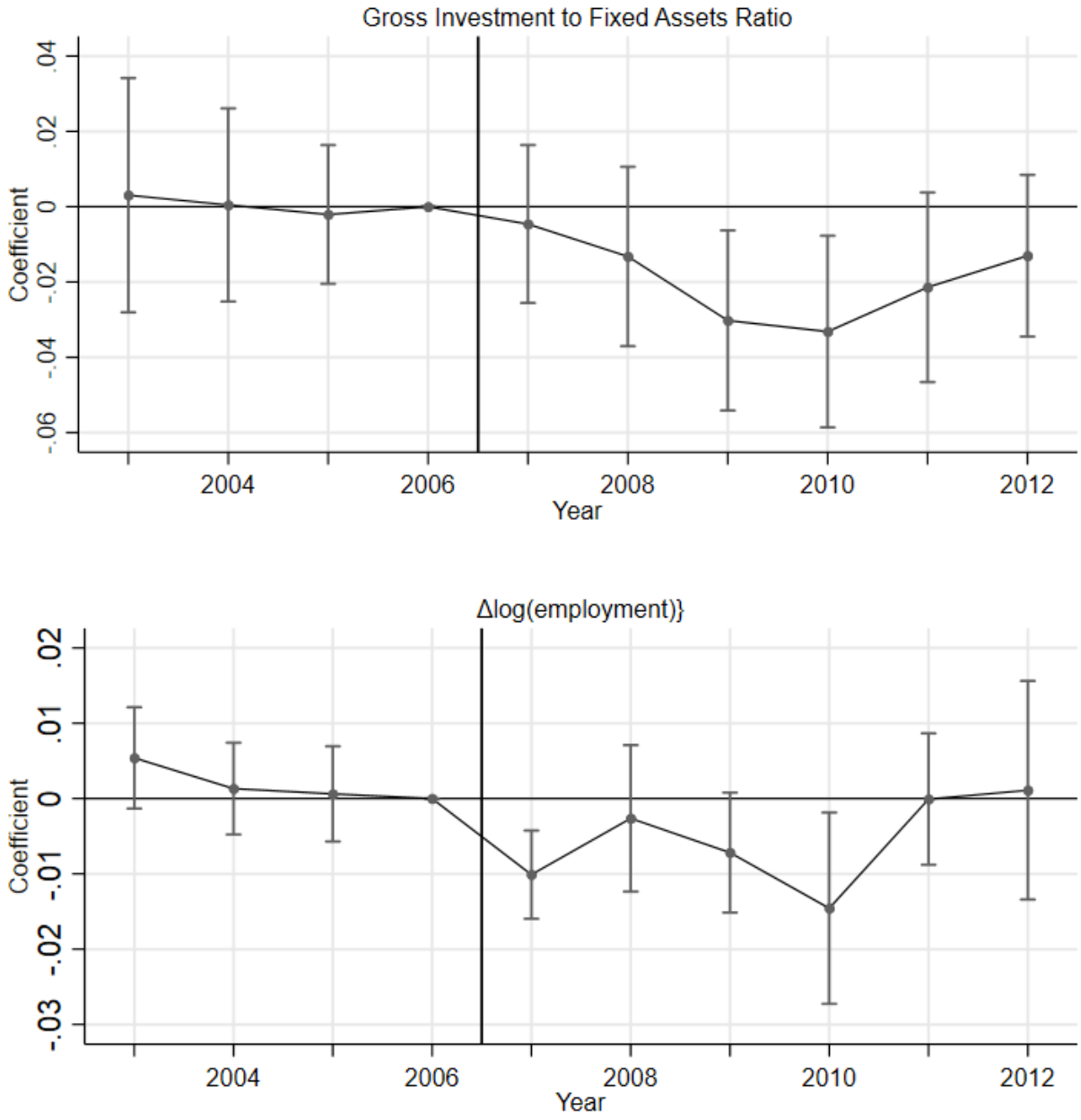


Note: A bank shift is defined as a firm changing its bank among the 122 Danish banks included in the study. Shifts occur for two reasons: first, firms voluntarily change banks; second, firms change banks due to bank mergers. Consequently, the number of bank shifts may be overestimated. Source: Statistics Denmark and own calculations

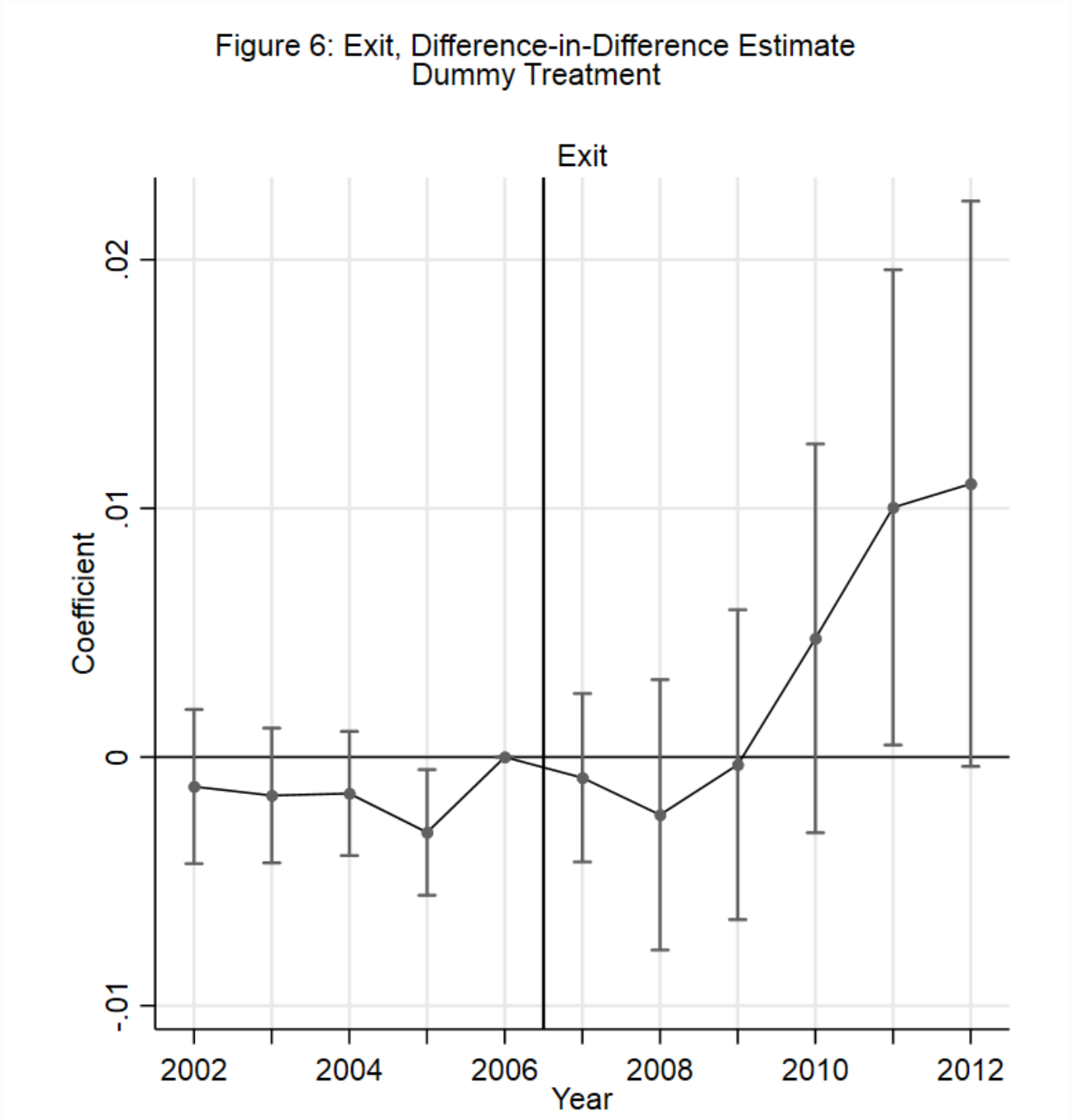


Note: Figure 4 illustrates the results where the dependent variable is log-change in bank loans in panel A, net financial expense ratio defined as net financial expenses divided by sales in panel B, and the interest rate defined as financial expenses divided by total debt defined as the average of initial debt and final debt in a year. The bars represent 95 percent confidence intervals of the point estimates based on standard errors clustered at the level of the primary bank in 2006. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. To limit the influence of outliers, regressions are reported with truncated variables that are bounded above the 2.5th percentile and below the 97.5th percentile. Source: Statistics Denmark and own calculations.

Figure 5: Gross Investments and Employment Difference-in-Difference Estimate



Note: Figure 5 illustrates the results where the dependent variable is gross-investments in relation to initial total fixed assets in panel A, and log change in employment in panel B. Using shrinking at the 2.5th and 97.5th percentiles on the dependent variable to eliminate the effect of outliers. The bars represent 95 percent confidence intervals of the point estimates based on standard errors clustered at the level of the primary bank in 2006. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. To limit the influence of outliers, regressions are reported with truncated variables that are bounded above the 2.5th percentile and below the 97.5th percentile. Source: Statistics Denmark and own calculations.



Note: Figure 6 illustrates the results where the dependent variable is exit. The bars represent 95 percent confidence intervals of the point estimates based on standard errors clustered at the level of the primary bank in 2006. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. Source: Statistics Denmark and own calculations.

Table 1: Bank Level Analysis 2001-2012

	Unweighted Dummy b/se	Unweighted Continuous b/se	Weighted Dummy b/se	Weighted Continuous b/se
Post x TB	-0.10***		-0.12***	
	(0.02)		(0.04)	
Post x LTDB		-0.13***		-0.21***
		(0.02)		(0.07)
Constant	0.10***	0.10***	0.06***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)
R-squared	0.28	0.31	0.46	0.48
Number of observations	1333	1333	1333	1333
Number of banks	122	122	122	122

Notes: Table 1 reports regression estimates from bank-level regressions where the dependent variables are described in the note to Figure 2. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. TB equals 1 if bank has an LTD ratio above the median and 0 otherwise. The applied medians are unweighted median in Column (1) and the weighed median using loans in 2006 as weights. LTDB is the LTD ratio of the bank in 2006. The regressions include a full set of year fixed effects and bank fixed effects. To limit the influence of outliers, regressions are reported with truncated variables that are bounded above the 0.5th percentile and below the 99.5th percentile. * p<0.10, ** p<0.05, *** p<0.01.
Source: Statistics Denmark and own calculations.

Table 2: Descriptive Statistics for the Full Sample, 2006

	All firms			Firms with nonexposed banks			Firms with exposed banks		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Treatment or Control	45710	.412	0.5	26897	0		18813	1	
Founding year	45710	1997.7	8.6	26897	1997.2	8.9	18813	1998.5	8.2
Bank loan in DKK	45248	816905	2088383	26740	626061	1754997	18508	1092632	2466617
Log-change Bank loans	20829	.053	1.3	11300	.02	1.	9529	.091	1.3
Net-financial Expense Ratio	36439	.184	6.8	21809	.148	6.3	14630	.237	7.5
Interest rate	33461	.039	0.046	20058	.037	0.046	13403	.041	0.046
Gross Investment	29433	435.1	1573	17762	399.2	1507	11671	489.7	1667
Gross investment Intensity	28562	.492	1.6	17183	.478	1.6	11379	.513	1.6
Employment	45271	4.1	6.5	26594	4.2	6.5	18677	4.0	6.4
Log-change employment	19511	.037	0.34	12228	.033	0.25	7283	.043	0.27
Value-Added	29433	2754300	4654151	17711	2784851	4676197	11722	2708138	4620456
Log-change Value-Added	20840	.062	0.9	12747	.043	0.9	8093	.093	1.0
ROE	34401	.387	1.4	20604	.377	1.4	13797	.401	1.5
ROA	34381	.065	0.3	20558	.069	0.3	13823	.059	0.3
Total Assets	39591	5184	9873	23467	4909	9494	16124	5584	10387
Private Equity	39587	1555	4049	23432	1576	4026	16155	1524	4083

Notes: Table 2 reports regression estimates from bank-level regressions where the dependent variables are described in the note to Figure 2. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. TB equals 1 if bank has an LTD ratio above the median and 0 otherwise. LTDB equals 1 if bank has an LTD ratio above the median weighted by loans in 2006 and 0 otherwise. The regressions include a full set of year fixed effects. Using shrinking at the 1th and 99th percentiles on the dependent variable to eliminate the effect of outliers. Source: Statistics Denmark and own calculations.

Table 3 Sticky bank-borrower relationships – Nonfinancial Firms Shift of Bank Connection:

Firm x year observations	Bank shift=0	Bank shift=1	Nonexposed Bank shift=0	Nonexposed Bank shift=1	Exposed Bank shift=0	Exposed Bank shift=1
Post=0	107,024	3,033	62,704	2,164	44,320	869
	(97.24)	(2.76)	(96.66)	(3.34)	(98.08)	(1.92)
Post=1	172,876	9,381	99,855	6,771	73,021	2,610
	(94.85)	(5.51)	(93.65)	(6.35)	(96.55)	(3.45)
Total	279,900	12,414	162,559	8,935	117,341	3479
	(95.75)	(4.25)	(94.79)	(5.21)	(97.12)	(2.88)

Notes: The bank shift variable is described in note to Figure 3. Source: Statistics Denmark and own calculations.

Table 4: Bank Shifts, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
post x T	-0.03*	-0.04**	-0.04**	-0.03*
	(0.02)	(0.02)	(0.02)	(0.02)
Medium-sized x post x T		0.01***		
		(0.00)		
R-squared	0.03	0.03	0.04	0.03
Number of observations	280287	280287	124669	155618
Number of firms	45696	45696	20442	25254

Note: The bank shift variable is described in note to Figure 3. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. T equals 1 for firms with exposed banks in 2006 and 0 otherwise. Medium-sized equals 1 if the firm has total assets above the median. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Source: Statistics Denmark and own calculations

Table 5: Financial Outcomes, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
Loans				
post x T	-0.08***	-0.04*	-0.03*	-0.10***
	(0.02)	(0.02)	(0.02)	(0.03)
Medium-sized x post x T		-0.06**		
		(0.03)		
R-squared	0.01	0.01	0.01	0.02
Number of observations	167917	164054	65821	98233
Number of firms	37138	35608	15252	20356
Net Financial Expenses Ratio				
post x T	0.04***	0.02***	0.03***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)
Medium-sized x post x T		0.03***		
		(0.01)		
R-squared	0.01		0.01	0.02
Number of observations	316721	309725	144614	165111
Number of firms	44710	42407	19575	22832
Interest Rate				
post x T	0.00*	-0.00	-0.00	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
Medium-sized x post x T		0.01***		
		(0.00)		
post x LTD				
R-squared	0.02	0.02	0.01	0.03
Number of observations	298663	291779	127121	164658
Number of firms	45885	43498	19754	23744

Note: The dependent variables are described in the note to Figure 4. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. T equals 1 for firms with exposed banks in 2006 and 0 otherwise. Medium-sized equals 1 if the firm has total assets above the median. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. * p<0.10, ** p<0.05, *** p<0.01. To limit the influence of outliers, regressions are reported with truncated variables that are bounded above the 2.5th percentile and below the 97.5th percentile. Source: Statistics Denmark and own calculations.

Table 6: Primary Input Factors, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
Gross Investment to Fixed Assets Ratio				
post x T	-0.017**	0.005	0.005	-0.030***
	(0.007)	(0.009)	(0.009)	(0.011)
Medium-sized x post x T		-0.035**		
		(0.015)		
R-squared	0.02	0.02	0.01	0.03
Number of observations	238625	238625	102550	136075
Number of firms	38730	38730	17582	21148
Δlog(employment)				
post x T	-0.008***	-0.010***	-0.009***	-0.006*
	(0.003)	(0.003)	(0.003)	(0.004)
Medium-sized x post x T		0.004		
		(0.004)		
R-squared	0.02	0.02	0.01	0.03
Number of observations	124862	123812	55490	68322
Number of firms	28801	28278	13435	14843

Note: The dependent variables are described in the note to Figure 5. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. T equals 1 for firms with exposed banks in 2006 and 0 otherwise. Medium-sized equals 1 if the firm has total assets above the median. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. To limit the influence of outliers, regressions are reported with truncated variables that are bounded above the 2.5th percentile and below the 97.5th percentile. Source: Statistics Denmark and own calculations.

Table 7: Performance and Profitability, Difference-in-Difference Estimate

Δlog(Value Added)	(1)	(2)	(3)	(4)
post x T	-0.019***	-0.020**	-0.021**	-0.016*
	(0.006)	(0.010)	(0.010)	(0.008)
Medium-sized x post x T		0.005		
		(0.014)		
R-squared	0.01	0.01	0.01	0.01
Number of observations	170466	170466	76511	93955
Number of firms	34087	34087	15561	18526
ROE				
post x T	-0.021***	0.004	0.005	-0.033***
	(0.007)	(0.011)	(0.011)	(0.008)
Medium-sized x post x T		-0.036**		
		(0.015)		
R-squared	0.01	0.02	0.01	0.03
Number of observations	301225	301225	137524	163701
Number of firms	43148	43148	20009	23139
ROA				
post x T	-0.006***	-0.002	-0.002	-0.006**
	(0.002)	(0.003)	(0.003)	(0.002)
Medium-sized x post x T		-0.003		
		(0.004)		
R-squared	0.03	0.03	0.01	0.06
Number of observations	301040	301040	134994	166046
Number of firms	43001	43001	19875	23126
ROE Based on EBIT				
post x T	-0.021**	0.001	0.001	-0.031**
	(0.010)	(0.009)	(0.009)	(0.013)
Medium-sized x post x T		-0.030**		
		(0.014)		
R-squared	0.02	0.02	0.01	0.03
Number of observations	301069	301069	137478	163591
Number of firms	43149	43149	20002	23147
ROA Based on EBIT				
post x T	-0.000	0.000	0.000	0.000
	(0.001)	(0.003)	(0.003)	(0.002)
Medium-sized x post x T		0.000		
		(0.004)		
R-squared	0.02	0.02	0.01	0.04
Number of observations	300597	300597	134095	166502
Number of firms	42956	42956	19849	23107

Note: The dependent variables are log change in value added, ROE measures net income divided by private equity, and ROA measures net income divided by total assets. ROE and ROA based on EBIT are similar measures using earnings before interest and taxes instead of net income. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. T equals 1 for firms with exposed banks in 2006 and 0 otherwise. Medium-sized equals 1 if the firm has total assets above the median. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. * p<0.10, ** p<0.05, *** p<0.01. To limit the influence of outliers, regressions are reported with truncated variables that are bounded above the 2.5th percentile and below the 97.5th percentile. Source: Statistics Denmark and own calculations.

Table 8: Exit, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
post x T	0.006**	0.008***	0.008***	0.005
	(0.003)	(0.002)	(0.002)	(0.004)
Medium-sized x post x T		-0.003		
		(0.004)		
R-squared	0.05	0.05	0.07	0.05
Number of observations	406242	406242	184882	221360
Number of firms	45710	45710	20449	25261

Note: The dependent variables are described in the note to Figure 6. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. T equals 1 for firms with exposed banks in 2006 and 0 otherwise. Medium-sized equals 1 if the firm has total assets above the median. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. * p<0.10, ** p<0.05, *** p<0.01. Source: Statistics Denmark and own calculations.

Table 9: Loans, Difference-in-Difference Estimate – Reduced form and IV regressions

Financial Outcomes	Loans FE	Loans Reduced	Loans IV	Fin Costs FE	Fin Costs Reduced	Fin Costs IV
post x T	-0.07***		-0.06**	0.09***		0.08**
	(0.02)		(0.03)	(0.02)		(0.04)
post x T(founder)		-0.04**			0.05**	
		(0.02)			(0.02)	
R-squared	0.02	0.02	0.02	0.02	0.02	0.02
Number of observations	83338	83338	81561	122295	122295	121480
Number of firms	16448	16448	14671	18490	18490	17675
Primary Input Factors	Gross inv FE	Gross inv Reduced	Gross inv IV	Empl FE	Empl Reduced	Empl IV
post x T	-0.02*		-0.03**	-0.01**		-0.01
	(0.01)		(0.01)	(0.00)		(0.00)
post x T(founder)		-0.02**			-0.00	
		(0.01)			(0.00)	
R-squared	0.03	0.03	0.03	0.02	0.02	0.02
Number of observations	100710	100710	99605	90946	90946	86613
Number of firms	17814	17814	16709	24663	24663	20330
Performance and Profitability	ROE FE	ROE Reduced	ROE IV	Δlog(VA) FE	Δlog(VA) Reduced	Δlog(VA) IV
post x T	-0.02*		-0.05***	-0.03**		-0.01
	(0.01)		(0.02)	(0.01)		(0.02)
post x T(founder)		-0.03**			-0.01	
		(0.01)			(0.01)	
R-squared	0.04	0.04	0.04	0.01	0.01	0.01
Number of observations	115158	115158	114280	133615	133615	129331
Number of firms	19332	19332	18454	31146	31146	26862

Note: The dependent variables are defined in the figures and tables above. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. T equals 1 for firms with exposed banks in 2006 and 0 otherwise. The founder's private bank connection for their personal loans and the LTD ratio of the private bank are used as instruments for T. All F-tests for the instrument in the first stage regressions (not shown) are considerably greater than 10. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. To limit the influence of outliers, regressions are reported with truncated variables that are bounded above the 2.5th percentile and below the 97.5th percentile. * p<0.10, ** p<0.05, *** p<0.01. Source: Statistics Denmark and own calculations.

APPENDIX

Appendix Table A1: Loans, Difference-in-Difference Estimate
Alternative Heterogeneity

	(1)	(2)	(3)	(4)
Industry				
post x T	-0.08***	-0.08***	-0.08***	-0.07***
	(0.02)	(0.03)	(0.03)	(0.03)
Industry x post x T		0.01		
		(0.03)		
R-squared	0.01	0.01	0.02	0.01
Number of observations	167917	167917	60182	107735
Number of firms	37138	37138	13755	24013
Young vs Old	(1)	(2)	(3)	(4)
post x T	-0.08***	-0.07***	-0.07***	-0.07*
	(0.02)	(0.02)	(0.02)	(0.04)
Young x post x T		-0.00		
		(0.04)		
R-squared	0.01	0.02	0.01	0.03
Number of observations	167917	167917	87315	80602
Number of firms	37138	37138	17549	19589

Note: The bank shift variable is described in note to Figure 3. The Post variable equals 1 for 2007 and later, whereas it equal 0 for 2006 and earlier. T equals 1 for firms with exposed banks in 2006 and 0 otherwise. Industry equals 1 if the firm is manufacturing or retail or wholesale trade and 0 otherwise. Young equals 1 if founding year is 2001 or younger and 0 otherwise. The model includes industry dummies, municipality dummies, time dummies, as well as firm fixed effects. * p<0.10, ** p<0.05, *** p<0.01. Source: Statistics Denmark and own calculations.

Online APPENDIX – CONTINUOUS DIFFERENCE-IN-DIFFERENCES VARIABLE

Appendix Table A2: Bank Shifts, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
post x LTD	-0.04	-0.04	-0.04	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)
Medium-sized x post x LTD		0.01		
		(0.01)		
R-squared	0.03	0.03	0.03	0.03
Number of observations	280287	280287	124669	155618
Number of firms	45696	45696	20442	25254

Note: * p<0.10, ** p<0.05, *** p<0.01. Outcomes are winsorized at the two and a half and ninety-seven and a half -ninth percentile to exclude extreme values.
Source: Statistics Denmark and own calculations

Appendix Table A3: Financial Outcomes, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
Loans				
post x LTD	-0.11***	-0.02	-0.02	-0.15***
	(0.03)	(0.03)	(0.03)	(0.03)
Medium-sized x post x LTD		-0.13***		
		(0.03)		
R-squared	0.01	0.01	0.01	0.02
Number of observations	167917	164054	65821	98233
Number of firms	37138	35608	15252	20356
Net Financial Expenses Ratio				
post x LTD	0.06***	0.03***	0.03***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)
Medium-sized x post x LTD		0.05***		
		(0.01)		
R-squared	0.01	0.01	0.01	0.02
Number of observations	316721	309725	144614	165111
Number of firms	44710	42407	19575	22832
Interest Rate				
post x LTD	0.01**	0.00	0.00	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Medium-sized x post x LTD		0.01***		
		(0.00)		
R-squared	0.02	0.02	0.01	0.03
Number of observations	292740	285996	126440	159556
Number of firms	45077	42735	19647	23088

Note: * p<0.10, ** p<0.05, *** p<0.01. Outcomes are winsorized at the two and a half and ninety-seven and a half -ninth percentile to exclude extreme values.
Source: Statistics Denmark and own calculations

Appendix Table A4: Primary Input Factors, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
Gross Investment to Fixed Assets Ratio				
post x LTD	-0.026***	0.013*	0.013*	-0.044***
	(0.006)	(0.007)	(0.007)	(0.011)
Medium-sized x post x LTD		-0.058***		
		(0.014)		
R-squared	0.02	0.02	0.01	0.03
Number of observations	238625	238625	102550	136075
Number of firms	38730	38730	17582	21148
Δlog(employment)	(1)	(2)	(3)	(4)
post x LTD	-0.009**	-0.011***	-0.011***	-0.005
	(0.004)	(0.003)	(0.004)	(0.005)
Medium-sized x post x LTD		0.007		
		(0.006)		
R-squared	0.02	0.02	0.01	0.03
Number of observations	124862	123812	55490	68322
Number of firms	28801	28278	13435	14843

Note: * p<0.10, ** p<0.05, *** p<0.01. Outcomes are winsorized at the two and a half and ninety-seven and a half -ninth percentile to exclude extreme values.
Source: Statistics Denmark and own calculations

Appendix Table A5: Performance and Profitability, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
Δlog(Value Added)				
post x LTD	-0.025***	-0.027**	-0.027**	-0.021*
	(0.008)	(0.012)	(0.012)	(0.011)
Medium-sized x post x LTD		0.006		
		(0.016)		
R-squared	0.01	0.01	0.01	0.01
Number of observations	170466	170466	76511	93955
Number of firms	34087	34087	15561	18526
ROE				
post x LTD	-0.034***	0.007	0.007	-0.051***
	(0.008)	(0.013)	(0.013)	(0.006)
Medium-sized x post x LTD		-0.055***		
		(0.014)		
R-squared	0.01	0.02	0.01	0.03
Number of observations	301225	301225	137524	163701
Number of firms	43148	43148	20009	23139
ROA	(1)	(2)	(3)	(4)
post x LTD	-0.009***	0.002	0.002	-0.012***
	(0.003)	(0.004)	(0.004)	(0.003)
Medium-sized x post x LTD		-0.015***		
		(0.005)		
R-squared	0.03	0.03	0.01	0.06
Number of observations	301040	301040	134994	166046
Number of firms	43001	43001	19875	23126
ROA With EBIT				
post x LTD	0.000	0.006**	0.006**	-0.002
	(0.002)	(0.003)	(0.003)	(0.002)
Medium-sized x post x LTD		-0.008**		
		(0.004)		
R-squared	0.02	0.02	0.01	0.04
Number of observations	300597	300597	134095	166502
Number of firms	42956	42956	19849	23107
ROE With EBIT	(1)	(2)	(3)	(4)
post x LTD	-0.033***	-0.003	-0.003	-0.045**
	(0.011)	(0.012)	(0.011)	(0.018)
Medium-sized x post x LTD		-0.038*		
		(0.021)		
R-squared	0.02	0.02	0.01	0.03
Number of observations	301069	301069	137478	163591
Number of firms	43149	43149	20002	23147

Note: * p<0.10, ** p<0.05, *** p<0.01. Outcomes are winsorized at the two and a half and ninety-seven and a half -ninth percentile to exclude extreme values. Source: Statistics Denmark and own calculations

Appendix Table A6: Exit, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
post x LTD	0.004	0.007***	0.007***	0.002
	(0.003)	(0.002)	(0.002)	(0.004)
Medium-sized x post x LTD		-0.005		
		(0.004)		
R-squared	0.05	0.05	0.07	0.05
Number of observations	406242	406242	184882	221360
Number of firms	45710	45710	20449	25261

Note: * p<0.10, ** p<0.05, *** p<0.01. Outcomes are winsorized at the two and a half and ninety-seven and a half -ninth percentile to exclude extreme values.
Source: Statistics Denmark and own calculations

Appendix Table A7: Loans, Difference-in-Difference Estimate

	(1)	(2)	(3)	(4)
Industry				
post x LTD	-0.11***	-0.10***	-0.11***	-0.11***
	(0.03)	(0.04)	(0.04)	(0.03)
Industry x post x LTD		-0.01		
		(0.04)		
R-squared	0.01	0.01	0.02	0.01
Number of observations	167917	167917	60182	107735
Number of firms	37138	37138	13755	24013
Young vs. Old				
post x LTD	-0.11***	-0.12***	-0.12***	-0.06*
	(0.03)	(0.02)	(0.02)	(0.03)
Young x post x LTD		0.06**		
		(0.02)		
R-squared	0.01	0.02	0.01	0.03
Number of observations	167917	167917	87315	80602
Number of firms	37138	37138	17549	19589

Note: * p<0.10, ** p<0.05, *** p<0.01. Outcomes are winsorized at the two and a half and ninety-seven and a half -ninth percentile to exclude extreme values.
Source: Statistics Denmark and own calculations