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# Proximity in Bank-Borrower Relationships

## Are Small and Newly Established Firms Hit Harder by Bank Branch Closures?

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SNF

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**by**

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# Abstract

In this paper, we use an empirical approach to provide evidence on the topic of relationship lending, by analysing if small and newly established firms are hit harder by a regional bank withdrawal. We use comprehensive data from the Norwegian banking market, containing information on 127 banks and approximately 70,000 firms. We find that small and newly established firms receive an increase in average interest rate of 2 percentage points after a bank withdrawal. This is 1.7 percentage points higher than for large and mature firms. Small and newly established firms also experience a decrease in debt ratio of 0.027, while the decrease is even more substantial for large and mature firms. Our findings indicate that small and newly established firms are hit harder in terms of increased interest rate, while the decrease in debt ratio could be caused by changes in credit supply or demand. The effects imposed on small and newly established firms do not seem to affect the firms' growth, indicating that firms are able to withstand the increased interest rate.

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# 1. Introduction

## 1.1 Motivation and Purpose

Over the past decades, there has been a rapid decline in the number of bank branches in Norway. Digitalization, cost reductions and internet banking have redefined how banks operate. DNB, the largest bank in Norway (Norges Bank, 2017), announced a massive downscaling of branches due to the rise of internet banking, and have closed over 129 branches since 2014 (Fjelltveit & Aldridge, 2016). Assuming that firms establish personal relationships with their bank (e.g., Berger and Udell, 2006; Kusucky and Norden, 2016), we ask the question; how will a bank branch closure, and hence loss of the physical bank relationship, affect the bank's corporate customers? We are particularly interested in whether, and how, this loss impacts smaller and newly established firms.

There is a clear consensus in the banking community that there is a case of asymmetric information between the inside and the outside bank. The inside bank being the customer's current bank and main source of finance, while an outside bank is defined as a competing bank. Existing literature suggests that the asymmetric information is caused by a personal relationship between the bank and the customer (e.g., Sharpe, 1990; Diamond, 1984; Berger and Udell, 1995). For small and newly established firms, which often have more difficulties obtaining credit, this relationship can be particularly important. Kusucky and Norden (2016) points out that the relationship lending technique is a key source of external financing for small and medium sized enterprises (SMEs), and the majority of the research on relationship lending and asymmetric information looks at SMEs. However, as small and newly established firms are even more opaque, we believe the observed effect to be even greater for them than for SMEs.

A bank branch closure would entail that the proximity between the bank and customer decreases. When a firm loses its proximity to the bank, we hypothesize that this will lead to higher interest rates and lower credit volumes. Based on the existing literature of e.g. Boot and Thakor (1994) we believe that this effect will be more salient for small and newly established firms, since small and newly established firms are believed to be more dependent on their bank relationship. However, if the bank has multiple branches in the vicinity, the relationship may be transferred to a neighbouring branch. Because of this, we will instead look at cases where

banks withdraw entirely from a region – i.e. when there are no branches left in the firm's region.

Early literature (e.g., Diamond, 1991; Raja, 1992) points to small firms seeking financing from banks (commercial loans), while large corporations borrow from the corporate bond market. However, we observe that the majority of the Norwegian market are dependent on bank lending, regardless of the firms' size. The important distinction between small and newly established firms, and less opaque firms, is more likely related to the availability of bank financing. Since SME's may have a harder time obtaining credit, we predict that a firm's growth will decrease or stagnate when a bank branch closes, as they will have a harder time obtaining financing for new projects. Their debt burden, and interest payments, can be crucial for a firm's performance if the firm is capital intensive. We therefore aim to measure whether the loss of these relationships affects the firms' growth, and their lending conditions.

This research will not only help to shed light on firms' dependence on banking relationships, but also that bank branch closures may entail a loss of value for the banks in addition to the book value of the bank - the loss of a relationship. We aim to quantify the value of this relationship, mainly for the small and newly established firms. In the era of internet banking, it will also be interesting to see if relationship lending still plays an important role, or if the lending process is becoming more or less streamlined.

## 1.2 Research Question

To investigate the relationship between bank branch closures and the performance of small and newly established firms, we propose the following research question:

*Are small and newly established firms hit harder by regional bank withdrawals than larger and more established firms?*

We attempt to answer this question by regressing measures of performance and loan conditions when a bank withdraws from a region.

## 1.3 Outline

This paper will be organized as follows: In **Section 2** we present a brief background for the Norwegian bank sector and market characteristics of Norwegian firms. **Section 3** introduces relevant theory and related empirical research. This section discusses several theoretical views on relationship lending and the case for asymmetric information in bank lending, as well as previous findings in related empirical research. **Section 4** presents our empirical strategy. **Section 5** gives a description of the treatment of our dataset and the construction of our analysis' most relevant variables. In **Section 6** we present some descriptive statistics of our variables and trends in the Norwegian banking market over the sample period. In **Section 7** we present the results from our regressions, while in **Section 8** we present some possible sources of divergence from previous findings. Finally, our concluding remarks are included in **Section 9**.

# 2. Background

## 2.1 Overview

Norwegian banks are categorized as either commercial or savings banks. Compared to other countries, Norwegian savings banks have considerable higher lending activities, which is due to the late market entry by commercial banks in Norway (Meinich, 2016). Traditionally, savings banks have focused on consumer lending activity, while commercial banks primarily lent to firms. However, an important principle for the savings banks has been to help the district's firms through lending (Meinich, 2016). Due to several legal changes in the mid 1980's and early 1990's, the differences between commercial and savings banks has become less salient. The distinction is also less important, since the main difference is related to ownership structure, and not the services they provide (Norges Bank, 2017). The period was also characterized by several mergers and acquisitions in the banking sector. In addition, there have been a vast number of bank branch closures throughout the last decades (Aamo, 2016). Especially, the changed customer behaviour due to technological development is seen as a contributing factor to the closures. In recent years, major digital changes have taken place in the banking sector, which is often referred to as the FinTech revolution (Kreutzer I. , 2016).

## 2.2 Market Characteristics of the Norwegian Banking Sector

In 2017, there were 137 banks operating in the Norwegian market, of whom 22 were commercial (Norges Bank, 2017). Despite the large number of banks, there are a few banks that dominate the market. For instance, as illustrated in Figure 1, DNB's share of the total gross lending in the corporate market is 30% (Norges Bank, 2017).

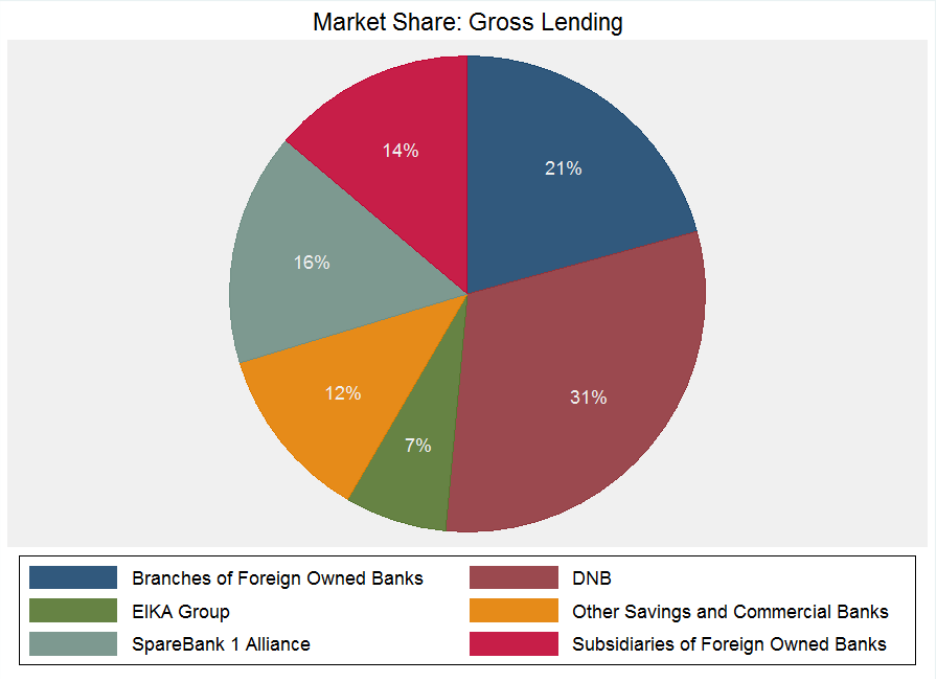


***Figure 1:*** *The Norwegian banking market: Market shares by gross lending. Source: Norges Bank (2017)*

Compared to other European countries, the Norwegian banking sector is small in terms of value added (Norges Bank, 2017). For instance, the Norwegian banks' total assets are two times GDP, while in comparison, Swedish banks' totals assets are four times GDP. Several of the European banks operate internationally, and thus have a larger contribution to the nations GDP, while Norwegian banks mainly lend to domestic customers. After the financial crisis in 2008, several European countries have experienced a considerable decrease of their banking sector, while in Norway, the development of the banking sector has been steady (Norges Bank, 2017).

The banking crisis in 1987-1993 disrupted the Norwegian banking system, and the severity of the crisis was in large due to poor bank management, combined with deregulations and unsuccessful crisis solutions from the authorities (Gram, 2017). After the crisis, the government forced cost cutting and other efficiency measures on banks to improve their results (Moe, Solheim, & Vale, 2004). Allen and Gale (2009) compared the handling of the banking crisis in Norway and Japan, and argued that "The return to robust economic growth in turn reinforced the recovery in the banking sector". The banks took advantage of the structural changes implemented by the government, and have continuously made changes to enhance their efficiency and robustness.

Over the past decades there has been a considerable decrease in the number of savings banks in Norway. Since 1960, nearly 500 savings banks have been terminated due to mergers and acquisitions (Norges Bank, 2017). Many of these mergers and acquisitions was part of a natural development, induced by the changes in settlement and industry structure. Mergers have been instrumental for the savings banks being able to compete, as a full-service provider, against nationwide commercial banks. In addition, foreign owned banks have had the opportunity to operate in Norway since 1985. Mergers between Norwegian banks, and acquisitions by foreign owned banks, characterized the late 80's and 90's. Another important development feature during the 90's was the prominence of alliances between smaller savings banks (Norges Bank, 2017). The idea behind alliances is to share service providers to cut costs, while the banking activity itself is driven individually. Thus, alliances enable smaller banks to offer the same kind of products and services as the largest commercial banks who are often full service providers.

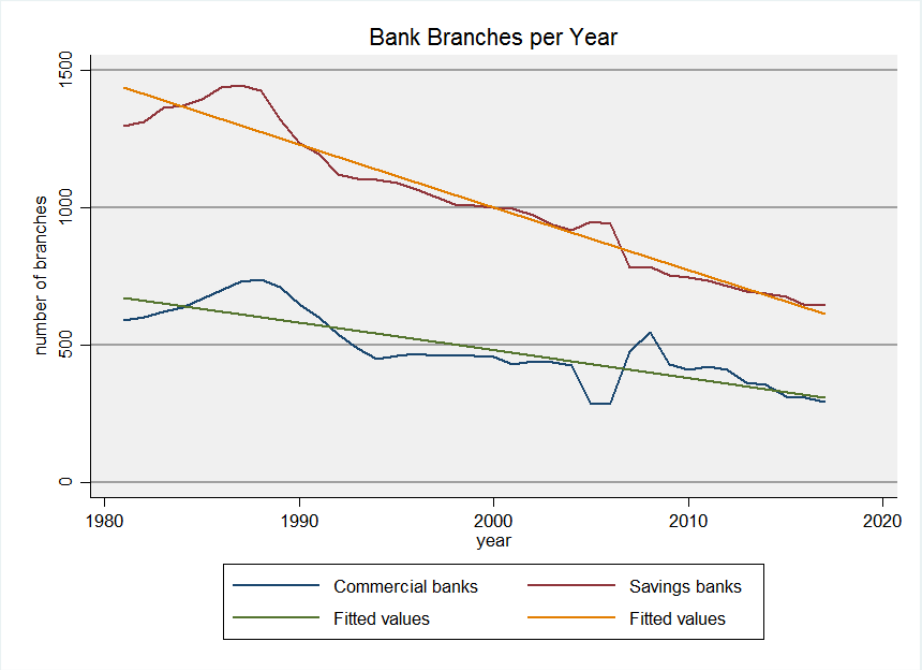


***Figure 2:*** *Development in the number of bank branches in Norway.*
*Source: Finans Norge (2018)*

Figure 2 illustrates the development in the number of bank branches in Norway from 1981 to 2017. As the figure illustrates, there has been a significant number of bank branch closures in Norway over the last thirty years. Since the peak in 1987, with 2,177 bank branches, the number of bank branches has decreased by more than 1,000, and the development indicates that this trend will continue (Aamo, 2016). For instance, DNB completed 129 closures of bank

branches in the period 2014-2016. However, DNB has later stated that their predictions of non-digital customers were somewhat premature (NTB, 2018). Though this refers to the consumer market, we assume that the same is true for corporate customers. Changes in customer behaviour have caused a shift in how bank branches are being used. Norges Bank (2017) found that online banking was one of the most important reasons for the reduction in the number of bank branches. Compared to other countries, Norwegian banks were early implementers of online banking, and have continued to facilitate the customers' use of internet banking. As early as 1994, supervision of the technological development of the financial industry was one of the main tasks of the Financial Supervisory Authority of Norway (Aamo, 2016).

Idar Kreutzer, CEO of Finans Norge, claims that financial technology (FinTech) is going to be the most important strategic incentive for banks in the future (Kreutzer & Staavi, 2017). FinTech can be defined as an intersection between technology, digitalization and finance (IKT Norge, 2018). Regulatory changes, such as PSD2, are important incentives for finding good solutions in the field of FinTech. PSD2 is short for EU's Payment Service Directive, and regulates payment services in EU's internal market (Finans Norge, 2018). One of the intentions with PSD2 is to facilitate better competition between different players who wish to offer payment services (Finans Norge, 2018). The implementation of PSD2 can in turn disrupt the market by removing established barriers and opening for new players to enter the market. How banks manage PSD2, and embrace FinTech, is likely to be crucial to determine the future of a bank (Strøm, 2016).

## 2.3 Market Characteristics of Norwegian Firms

The Norwegian economy is characterized by a large share of small and medium sized firms, and employees in these firms make up 64% of the total Norwegian workforce. Norway has experienced significant economic growth over the last 150 years, in large part because of the efficient utilization of labour and capital. In addition, Norway has had a successful transition to less labour-intensive industries. In 2016, service industries, like retail and public service, contributed to around 78% of the total employment (Statistics Norway, 2018b). As Norway is a high-cost country, human capital has been an important basis for innovation and higher productivity in recent years, and will also be important to remain competitive (St.Meld 7 (2014–2015), 2014). In 2016, Norway's GDP per capita was 48% higher than the European average (Statistics Norway, 2017a).

With a positive trade balance, exports are an important part of the Norwegian market. A significant portion of the Norwegian workforce is involved in the exporting industry. Either directly through export firms, or indirectly through supply and service firms. Consequently, the Norwegian market is vulnerable to changes in the global business market (Kristiansen, 2017).

The Norwegian market can be divided into 46 different economic regions (Bhuller, 2009) (see Appendix 1 for a complete list of regions). The division into economic regions is based on the commuting distance between the centre municipality, and the surrounding municipalities. This is done to reflect actual workforce-flow between the municipalities, in addition to trade-flow. The highest concentration is in region 12, Oslo, where 15% of all firms are located (Statistics Norway, 2018a). This is not surprising given the fact that Oslo is the region with the largest, and densest population (Statistics Norway, 2017c). Oslo is also the region with the greatest presence of large corporations. Over 30% of all firms with more than 250 employees is situated in Oslo. The remaining regions have a relatively similar distribution of firms, where regions with large cities have approximately 10%, while regions with a lower population have approximately 5%. The net growth of firms is close to zero; there are about as many bankruptcies as there are establishments each year (Statistics Norway, 2018b).

# 3. Related Literature

The traditional market power view of competition and business lending holds that the lower the level of competition, the higher the price of credit and the lower the level of credit availability. SME business lending will, as other types of lending, be affected by the level of competition in the market. Greater market power allows banks to set prices for SME borrowing above marginal costs (Rosen and Udell, 2017).

One important distinction in bank lending is the distinction between transparent firms, often large firms such as those who are publicly traded, and more opaque firms, often SMEs. Because of this distinction, early literature on SME lending focuses on the differences in types of loans; those offered to transparent firms, and those offered to more opaque firms (see e.g., Sharpe, 1990; Diamond, 1991). The difference is often made between transaction-based lending, which is based on hard quantifiable information about the lender, and relationship lending, where banks pursue their role as delegated monitors producing soft information in the context of relationship building (Petersen and Rajan, 1995; Berger and Udell, 1995).

The vast research conducted on relationship lending is not unanimous in terms of how relationships benefit firms or banks (see Bonini et al., 2016). However, the pioneering findings of Stiglitz and Weiss (1981) and Akerlof (1970) show that there exists asymmetric information between the inside bank (current lender) and an outside bank. In the following we will present some theoretical literature that presents the most important findings on SME lending and relationship lending. Most of the research conducted on SME lending is theoretical. However, some interesting empirical research has also been conducted, and will be presented in section 3.2.

## 3.1 Theoretical Literature

In the theoretical literature of relationship lending, one often makes the distinction between two different views on the effect of relationship lending: the “bright side”, that relationship lending generates positive outcomes for both parties, and the “dark side”, asserting that relationship lending generates positive outcomes for the lender, and negative for the borrower (Bonini et al., 2016). Before going in to the particular effects of relationship lending, we do however believe it is necessary with a brief introduction to SME lending.

### 3.1.1 Conceptual Framework for Financing

When banks assess a customer to determine whether to grant them financing, they seek information about the customer. Related literature on the subject often distinguishes between two types of information, soft and hard. Petersen (2004) identifies hard information as quantifiable information about the lender, which includes information from financial statements, payment history, credit rating etc. Soft information on the other hand, is information that is harder to quantify.

Berger and Udell (2006) define relationship lending as the collection of soft information over time, where the bank uses this information to base loan decisions. Transaction-based lending refers to all other lending processes, often based solely on hard information. Transaction-based lending is often said to be used when dealing with transparent customers. However, Berger and Udell (2006) found that this was an oversimplification, and that some transaction-based lending techniques could also be used for more opaque firms. They list eight different lending technologies for banks to use, either separately or simultaneously. In short, these consist of financial statement lending, small business credit scoring, asset-based lending, factoring, fixed-asset lending, leasing, trade credits and relationship lending.

In Norway, there are big differences between banks. It is likely that their lending technologies differ as such. Since small firms have less obligations regarding financial reporting, banks to a bigger extent rely on soft information and internal customer history. To this date, there is no public debt registry, which means that information about repayment, interest and success is kept within the bank-borrower relationship.

Stein (2002) makes the important distinction between large and small financial institutions, concluding that small banks have an advantage over large banks in relationship lending, but not in transaction-based lending. Large bank corporations can take advantage of economies of scale, and thereby to a bigger extent rely on hard information. Smaller banks on the other hand, may be more reliant on soft information and personal relationships. However, small firms do not only obtain financing through relationship lending. They are, as large firms, subject to credit ratings and other types of more transaction-based lending. The main difference is that this information often is used as secondary information, while relationship lending remains the main lending technology (Berger and Udell, 2006).

### 3.1.2 The "Dark Side" of Relationship Lending

Some scholars claim there is a "dark side" to relationship lending, and points to the relationship creating a positive outcome for the inside bank, but a negative impact for the customer. This view is in part based on the work of Sharpe (1990). He claims that information asymmetry between the inside and outside banks affects the competition between them when a borrower seeks secondary financing. He developed a stylized model of customer relationships, built upon the traditional view of bank lending behaviour. His model considers repeated corporate borrowing under adverse selection, in which lenders obtain inside information about their borrowers' quality. This inside information gives existing lenders an informational advantage over potential competitors at the refinancing stage and reduces ex post competition (Sharpe, 1990).

His analysis of this ex post interaction, a contract offer game under asymmetric information, show that the asymmetric evolution of borrower information in the bank loan market yields ex post monopoly power, even though banks are ex ante competitive. That way, the inside bank creates a hold up effect, and the customer gets a higher mark-up on secondary loans.

In 2004, von Thadden raised some important questions about Sharpe's model. He claims that repeated lending under asymmetric information leads to a winner's curse type of distortion of competition. Contrary to Sharpe's (1990) claims, von Thadden (2004) points to the game only having one equilibrium in mixed strategies, which features a partial informational lock-in by firms and random termination of lending relationships. His basis for claiming the non-existence of pure-strategy equilibrium in this situation is a "winner's curse" type phenomenon, known from the theory of competitive bidding.

Under asymmetric information about the common value of an object, bidding must not only take individual private information into account, but also the potentially revealed information if the bid wins over the others. However, even though von Thadden only assumes a limited informational capture of borrowers, he points to interest rates being charged above the full-information market rate. These findings are supported by Degryse and Cayseele (1998), who in their research of European small businesses, found that the length of a bank-firm relationship increased the loan rate.

### 3.1.3 The "Bright Side" of Relationship Lending

Contrary to the beliefs of the "dark side" of the relationship lending literature, the "bright side" finds that relationship lending not only benefits the bank, but also the borrower. One of the first studies to find a positive effect for the borrower was Boot and Thakor's (1994). They showed that a long-term relationship enables the bank to efficiently tax and subsidize the borrower through time to reduce the use of costly collateral. In addition, one successful project was enough to guarantee the borrower an unsecured loan contract over the rest of its infinite planning horizon.

Their findings are somewhat supported by Petersen and Rajan (1995), who find that relationship building increased the availability of financing. However, they did only find smaller effects on the price of credit. Berger and Udell (1995) have similar findings, where the value of information increases over the duration of the relationship, which in turn causes lower interest rates and less collateral required.

An important part of relationship lending is collecting soft information through learning over the duration of the relationship. Diamond (1991) found that banks are more likely to give secondary financing to firms who have had previous successes with servicing their loans. This is reasonable as banks base their decision-making on previous experiences with the customer, and good repayment history suggests less risk for future defaults.

In addition, a meta-analysis completed by Kysucky and Norden (2016) tested the commonly supported hypothesis about relationship lending being a good way to reduce the problem of asymmetric information. They find that longer, exclusive, and synergy-creating bank relationships were likely to result in higher credit volumes and lower interest rates. However, they did also find that a close bank-borrower relationship could create a lock-in effect if the borrower lack sufficient alternative banking relationships or if switching costs are high (Kysucky and Norden, 2016).

## 3.2 Empirical Literature

Most of the existing literature on relationship lending is theoretical and focuses on relationship lending's importance in the bank-borrower relationship. Few have measured the actual effect of the relationship and asymmetric information, primarily due to lack of data on individual bank loan exposures. However, some interesting studies have been conducted.

In 1995, Berger and Udell conducted an empirical analysis on the impact of relationship lending regarding lines of credits for small firms in the US. They found that small firms with longer relationships pay less interest, and are less likely to pledge collateral than other firms. They also suggest that banks accumulate increasing amounts of private information over the duration of the bank-borrower relationship and use this information to refine their loan contracts.

### 3.2.1 Bank Switches and Transfers

Ioannidou and Ongena (2010) performed a study on the Bolivian market where they investigated loan conditions when firms switch bank. The study looks at firms that voluntarily switches bank, and as suspected, firms that do receive a discount. However, the study does not consider what happens when a firm forcibly switches bank because of a bank branch closure. The study provides empirical evidence that the loan granted by a new (outside) bank carries a loan rate that is significantly lower than the rates on comparable new loans from the firm's current (inside) banks. The new bank initially decreases the loan rate, but eventually ratchets it up sharply. In their setting, switchers obtain a discount of 0.89 percentage points.

The eminent study by Bonfim, Nogueira and Ongena (2017) uses von Thadden's (2003) model to look at the implications of bank branch closures in the Portuguese banking market. They use the public credit registry to assess new loans. They make a distinction between switches, where customers voluntary switch bank, and transfers, i.e. forced transfer of loans after a bank branch closure. They then test if loan conditions after switching, or transferring, follow distinct patterns. By only looking at newly established loans, and comparing it with a register of bank branch closures, they can distinguish the two.

They find that, on average, switching loans receive interest rates that are 58 basis points lower than non-switching loans. Though lower, their findings are consistent with the findings of Ioannidou and Ongena (2010). They do not find a significant difference between transferring loans and non-switching loans. They did however find pool pricing of loans to groups of transferring firms, *en masse*, in a clean quasi-experimental setting in which branches close as part of a bank restructuring programs. This means that a discount will be the result of the presence of inside information and holdup in bank credit provision.

### 3.2.2 The Implications of Internet Banking

The digital evolution has had a major impact on how banks operate in recent years, and the effect of a bank branch closure may therefore be less salient in the later years of our study. Gropp and Kok (2017) found that internet banking and new internet competitors have increased competition, especially in markets with high physical banking concentration. The effect is most significant for deposits, which may be explained by asymmetric information not being as prevalent for deposit customers, but recent years the effect has also extended to loans. They do, however, conjecture that the effect may be strongest for retail loans to households and less prevalent for corporate loans, but they lack sufficient data to support this.

This is consistent with the trend we have witnessed in Norway over the last decade. Several banks have spent vast resources building up well-functioning internet banking platforms, and some banks are solely internet-based banks. Gropp and Kok's study uses data from 14 European countries, where the bank concentration varies. When assessing the effect of internet banking, they look at the level of implementation of digitalization in the society. In an international survey, Statista measured E-banking penetration (Statista, 2017). Norway ranks high in this survey, with 91 percent of the population between 16 and 74 using internet banking frequently. In other words, the Norwegian market has adapted well to internet banking. However, the survey measures consumer behaviour, and not corporate behaviour. It is nonetheless likely that some of this effect will have extended to the business market.

# 4. Empirical Strategy

The main purpose of our study is to research how a regional bank withdrawal will affect small and newly established firms. Our model uses a difference-in-difference approach, by rollout. This allows us to measure the effect of treatment, even when treatment occurs in different years in different places in our sample period. The model is a linear two-way model, using fixed effects and cluster-robust standard errors in all regressions. A more thorough, theoretical, explanation behind these choices can be found in Appendix 2.

Firms can be affected in several ways. The impact is measured three different ways; direct loan conditions by relative loan volume and average interest rate, and firm growth. To address this, we propose the following general model to measure the impact of a regional bank withdrawal:

$$y_{ict} = \alpha + \gamma_1 D_{ict} + \gamma_2 R_{ct} + \beta X_{ict} + \theta_{it} + \mu_{ct} + \lambda_i + \varepsilon_{ict} \quad (1)$$

where $y_{ict}$ is one of our dependent variables for firm $i$, in region $c$ at year $t$. $D_{ict}$ indicates the direct treatment, illustrated by the share of loans subject to a withdrawal. $R_{ct}$ is a dummy equal to 1 for all firms in region $c$, if a withdrawal occurs. $X_{ict}$ is a vector of firm-specific variables. Fixed effects within regions, and over time, are accounted for by including $\mu_{ct}$. This includes an interaction between year, $t$, and region $c$, and separate dummies for year and region. We control for cohort fixed effects for firm $i$ in year $t$ by including $\theta_{it}$. The cohort fixed effects are represented by the duration of the bank-borrower relationship. Finally, the firm fixed effects are represented by $\lambda_i$.

By including both regional and direct treatment, we measure all firms within a treated region, even if they are not customers of the closing bank. $D_{ict}$ accounts for firms having multiple bank relationships. If all loans of firm $i$ are held at the withdrawing bank, $D_{ict}$ will be equal to 1. However, if the firm only holds 50 percent of their loans at the withdrawing bank, $D_{ict}$ will be 0.5. Equally, firms within the region that are not customers of the withdrawing bank, will have $D_{ict}$ equal to 0. $R_{ct}$ controls for effects that may affect the entire region because of a bank withdrawal. The inclusion of both treatments allows us to utilize the effect of the difference-in-difference method. For a firm that loses their bank-borrower relationship, the effect will thus be $\gamma_1 + \gamma_2$.

The inclusion of the interaction term $\mu_{ct}$ is important to control for fixed regional variation, and development among regions. The regions, $c$, may experience different changes for each year, $t$. This can be variation among regions, which can change over time. For instance, some regions in the western part of Norway are more vulnerable to changes in oil or shipping markets, because of a high concentration of related firms. Year and region dummies are also included separately. The year dummies will control for variation across years, for example the national interest rate level, or other macroeconomic developments. The region dummies will accordingly control for variation between regions.

Some industries are more capital intense than others, and some industries experience industry-specific fluctuations that do not correlate with the national business cycle. However, by including firm fixed effects, $\lambda_i$, in all regressions, this is accounted for, as firms will remain within the same industry over the duration of the sample period.

Finally, the cohort fixed effects, $\theta_{it}$, are included as the length of the bank-firm relationship for each year $t$, for firm $i$. We assume that longer relationships will entail greater implications when the relationship is lost.

The general model measures effects of a bank withdrawal for the full sample, but we also aim to measure differences between subgroups. Our research aims to study whether the subgroup small and newly established firms are hit harder. To achieve this, we introduce interaction terms to our general model:

$$y_{ict} = \alpha + \gamma_1 D_{ict} + \gamma_2 R_{ct} + \gamma_3 D_{ict} S_{it} A_{it} + \gamma_4 R_{ct} S_{it} A_{it} + \gamma_5 D_{ict} A_{it} + \gamma_6 R_{ct} A_{it} \quad (2)$$
$$+ \gamma_7 D_{ict} S_{it} + \gamma_8 R_{ct} S_{it} + \gamma_9 A_{it} S_{it} + \beta X_{ict} + \theta_{it} + \mu_{ct} + \lambda_i + \varepsilon_{ict}$$

The model is based on the general model in (1), but introduces interactions with $S_{it}$ and $A_{it}$. $S_{it}$ is a dummy for size of firm $i$ in year $t$, while $A_{it}$ represents the age for firm $i$ in year $t$. Size, $S_{it}$, can be either small or large, while age, $A_{it}$, can be either young[1] or mature. This gives us four subgroups in total; young and small, young and large, mature and small and

[1] The terms young and newly established are used with equal interpretation

finally mature and large. In addition, we include several interaction terms between size, age and the two treatments. These will be presented in more detail below:

$$D_{ict}S_{it}A_{it}$$

The interaction $D_{ict}S_{it}A_{it}$ allows us to compare the effect of treatment, $D_{ict}$, on two opposite subgroups. The size and age component will measure difference in effect, if the treatment was imposed on an opposite subgroup. For example, if our reference group is large and mature firms, $S_{it}A_{it}$ will be small and young firms. The linear combination of the interaction's estimated coefficients, allows us to determine the difference between the two subgroups.

$$R_{ct}S_{it}A_{it}$$

This interaction follows the same interpretation as the previous triple interaction, but gives us the relationship between subgroups for the regional treatment, imposed on all firms within the region, $c$. The effect is measured by computing the linear combination of the estimated coefficients of the triple interaction. The regional treatment is a result of an already imposed direct treatment, and the full effect for directly treated firms will therefore be a combination of $R_{ct}$ and $D_{ict}$.

When using triple interactions, one also need to include all double interactions, and the variables separately. The interpretation of $D_{ict}A_{it}$ follows the triple interaction's, but instead of changing both size and age, this interaction allows us to see if change in only one variable, age, will cause any differences in effect. For instance, if the reference group is mature and large firms, $D_{ict}A_{it}$ will represent the difference in effect if only age changes, i.e. the firm is young and large. The interpretation of $D_{ict}S_{it}$ is identical, only for size instead of age. This is also the case with the interactions with regional treatment. Finally, $A_{it}S_{it}$ is an interaction between age, $A_{it}$, and size, $S_{it}$, and illustrates the differences in the dependent variable, $y_{ict}$, between two opposite subgroups without treatment.

The dummies for age, $A_{it}$, and size, $S_{it}$, are also included separately, but are part of the firm-specific vector.

After conducting our main regressions, we test the robustness of our analysis by implementing the same procedure on bank branch closures, measured as withdrawals from a municipality. From this point forward, we will refer to withdrawals from municipalities as bank branch

closures. We follow the same procedures as in our main regressions, by first introducing the treatment for the full sample, by using the following general model:

$$y_{ivt} = \alpha + \gamma_1 D_{ivt} + \gamma_2 M_{vt} + \beta_3 X_{ivt} + \theta_{it} + \mu_{ct} + \lambda_i + \varepsilon_{ivt} \quad (3)$$

The model has many similarities to the model in (1), however we make some minor, but important changes. We introduce the subscript $v$, for municipality. $D_{itv}$ is now interpreted as the share of loans firm $i$ holds at the bank closing a branch in municipality $v$ in year $t$. We include $M_{vt}$, a dummy variable equal to 1 for all firms within a municipality, $v$, where a bank closes a branch in year $t$. The firm-specific vector presents the firm-specific variables for firm $i$ in municipality $v$ in year $t$.

We still include the interaction term $\mu_{ct}$, for region $c$ in year $t$. The municipalities are often small, and the variance between neighbouring municipalities will likely be limited. Since the regions are made in terms of actual workforce and trade flow, we believe this to be sufficient. Making interaction terms on municipality level would entail including interactions between 429 municipalities and 17 years.

As in our main regression, we aim to measure differences between subgroups to determine if small and newly established firms are hit harder. We therefore use a model similar to equation (2), only for municipality treatment:

$$y_{ivt} = \alpha + \gamma_1 D_{ivt} + \gamma_2 M_{vt} + \gamma_3 D_{itv} S_{it} A_{it} + \gamma_4 M_{vt} S_{it} A_{it} + \gamma_5 D_{ivt} A_{it} + \gamma_6 M_{vt} A_{it} + \gamma_7 D_{ivt} S_{it} + \gamma_8 M_{vt} S_{it} + \gamma_9 A_{it} S_{it} + \beta X_{ivt} + \theta_{it} + \mu_{ct} + \lambda_i + \varepsilon_{ivt} \quad (4)$$

The model follows the same interpretation as equation (2), but uses the newly introduced variables from (3). This entails that the interaction terms will present differences between subgroups for municipality treatment, and not regional treatment.

# 5. Data

## 5.1 Data Sources and Treatment of Data

To conduct this study, we used data from several sources. First, we acquired detailed information about firms through a rich database assembled by the Institute for Research in Economics and Business Administration (SNF). The database includes firm-specific information about location, industry codes, and detailed accounting information for the years 1993-2015. Second, a unique dataset provided by the Norwegian Tax Authorities (Skatteetaten) provides insight to corporate customers' individual accounts in Norwegian banks. The dataset consists of approximately 16 million observations in the period 1997-2013, with 5 million unique accounts divided on 800,000 customers. This enables us to connect information about firms, to their bank relationships. Finally, information about bank branch locations, provided by Finance Norway (Finans Norge) in their annual bank location register (Bankplassregisteret), enables us to match firms and banks to locations.

The datasets from SNF and Skatteetaten are both extensive, and our research requires several variables from both datasets. By first treating the SNF dataset, we find which firms we want to measure. We merged data for firm and accounting information for each year. Then, the data is gathered in one panel data ranging from 1997 to 2013. Our initial cleaning of the data consisted of omitting all financial firms, since financial firms' lending structure often deviates from other firms. In addition, we only include limited liability firms, since we only wish to measure profit maximizing firms. Although it would be interesting to measure firms who are sole proprietorships, ENK, only firms over a certain size are represented in our dataset. In some cases, we have firms that go bankrupt in year *t*, but there are subsequent observations after the bankruptcy. In those cases, we only include observations until year *t*.

To categorize the firms in different industries, we created new industry codes. In our research, we require that firms remain in the same industry over the duration of the sample period. The dataset contains industry information, but uses two different classifications. These are not consistent throughout the sample period, and we therefore created new, consistent classifications. We divided the firms into twelve different industries. Observations that were lacking sufficient industry information, were placed in the category "Other industries".

The dataset contains information about municipality numbers, but lack information about the affiliation to regions. We therefore used Bhuller's (2009) classification of economic regions, and aligned the municipality numbers to regions. All observations with missing locational information are omitted. Since Oslo, region 12, is an anomaly compared to the other regions, we chose to omit this region from our sample.

We used the accounting information to construct some of our variables, but we have several firms with missing accounting information in 2003 and/or 2004, rendering a large number of observations useless for our estimation purposes. In the cases where we have data from the surrounding years, we interpolated a moving average between the two following, and two previous years. This procedure is conducted for approximately 2 percent of our observations, and we believe the benefit from having information for all years are greater than the possible negative implications of interpolating the values.

The dataset provided by Skatteetaten includes information about bank-borrower relationships with detailed account information. The initial dataset included 1,176 unique banks or financial institutions. However, we only wish to measure implications of a bank branch closure, and thus exclude observations of other financial institutions. Additionally, we excluded banks who primarily lend to consumers, i.e. Bank Norwegian and Santander Consumer Bank.

Since the purpose of our analysis is to measure the effect of physical bank-borrower relationships, we require information about branch locations, and especially banks' presence in different regions. This is obtained by combining information from Bankplassregisteret and Bhuller's classification of economic regions.

The banks' organization number is used to identify a bank-borrower relationship. Several banks change organization number during the sample period, entailing that the full length of a bank-borrower relationship cannot be measured. Thus, we changed the organization numbers, making them consistent throughout the sample period. In addition, we observe several mergers and acquisitions in our sample. We assume that a merger does not necessarily entail the loss of a bank relationship, unless the merger induces bank branch closures. Thus, in the case of mergers, we use one organization number for the merged banks, while keeping the separate information regarding the merged banks' location prior to the merger.

After cleaning the two separate datasets, we merged them using the customer, or firm, as the identification key. Since the dataset from Skatteetaten contains all accounts firms have in different banks, there are several observations each year for each firm. To transform our dataset to a panel dataset - with one observation per year per firm, we needed to make some restrictions. First, all accounts at the same bank are aggregated, leaving us with one observation for each bank-borrower relationship per year. Second, since firms may have multiple bank relationships, we chose to only include their "main bank", i.e. their primary lender. The main bank is defined as the bank where the customer has the majority of their loan engagements during the sample period.

When merging the two datasets, we observed that the information obtained from Bankplassregisteret differs from the data from SNF regarding the municipality numbers. Bankplassregisteret does not use updated municipality numbers, so observations from the first years in our sample are inconsistent with the municipality numbers in the SNF dataset. Thus, we had to find the new municipality numbers from a public registry and manually change the inconsistent municipality numbers to be able to correctly match banks and firms in terms of location.

## 5.2 Constructed Variables

In the following we present the construction of our most important variables. First, we construct our explanatory variables, or treatments, as a dummy variable to illustrate if a bank withdraws from a region. Second, we present the construction of our dependent variables. Finally, we present the variables included in the firm-specific vector.

### 5.2.1 Treatment Variables

**Direct Treatment**

To measure the direct impact a bank withdrawal may have on a firm, we introduce an intensity level. Firms who have multiple banking relationships will likely gain less benefits from a bank-borrower relationship. This is consistent with the findings of Petersen & Rajan (1995), who found that multiple banking relationships increased the price of credit and reduced credit availability. The direct treatment will thus illustrate the share of total loan volume a firm holds with the withdrawing bank. The value can vary from 0 to 1. Our assumption is that the effect will be small, or absent, when firms only have holds a small share of their total loans in the

withdrawing bank. The share of loans is constructed as the sum of loans for each individual bank, divided by the firm's total loan volume. We only keep the bank affiliation with the largest share in our sample.

In order to measure the effect of a bank withdrawal, we activate the direct treatment the last year a bank is present in a region, and the four following years. Since we assume that the firms are most likely to be notified in advance, firms will take this into account and thereby de facto be losing their physical bank-borrower relationship in the last year before a bank withdraws. The four years following the withdrawal are also included as the effect most likely will persist some years after the withdrawal. There is some uncertainty to how long the effect will persist; it is likely that the effect on loan conditions will be highest in the first years, while the effect on growth demand a longer treatment period. When regions experience several withdrawals during a short period, the four years following the last withdrawal will apply.

When using debt ratio as a dependent variable, the expected results are two-sided. A small and newly established firm may have greater difficulties obtaining credit when they lose their bank relationship than other firms. Therefore, one could expect that the total loan volume would decrease, leading to a decrease in debt ratio, all else equal. However, an increase in the debt ratio could indicate that a firm's financial health is deteriorating, and thereby increase the risk of bankruptcy. It is reasonable to assume that a firm's interest rate will increase when their bank withdraws, thus leaving the estimated coefficient for $D_{ict}$ positive. When using growth as the dependent variable, the estimated coefficient is expected to be negative. The loss of a bank relationship can also make it harder to receive funding for new projects. Thus, new projects may be put on hold, which in turn can cause a firm's growth to decrease, or stagnate.

**Regional Treatment**

To measure the regional impact of withdrawals we use a dummy variable, $R_{ct}$, equal to 1, for all firms within a region, if there is a bank withdrawal within the region. Following the same logic as in the previous paragraph, the dummy variable will be equal to 1 in the last year a bank is present in a region, and the four following years. The regional treatment is included to

control for effects that impact the entire region when a bank withdraws. When a bank withdraws from a region, the competition between the remaining banks in the region may change. For instance, the remaining banks may capture larger market shares, and therefore be able to increase their interest rates.

### 5.2.2 Dependent Variables

We choose to focus on three different dependent variables. Two relates to a firm's loan conditions, interest rate and loan volume, while the third, growth, relates to a firm's overall performance. These are of course somewhat interdependent as a high debt ratio, and high interest payments, may inhibit a firm's growth. Additionally, an interesting aspect of the growth dimension is that decreased access to credit may reduce a firm's ability to facilitate new projects.

**Debt Ratio**

Our literary review illustrates that small and newly established firms may have difficulties obtaining credit. To measure if this effect is magnified by a bank branch withdrawal, we include a measure of credit availability. Since our sample includes a broad spectre of firms, it is expedient to use a relative size. The debt ratio gives the total loan volume relative to total assets:

$$Debt\ Ratio_{it} = \frac{\sum Loans_{it}}{Total\ Assets_{it}}$$

The total sum of loans includes all bank loans firm $i$ have in year $t$, which is divided by the firm's total assets. The total sum of loans does not discriminate between different types of loans. It would not be expedient to differentiate, since we measure how a bank withdrawal affects the overall access to credit. Thus, the total sum of loans can include everything from overdraft facilities to loans for financing fixed assets.

In our case, the debt ratio should reflect how much of a firm's total assets are funded by bank loans. The accounting data from SNF includes information on firms' total debt, but does not reflect the share of bank obtained debt. Thus, the information about total sum of loans is gathered from Skatteetaten. When constructing the debt ratio, our sample includes some

extreme values. Particularly, we observe several high values for firms that have an unusually high proportion of loans relative to their assets. We therefore omit observations outside the 1th and 99th percentile of the variable.

**Average Interest Rate**

Some studies on relationship lending suggest that the price of credit decreases as a result of bank-borrower relationships (e.g. Berger & Udell, 1995). The opposite effect might therefore occur when a bank withdraws, thus terminating the physical bank-borrower relationship. To measure the impact on the price of credit, we calculate the average interest rate, given by:

$$Average\ Interest\ Rate_{it} = \frac{\sum Interest\ Payments_{\ it}}{\sum Loans_{i,t-1}}$$

We calculate average interest rate by using the total interest payments for firm $i$ in year $t$ divided by the reported total sum of loans for firm $i$ in year $t-1$. Skatteetaten provides information on total sum of loans and total interest payments per year. The loan volume is reported as the total outstanding amount at the end of a year, which in turn will be the basis for the following year's interest payments. However, if a firm is granted a new loan at the beginning of the year, the interest rate will be artificially high. To address this issue, we change the denominator to the current year's total loans for these extreme values. Even after this adjustment, there are some extreme values. Thus, we remove all observations with an interest rate above 100 percent. We could make further restrictions, since average interest rates rarely exceeds 15 percent. However, our vast sample gives us an acceptable distribution.

**Growth**

Firms are dependent on financing to invest in new projects or equipment. Since small and newly established firms are believed to be more dependent on relationship lending, it is therefore reasonable to believe that their growth will be affected by a bank withdrawal. We measure growth as:

$$Growth_{it} = \Delta\, Employees_{i,t-1}$$

We measure the effect on growth by using the change in number of employees for firm $i$, between year $t$ and $t-1$. This can be good indicator of how a firm develops, as hiring new employees often serves as a proxy for the activity within a firm. In addition, the opposite,

terminations, are often observed in times of low activity. An alternative would be to use sales per employee as a variable for growth. However, as sales often will increase in line with the increase in employees, it could be difficult to isolate the actual growth.

Mergers and acquisitions cause a few extreme values in the growth variable. However, since our sample is so extensive, we have a normal distribution, and hence choose to include all observations.

### 5.2.3 Control Variables

To control for firm-specific variations, we include a set of control variables. We construct measures of firms' performance, financial health and liquidity, by looking at return on assets (ROA), solvency and current ratio respectively. In addition, we construct variables for firms' age and size. When calculating the control variables, we use accounting data provided by SNF.

The dependent variables will vary over the lifecycle of a firm, and a firm's size. First, we create two dummies, to illustrate if a firm is young, or mature. Only 27 percent of new firms still operate five years after establishing (Statistics Norway, 2017b). Thus, young firms are defined as firms that are five years or younger, while the remaining firms are categorized as mature. Second, we create dummies for small, and large firms. Size is determined by the number of employees. Previous studies on relationship lending often research SME's, but we choose a narrower definition, as the smallest firms often are the opaquest. A large fraction of our sample is SME's, and a narrow definition of small firms is important to obtain sufficient basis for comparison. These distinctions are also important to give a complete answer to our research question. Note that a firm can go from small to large during the sample period. The same applies for a firm's age, since this evolves each year.

$$ROA_{it} = \frac{Pre - tax\ Profit_{it}}{Total\ Assets_{it}}$$

The variable $ROA_{it}$ is constructed by dividing the pre-tax profit for firm $i$ in year $t$ by the firm's total assets in year $t$. ROA is an important measure of a firm's performance and is likely to be considered when banks offer credit. Constructing the ROA, we observe that our sample includes several extreme values. The extreme values are in large caused by newly established firms and firms that go bankrupt during the period, with negative equity or negative assets.

We solve this by first omitting all observations with negative total assets. After omitting these observations, we still have several extreme values, and therefore omit all observations outside the 1th and 99th percentile for the variable ROA.

$$Solvency_{it} = \frac{Total\ Liabilities_{it}}{Total\ Equity_{it}}$$

The variable $Solvency_{it}$ is constructed by dividing the total liabilities for firm $i$ in year $t$ by the firm's total equity in year $t$. The solvency can be used to illustrate a firm's financial health. The debt to equity ratio illustrates how a firm's total assets are funded, so a high ratio would imply a high degree of funding through creditors. Firms that have a high solvency often have trouble obtaining sequential financing since their debt burden already is high.

$$Current\ Ratio_{it} = \frac{Current\ Assets_{it}}{Current\ Liabilities_{it}}$$

We construct the variable $Current\ Ratio_{it}$ by dividing the current assets for firm $i$ in year $t$ by the firm's current liabilities in year $t$. The current ratio can be used to measure a firm's liquidity. It reflects a firm's ability to cover short-term liabilities and may be closely correlated to a firm's bankruptcy risk. The higher the ratio, the more likely is it that the firm will be able to pay back their short-term obligations, and the interpretation is therefore somewhat the reversed of solvency.

## 5.3 Summary Statistics

After the construction of our variables, and cleaning of the dataset, we are left with the following distribution of our most relevant variables:

**Table 1:** Summary statistics for relevant variables in our regression analysis

| | Mean | Observations | Median | Std. Dev | Min | Max |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Interest Rate | 0.052 | 671 791 | 0.036 | 0.089 | 0.000 | 1.000 |
| Debt Ratio | 0.228 | 671 791 | 0.129 | 0.265 | 0.000 | 1.165 |
| Growth | 0.205 | 671 791 | 0.000 | 8.690 | -1943 | 1205 |
| ROA | 0.077 | 671 791 | 0.068 | 0.187 | -0.698 | 0.837 |
| Current Ratio | 4.043 | 671 791 | 1.305 | 99.320 | -3310 | 57007 |
| Solvency | 4.968 | 671 791 | 2.279 | 827.047 | -15334 | 665789 |

# 6. Descriptive Statistics

In total, there were 42 bank withdrawals during our sample period. However, this is not necessarily the number of withdrawals we study in our regression analysis, since we only measure withdrawals that impact firms within our sample. From Figure 3 we observe that, looking at the number of withdrawals per year, withdrawals are quite evenly distributed, although with some exceptions. In 2012, Nordea had six withdrawals as a part of their massive downscaling of branches in the recent years. Since establishing in Norway in 2000, they have closed over 60 branches (Nordea, 2000; 2013). Even though the total number of withdrawals is small, each withdrawal will impact several firms. By dividing Norway in to 46 regions, the average region will consist of approximately 9 municipalities (based on the number of municipalities in 2013).

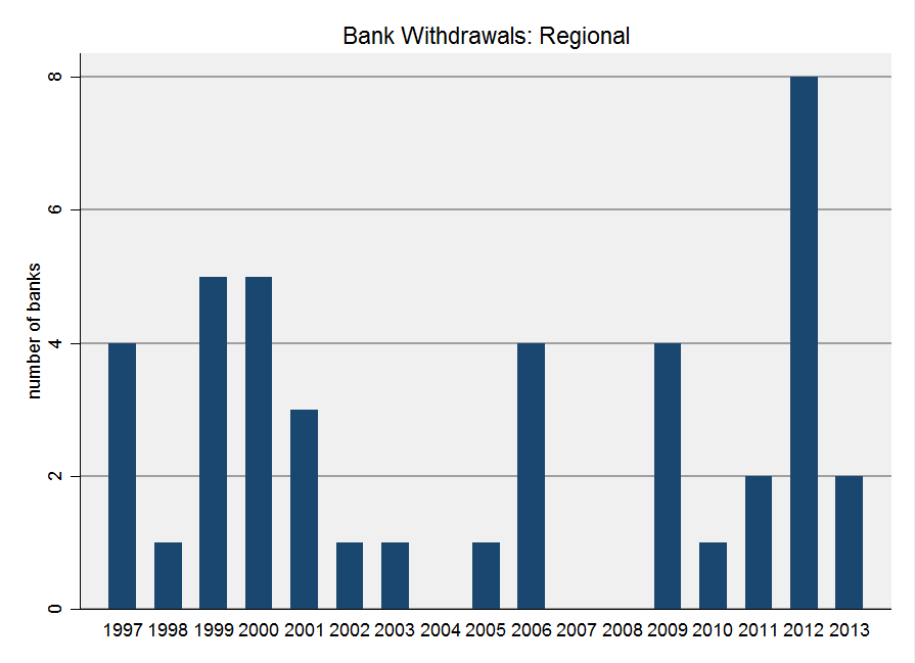


***Figure 3:*** *Regional bank withdrawals during our sample period*

An unfortunate implication of the large number of withdrawals in 2012 is that we only have data on the impacted firms for one consecutive year. The analysis of these closures will in other words be less conclusive. However, the majority of our withdrawals are in the first years of our sample, where we have more than five consecutive years of data.

Figure 4 illustrates the number of firms affected by a regional bank withdrawal, in the different subgroups. This is obviously closely related to the total number of observations within our subgroups. The distribution is however interesting to keep in mind when we analyse our results. Most firms seem to be mature, and few small and newly established firms experience a bank withdrawal.

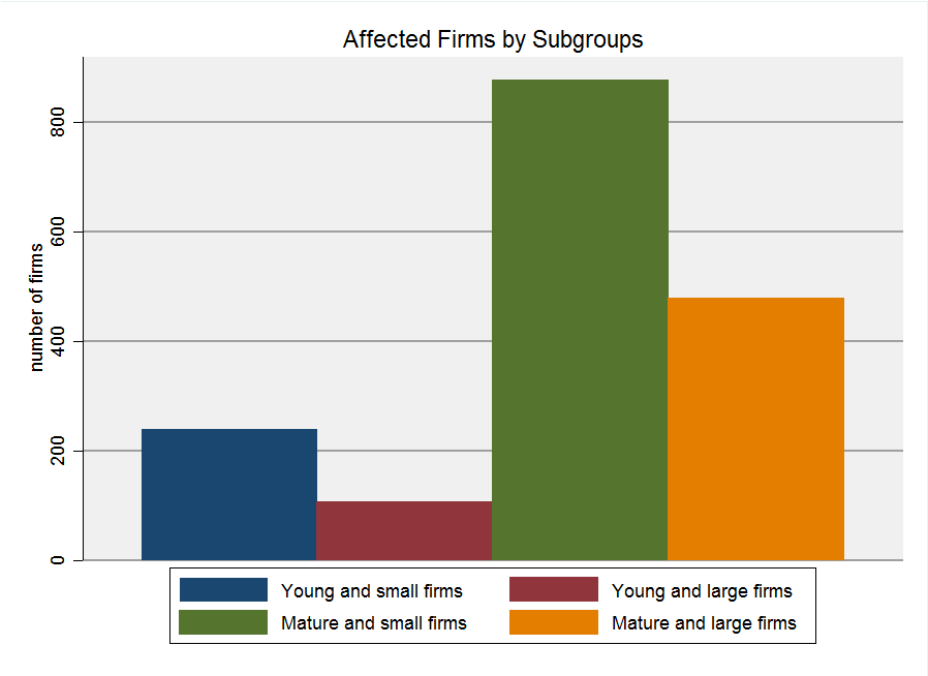


***Figure 4:*** *Affected firms by regional withdrawals, divided by subgroups*

While Figure 3 illustrates the bank withdrawals from regions, Figure 5 illustrates the bank branch closures. Like the regional withdrawals, the closures are evenly distributed, with some exceptions.

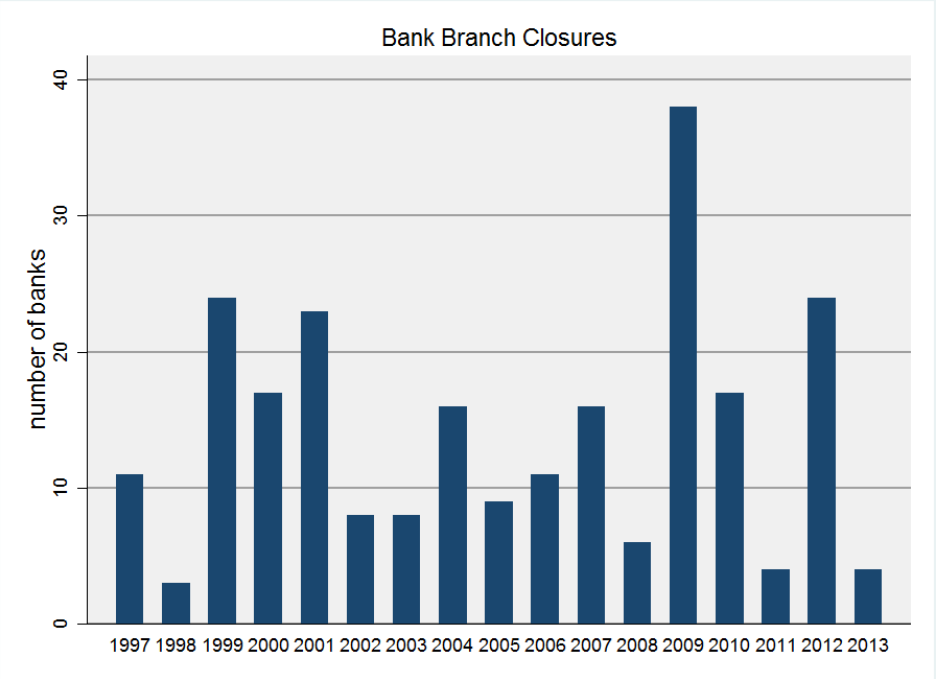


***Figure 5:*** *Bank branch closures during our sample period*

In 2009, DNB and several other banks closed multiple branches. The financial crisis in 2007 led banks to implementing multiple efficiency measures, as cost cutting. In addition, the digitalization has led to a shift from physical bank-customer relationships towards electronic customer communication. In fact, statistics from Finans Norge shows that from 2008 to 2009, Norwegian banks in total closed 146 branches (Finans Norge, 2017).

## **6.1** Sample Characteristics

The economic regions differ in size, both in terms of population and business activity. From Appendix 1 we observe that some regions are better represented than others in our sample. The distribution of loans follows the distribution of firms, indicating that there are no critical deviations between regions. However, region 13, Vestfold, seems to have a lower share of the total loan volume relative to the share of observations, which may indicate that firms in this region are less capital intensive. Additionally, the opposite is true for region 55, Ålesund, a region in the northwest part of Norway. This part of Norway has a lot of shipping activity, which is a capital intensive industry.

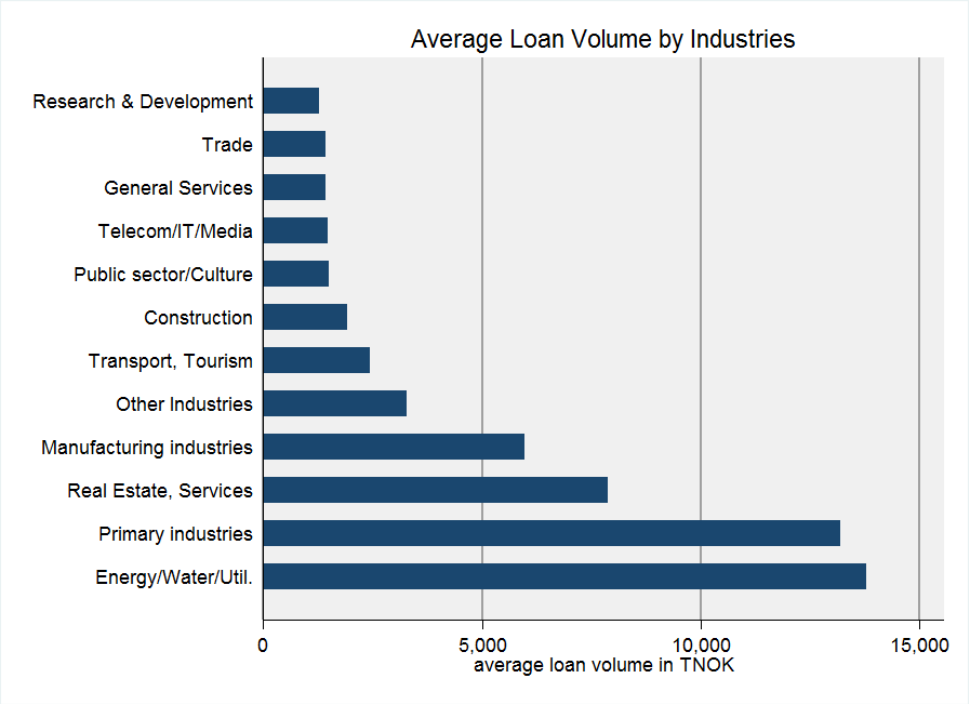


***Figure 6*** *Average loan volume by industries*

Figure 6 illustrates the average loan volume for different industries, omitting the shipping industry. Some industries are more capital intensive than others, and we observe that service industries, e.g. telecom, media or transportation, in general have a lower average loan volume than other industries. These industries are typically more labour intensive, and require less investments in tangible assets. Shipping is the most capital-intensive industry in our sample. This industry has an extremely high average loan volume, at almost MNOK 24, and is therefore excluded from Figure 6. Empirically, shipping is known to be capital intensive (Syriopoulos, 2010; Sand, 2015), but not to the extreme extent we observe in our sample. However, the industry is highly underrepresented relative to other industries in our sample, so extreme values will skew the mean.

Primary industries is one of the most capital intensive out of these industries, with an average loan burden of approximately MNOK 13. This is somewhat unexpected, since many small farms are operating in these industries. However, since we only include limited liability firms, most farms will be excluded, as they are often sole proprietorships. We observe that the real estate is capital intensive, which supports other empirical findings; lending to the real estate industry represented 41 percent of the total gross lending in the first quarter of 2013 (Statistics Norway, 2018). This suggests that the high degree of lending to this industry is not only due

to a high presence of real estate firms, but also that they are more capital intensive than other industries.

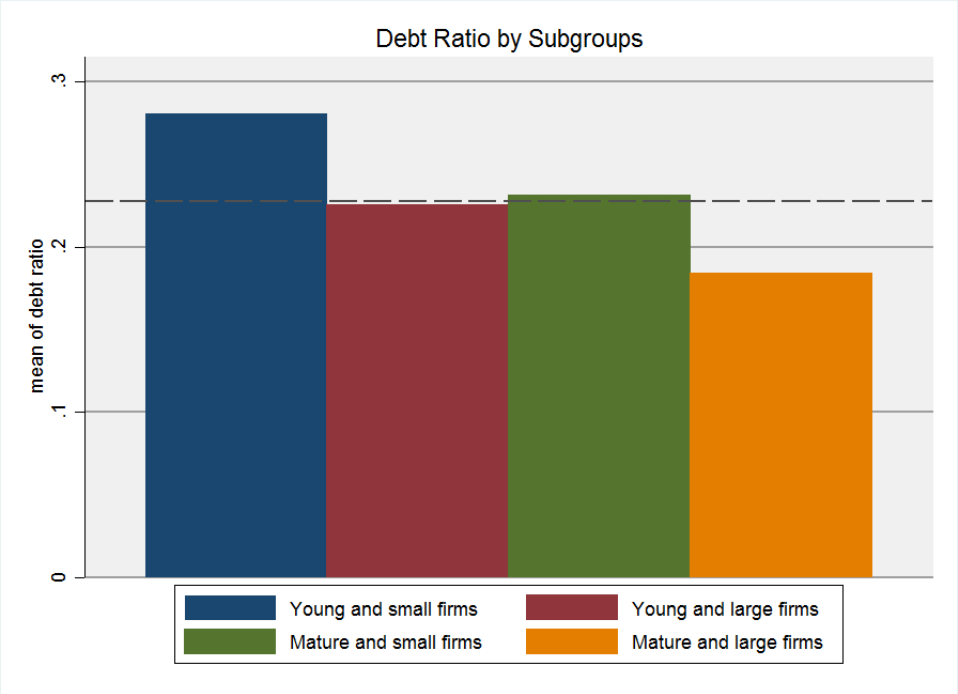


***Figure 7:*** *Average debt ratio, by subgroups*

Figure 7 presents the average debt ratio for our four subgroups. The debt ratio illustrates the risk exposure for owners with regards to lenders and other creditors. With a high ratio, a firm's cash flow will need to serve large, fixed costs of interest and deduction payments. In periods with poor profitability, there will be little left to the owners, as the creditors will have priority. Further, the investors will demand compensation for the financial risk in terms of a high yield in projects with high debt ratio. Unstable cash flows, and poor liquidity, is one of the main reasons why firms go bankrupt (Holm, 2015). Figure 7 illustrates that the subgroup small and young firms have a higher debt ratio than all other subgroups. This strengthens our beliefs that these firms often have weaker financial stability, and are more likely to go bankrupt. The difference between young and small firms, and mature and large firms, is almost 0.1, which is substantial. However, it is important to keep in mind that the debt ratio is calculated by using their gross lending, and does not include debt to other creditors or suppliers.

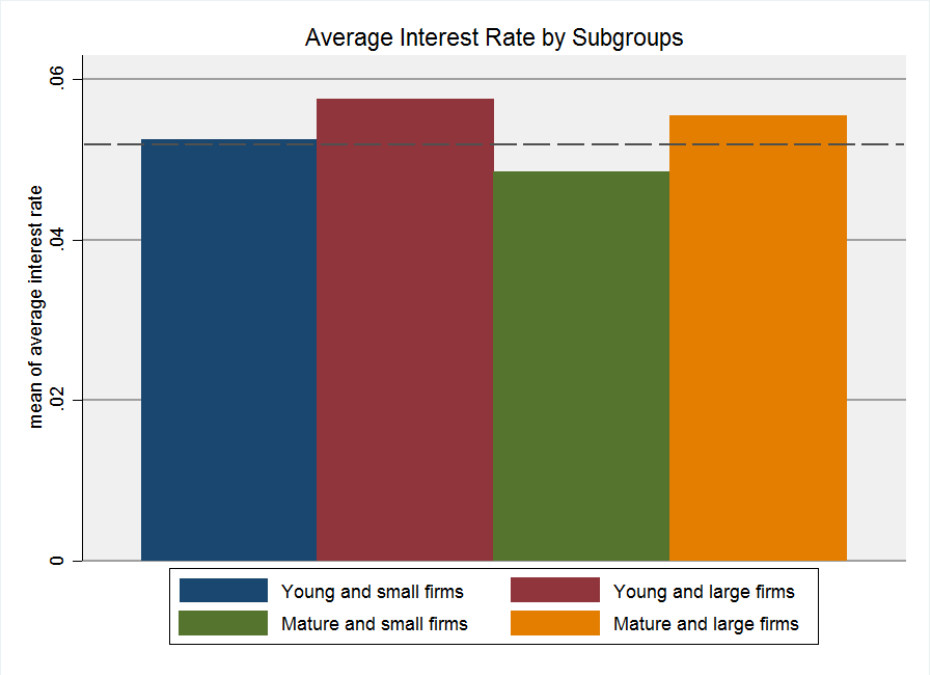


***Figure 8:*** *Average interest rate, by subgroups*

Figure 8 presents the average interest rate for all subgroups. We observe that there are no substantial deviations between the subgroups. However, large firms, both mature and young, seem to have a higher interest rate than small firms. Intuitively, one would think that small firms, and especially young and small firms, would receive the highest interest rate. The deviation may be caused by large firms having more risk-weighted debt, and that they thus receive higher interest rates. We also measure the distribution among industries, and find that "Trade", "Manufacturing industries" and "Energy/Water/Util." were the ones who received the highest interest rates. Trade and manufacturing are also the industries with the highest representation of large and mature firms. Trade may be a risky industry because of its volatility to foreign markets.

In a report from DNB we find that SME's receive a higher interest rate than large and international corporations (2018). However, their definition of large firms is quite different from ours. Some groups are less represented in our sample, so the accuracy of the mean may vary between subgroups. In addition, since we construct our average interest rate based on the firm's interest payments, we do not account for the repayment plan. It is possible that firms with a weak liquidity will try to obtain a longer repayment plan, and the annual interest payments may thus be lower.

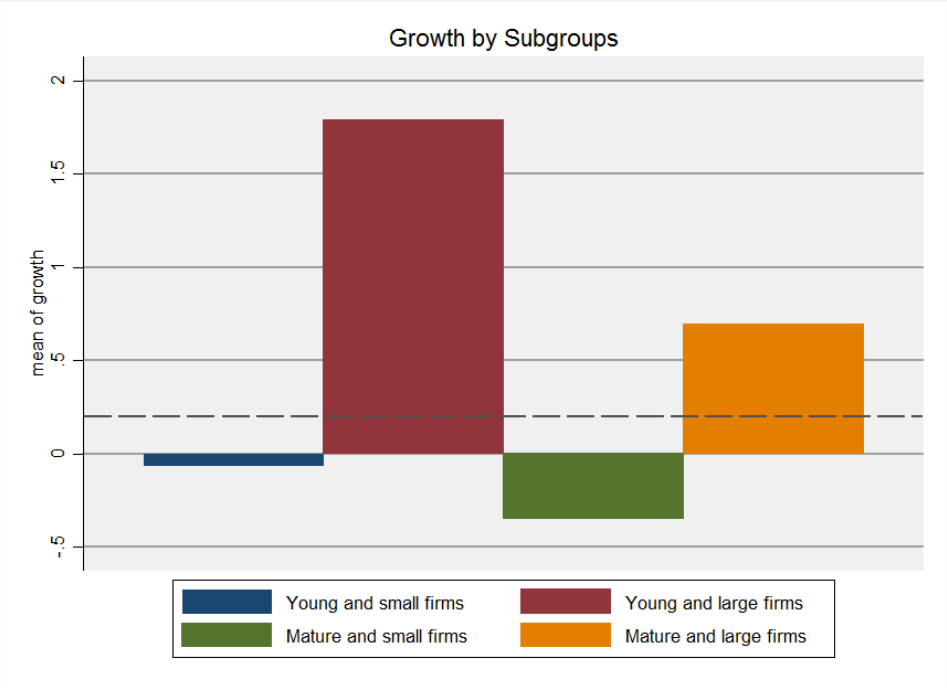


***Figure 9**: Average growth, by subgroups*

Figure 9 illustrates the average changes in growth for the different subgroups. Young and large firms clearly experience a higher growth than other subgroups. On average, they grow by 1.75 employees per year. In fact, only large firms, both young and mature, do on average experience growth. It seems reasonable that young and large firms have a more rapid growth than mature and large firms, since they have had more time to stabilize. More interestingly, in general, small firms seem to experience negative growth. Mature and small firms experience the largest decrease in growth. However, we must keep in mind that firms can change subgroups over time by increasing or decreasing the number of employees. The mature and small firms may in other words be previous mature and large firms who go through a period of downscaling. For the full sample, growth is on average positive, indicating that firms experience an average growth of approximately 0.25 employees per year.

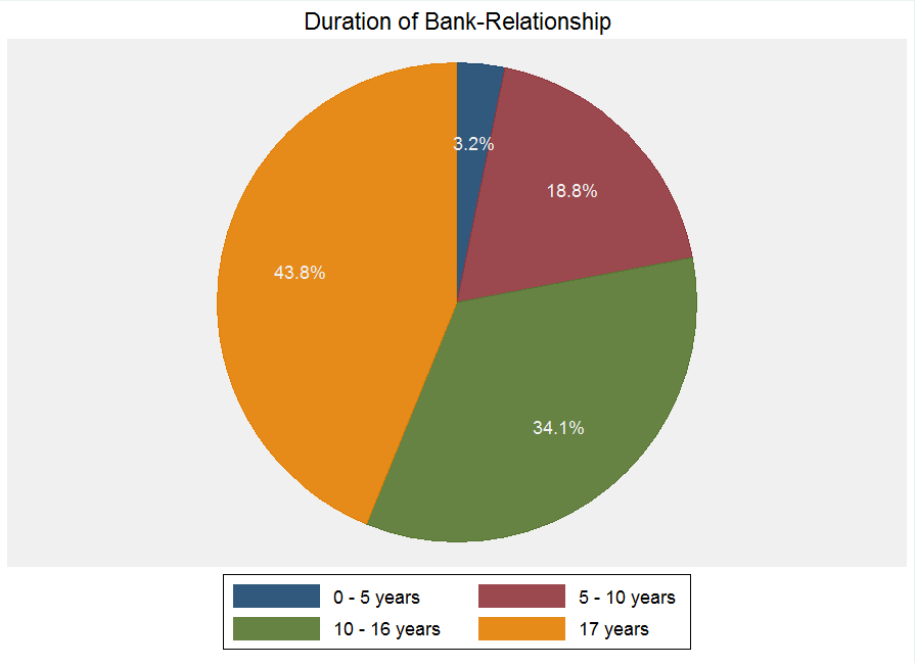


***Figure 10:*** *The duration of bank-relationships*

Figure 10 illustrates the duration of the bank relationships. We observe that most firms keep their bank relationship throughout the sample period. There are some bank transfers within the period, which results in the bank relationship being less than 17 years. However, not all firms are represented throughout the period, either because they are newly established or go bankrupt during the sample period. In the consumer segment, the share of customers who switched main banks in 2014 was only five percent (Finans Norge, 2014). Based on our data, we can assume that there still is a high degree of loyalty between banks and customers. The fact that customers are loyal makes our research more interesting, because loyal customers may experience a "shock" when forced to interact with a new bank after losing the relationship with their local branch.

# 7. Results

We include one regression for each dependent variable. In 7.1 we start by analysing the linear effect of regional bank withdrawals. To test the robustness of our analysis, we execute similar regressions for all dependent variables on municipality level in 7.2.

## 7.1 Using Regional Bank Withdrawals as Treatment

If a bank closes several branches within the same region, we register the treatment when the final branch closes[2]. This gives us some important insights. If a bank branch closes, but a branch in the neighbouring municipality is left open, it is likely that a large part of the banks soft information will remain within the region. The assumption is that banks' human capital can be moved within the region, especially since the regions are defined by commute and workforce-flow. The effect is likely to be more prevalent when a bank completely withdraws from a region, but evidently, less frequent.

When conducting our regressions, we start by presenting the effect of a withdrawal for the full sample, which is presented in Column 1 in all regression tables. Columns 2-5 presents the effect within the different subgroups; young and small, young and large, mature and small and mature and large, respectively. The column titles refer to the reference group for the specific regression. The interaction terms will thus present the difference in the estimated coefficients, $\gamma_n$, if size and/or age changes.

Due to lack of explanatory value, we choose to exclude current ratio and solvency from our group of control variables.

[2] We do not measure if the customers of the withdrawing bank remain customers - or if they switch banks. An interesting study would be to measure whether the two receive different treatment, much like the study of Bonfim et.al (2017).

### 7.1.1 The Effect of Regional Bank Withdrawals on Firms' Debt Ratio

**Table 2:** Two-way fixed effects regression using debt ratio as dependent variable

| Variables | (1) Full | (2) Young and Small | (3) Young and Large | (4) Mature and Small | (5) Mature and Large |
|---|---|---|---|---|---|
| Direct treatment (D) | 0.039*** | 0.042*** | 0.054*** | 0.048*** | 0.024** |
| | (0.008) | (0.016) | (0.021) | (0.011) | (0.010) |
| Regional treatment (R) | -0.067*** | -0.069*** | -0.063** | -0.065*** | -0.064** |
| | (0.026) | (0.025) | (0.025) | (0.025) | (0.025) |
| Age x Size x D | | -0.036 | 0.036 | 0.036 | -0.036 |
| | | (0.027) | (0.027) | (0.027) | (0.027) |
| Age x Size x R | | -0.004 | 0.004 | 0.004 | -0.004 |
| | | (0.003) | (0.003) | (0.003) | (0.003) |
| Size x D | | 0.012 | -0.012 | -0.024* | 0.024* |
| | | (0.024) | (0.024) | (0.013) | (0.013) |
| Size x R | | 0.006** | -0.006** | 0.002 | -0.002 |
| | | (0.002) | (0.002) | (0.001) | (0.001) |
| Age x D | | 0.006 | -0.030 | -0.006 | 0.030 |
| | | (0.017) | (0.022) | (0.017) | (0.022) |
| Age x R | | 0.003* | -0.001 | -0.003* | 0.001 |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Size x Age | | 0.005** | -0.005** | -0.005** | 0.005** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Size | | 0.007*** | -0.007*** | 0.012*** | -0.012*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Age | | -0.020*** | -0.014*** | 0.020*** | 0.014*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Return on Assets | | -0.178*** | -0.178*** | -0.178*** | -0.178*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Relationship | -0.008*** | -0.007*** | -0.007*** | -0.007*** | -0.007*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | 0.367*** | 0.384*** | 0.391*** | 0.365*** | 0.377*** |
| | (0.028) | (0.027) | (0.027) | (0.027) | (0.027) |
| *Lincom:* | | | | | |
| Age x Size x D | | -0.012 | -0.011 | 0.000 | 0.023 |
| | | (0.018) | (0.023) | (0.022) | (0.018) |
| Age x Size x R | | 0.010*** | 0.008** | -0.003 | 0.000 |
| | | (0.003) | (0.003) | (0.003) | (0.003) |
| Observations | 671,791 | 671,791 | 671,791 | 671,791 | 671,791 |
| Number of firms | 73,787 | 73,787 | 73,787 | 73,787 | 73,787 |
| Firm Fixed Effects | YES | YES | YES | YES | YES |
| Year x Region | YES | YES | YES | YES | YES |
| Cohort Fixed Effects | YES | YES | YES | YES | YES |

Note: The dependent variable represents the debt ratio of firm *i* in year *t*. The explanatory variables are the direct (D) and regional treatment (R), which shows share of loans for each firm directly affected by a bank withdrawal, and effect on the entire region by a withdrawal, respectively. Triple interactions between size, age and treatment are included to measure if the effect is greater for small and newly established firms. Included for both treatments. Interaction terms between region and year, and cohort fixed effects, are included in all regressions, but excluded from the table. Explanation age- and size dummies: Column 2: Size=1 if large, Age=1 if mature. Column 3: Size=1 if small, Age=1 if mature. Column 4: Size=1 if large. Age=1 if young. Column 5: Size=1 if small, Age=1 if young. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Column 1 presents the effect of a withdrawal for the full sample. The direct, and regional treatment are both significant at a 1% level, but points in opposite directions. Since the direct treatment is an intensity level, the estimated coefficient is interpreted as the effect if the withdrawing bank is the firm's sole lender. The effect of withdrawal will then be an increase in the debt ratio of 0.039. However, the regional effect is negative, so the effect for all firms in the region is a decrease of 0.067. Since the direct treatment cannot occur without the regional treatment being 1, the overall effect of a withdrawal will be a decrease in firms' debt ratio. The decrease in debt ratio could suggest a decrease in either supply or demand for credit. A decrease in demand for credit could indicate that firms in the region experience less activity, and thus need less financing for new projects or equipment. This could in turn lead the banks to withdraw from regions where demand is low, thus lowering the overall supply. This would mean that banks withdraw from regions because of low demand, and not that withdrawals lead to less supply.

An important part of our analysis is to compare the effect inflicted on small and newly established firms, relative to other firms. Column 2 presents our analysis conducted on the subgroup of young and small firms. The estimated coefficients for direct and regional treatment are 0.042 and -0.069, respectively. Both are significant at a 1% level. This entails that the overall decrease in debt ratio for young and small firms is 0.027, i.e. 10 basis points lower than for the full sample.

The linear combination in Column 2 illustrates the difference in effect for mature and large firms relative to young and small firms. Even though the linear combination is not significant for direct treatment, the direction of the estimated coefficient indicates that the effect for debt ratio for large and mature firms is smaller. However, the linear combination for regional treatment has a significant coefficient of 0.010, indicating that the effect will be 1 percentage point higher for mature and large firms. We observe that both interaction terms, for age and regional treatment, and size and regional treatment, are positive, thus leading to an increase in the effect.

Consistent with the linear combination for direct treatment in Column 2, the effect of direct treatment in Column 5 is far lower than other subgroups, with an estimated coefficient of 0.024. The regional treatment does not differ substantially from other subgroups. Both treatments are significant at a 5% level. This would indicate that the debt ratio for mature and

large firms, in total, will decrease more than for young and small firms when their bank withdraws.

Column 3 and 4 allows us to isolate the differences between subgroups, and determine whether size or age is the most important variable to explain the differences. For instance, the estimated coefficient for direct treatment is 0.054 in Column 3, significant at a 1% level. The difference relative to Column 2 is illustrated in the interaction term between size and direct treatment, with an estimated coefficient of -0.012, even though the difference is not significant. Similarly, Column 4 has an estimated coefficient of 0.048 for direct treatment, significant at a 1% level. The difference from Column 2 is in related to age, and we observe that the interaction between age and direct treatment is -0.006, which is the actual difference between the estimated coefficients for direct treatment in Column 2 and 4. Since the effects points in different directions, it indicates that the differences is not only due to difference in either size or age, but due to changes in subgroups.

The regional decrease in debt ratio is nearly identical for all subgroups, and could suggest a reduced supply, or demand for credit in the regional market. If the decrease in debt ratio is caused by a decrease in supply, it becomes harder for firms to obtain credit. Relationship lending would suggest that young and small firms would be the greatest victim to the decreased supply. However, as we observe from the direct treatment for small and young firms, the direct treatment eliminates some of the regional decrease. This could suggest that their demand remains unchanged, and they may be willing to accept loans with worse conditions. However, since debt ratio is a relative ratio, it could also mean that the reduced access to credit in turn makes firms invest less in assets, for example new equipment or products.

The regional effect could also be caused by a decrease in demand. Since mature and large firms experience the greatest reduction in debt ratio, it is possible that these firms are the reason for the decreased demand. It is also possible that they, unlike young and small firms, are not willing to accept loans with worse conditions, and instead obtain financing through equity expenditures.

Interestingly, the cohort effect is similar for all firms and subgroups. The estimated coefficient is -0.007, and significant at a 1% level in all regressions. This would suggest that a longer relationship in general indicates a lower debt ratio. This way, a longer relationship would increase the impact of the overall treatment.

Overall, all firms experience a decrease in the debt ratio from the regional and direct treatment combined. Even though we cannot say if the effect is significantly different for young and small firms, reflected in the linear combination, we do observe that the direct effect for small and young firms is higher than for mature and large firms. However, the regional effect is similar for all subgroups, indicating that all firms within the region are affected equally from a bank withdrawal. These results isolated is somewhat ambiguous, and can be explained by several factors. Changes in average interest rate and growth may for instance explain some of the effect we observe on debt ratio.

### 7.1.2 The Effect of Regional Withdrawals on Firms' Interest Rate

**Table 3:** Two-way fixed effects regression using interest rate as dependent variable

| Variables | (1) Full | (2) Young and Small | (3) Young and Large | (4) Mature and Small | (5) Mature and Large |
|---|---|---|---|---|---|
| Direct treatment (D) | 0.009*** | 0.026*** | 0.030*** | 0.007** | 0.006 |
| | (0.003) | (0.003) | (0.008) | (0.003) | (0.005) |
| Regional treatment (R) | -0.003 | -0.006 | -0.007 | -0.004 | -0.004 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| Age x Size x D | | -0.004 | 0.004 | 0.004 | -0.004 |
| | | (0.009) | (0.009) | (0.009) | (0.009) |
| Age x Size x R | | -0.000 | 0.000 | 0.000 | -0.004 |
| | | (0.001) | (0.001) | (0.001) | (0.009) |
| Size x D | | 0.003 | -0.003 | -0.001 | 0.001 |
| | | (0.008) | (0.008) | (0.005) | (0.005) |
| Size x R | | -0.001 | 0.001 | -0.001 | 0.001 |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Age x D | | -0.019*** | -0.024*** | 0.019*** | 0.024*** |
| | | (0.004) | (0.009) | (0.004) | (0.009) |
| Age x R | | 0.003*** | 0.002** | -0.003*** | -0.002** |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Size x Age | | -0.003*** | 0.003*** | 0.003*** | -0.003*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Size | | 0.011*** | -0.011*** | 0.008*** | -0.008*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Age | | 0.003*** | -0.000 | -0.003*** | 0.000 |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Return on Assets | | -0.014*** | -0.014*** | -0.014*** | -0.014*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Relationship | -0.001*** | -0.001*** | -0.001*** | -0.001*** | -0.001*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | 0.077*** | 0.073*** | 0.084*** | 0.076*** | 0.084*** |
| | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| *Lincom:* | | | | | |
| Age x Size x D | | -0.023*** | -0.020** | 0.026*** | 0.018*** |
| | | (0.005) | (0.008) | (0.008) | (0.006) |
| Age x Size x R | | -0.001 | 0.006*** | -0.000 | -0.005*** |
| | | (0.001) | (0.002) | (0.001) | (0.001) |
| Observations | 671,791 | 671,791 | 671,791 | 671,791 | 671,791 |
| Number of firms | 73,787 | 73,787 | 73,787 | 73,787 | 73,787 |
| Firm Fixed Effects | YES | YES | YES | YES | YES |
| Year x Region | YES | YES | YES | YES | YES |
| Cohort Fixed Effects | YES | YES | YES | YES | YES |

Note: The dependent variable represents the average interest rate of firm *i* in year *t*. The explanatory variables are the direct (D) and regional treatment (R), which shows share of loans for each firm directly affected by a bank branch withdrawal, and effect on the entire region by a withdrawal, respectively. Triple interactions between size, age and treatment are included to measure if the effect is bigger on small and newly established firms. Included for both treatments. Interaction terms between region and year, and cohort fixed effects, are included in all regressions, but excluded from the table. Explanation age- and size dummies: Column 2: Size=1 if large, Age=1 if mature. Column 3: Size=1 if small, Age=1 if mature. Column 4: Size=1 if large. Age=1 if young. Column 5: Size=1 if small, Age=1 if young.

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

For the full sample, as illustrated in Column 1, we observe that the effect of a regional withdrawal points to an increase in average interest rate for all corporate customers of a closing bank. If a customer has 100 percent of their loan volume to the withdrawing bank, they will experience an increase in interest rate of 90 basis points. The effect is significant at a 1% level. The regional treatment is not significant, but indicates that the effect for the entire region is negative. However, the overall effect of both regional and direct treatment suggests an increase in interest for customers of the withdrawing bank.

In Column 2 we include young and small firms as our reference group, and the estimated effect of direct treatment is 0.026, significant at a 1% level. Relative to the full sample, the effect is significantly higher. None of our triple interactions are significant, but our double interaction with direct treatment and age is significant at a 1% level, indicating that mature firms would receive a 1.9 percentage point lower increase in interest rate than young firms do. Size is however not significant, so we cannot say for sure that there is a difference in effect between small and young firms, and large and young firms. The regional treatment is still not significant, indicating that there are no significant changes in interest rates inflicted on all firms within a region after a bank withdrawal. However, as in Column 1, the effect is negative, which means that this levels out the effect of the direct treatment to some extent.

From the linear combination of direct treatment in Column 2, we observe that the effect for large and mature firms is 2.3 percentage points lower than for small and young firms. The difference is significant at a 1% level, and suggests that there is in fact a difference. This coincides with what we observe in Column 5, where the estimated effect of a bank withdrawal is 0.006 for large and mature firms, but not significant. This could suggest that large and mature firms do not experience a direct effect of a regional bank withdrawal. This is consistent with our assumptions, and the theoretical literature, that large and mature firms have less problems obtaining credit through new financing methods, either through new banks or the capital bond market. However, our broad definition of large and mature firms makes the assumption of obtaining credit through the capital bond market less applicable to our findings, since this for the most part applies for larger, publicly traded corporations.

From Columns 3 and 4 we can isolate the sources for differences in effects. In Column 3, using young and large firms as a reference group, the estimated coefficient is 0.030, significant at a 1% level. This means that the effect for young and large firms is even higher than for young and small firms. However, this is a relatively small subgroup, since few firms under 5 years

have more than 5 employees. Again, this points to age being the most important variable in determining the direction of the effect. In Column 4, we look at mature and small firms, and the estimated coefficient drops drastically to 0.007, significant at a 5% level. The relationship between different ages is illustrated in the interaction between direct treatment and age. A change in age, from mature to young, would increase the effect by 1.9 percentage points, which is the effect we observe in Column 2.

The regional treatment shows little significance overall, and from our analysis we cannot determine a definite effect on the entire region because of a bank withdrawal. However, the regional effect is negative for all subgroups, indicating that firms within the region experience a decrease in average interest rate.

The substantial increase in average interest rate for young firms could explain some of the effects we observe for debt ratio. The decrease in debt ratio could thus be related to a lower supply of credit, leaving the opaquest firms to seek financing from other banks, and thus receiving considerable worsened conditions in terms of interest rates.

Overall, we observe a clear impact of a bank withdrawal, and small and young firms are definitely hit harder. How strong the effect is, seem to be determined by a firm's age. When determining the effect on interest rate, size seem to be a less important variable, as we observe that large firms in fact are hit even harder than small firms, if they are young.

### 7.1.3 The Effect of Regional Bank Withdrawals on Firms' Growth

**Table 4:** Two-way fixed effects regression using growth as dependent variable

| Variables | (1) Full | (2) Young and Small | (3) Young and Large | (4) Mature and Small | (5) Mature and Large |
|---|---|---|---|---|---|
| Direct treatment (D) | 0.064 | -0.184 | 0.174 | 0.052 | 0.044 |
| | (0.145) | (0.172) | (0.722) | (0.184) | (0.260) |
| Regional treatment (R) | 0.005 | 0.039 | -0.110 | 0.025 | -0.362 |
| | (0.458) | (0.463) | (0.496) | (0.461) | (0.467) |
| Age x Size x D | | -0.366 | 0.366 | 0.366 | -0.366 |
| | | (0.777) | (0.777) | (0.777) | (0.777) |
| Age x Size x R | | -0.238 | 0.238 | 0.238 | -0.238 |
| | | (0.152) | (0.152) | (0.152) | (0.152) |
| Size x D | | 0.357 | -0.357 | -0.009 | 0.009 |
| | | (0.745) | (0.745) | (0.311) | (0.311) |
| Size x R | | -0.149 | 0.149 | -0.387*** | 0.387*** |
| | | (0.133) | (0.133) | (0.076) | (0.076) |
| Age x D | | 0.236 | -0.130 | -0.236 | 0.130 |
| | | (0.205) | (0.742) | (0.205) | (0.742) |
| Age x R | | -0.015 | -0.253* | 0.015 | 0.253* |
| | | (0.034) | (0.151) | (0.034) | (0.151) |
| Size x Age | | -0.939*** | 0.939*** | 0.939*** | -0.939*** |
| | | (0.085) | (0.085) | (0.085) | (0.085) |
| Size | | 3.560*** | -3.560*** | 2.620*** | -2.620*** |
| | | (0.082) | (0.082) | (0.059) | (0.059) |
| Age | | 0.021 | -0.918*** | -0.021 | 0.918*** |
| | | (0.031) | (0.083) | (0.031) | (0.083) |
| Return on Assets | | 0.311*** | 0.311*** | 0.311*** | 0.311*** |
| | | (0.057) | (0.057) | (0.057) | (0.057) |
| Relationship | -0.010 | -0.006 | -0.006 | -0.006 | -0.006 |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| Constant | 0.304 | -1.114* | 2.445*** | -1.093 | 1.527** |
| | (0.709) | (0.669) | (0.671) | (0.667) | (0.668) |
| *Lincom:* | | | | | |
| Age x Size x D | | -0.712** | 0.818 | 1.060 | -1.167*** |
| | | (0.328) | (0.738) | (0.742) | (0.327) |
| Age x Size x R | | -1.341*** | 1.073*** | 0.805*** | -0.538*** |
| | | (0.103) | (0.188) | (0.122) | (0.131) |
| Observations | 671,791 | 671,791 | 671,791 | 671,791 | 671,791 |
| Number of firms | 73,787 | 73,787 | 73,787 | 73,787 | 73,787 |
| Firm Fixed Effects | YES | YES | YES | YES | YES |
| Year x Region | YES | YES | YES | YES | YES |
| Cohort Fixed Effects | YES | YES | YES | YES | YES |

Note: The dependent variable represents the growth for firm *i* in year *t*. The explanatory variables are the direct (D) and regional treatment (R), which shows share of loans for each firm directly affected by a bank withdrawal, and effect on the entire region by a withdrawal, respectively. Triple interactions between size, age and treatment are included to measure if the effect is bigger on small and newly established firms. Included for both treatments. Interaction terms between region and year, and cohort fixed effects, are included in all regressions, but excluded from the table. Explanation age- and size dummies: Column 2: Size=1 if large, Age=1 if mature. Column 3: Size=1 if small, Age=1 if mature. Column 4: Size=1 if large. Age=1 if young. Column 5: Size=1 if small, Age=1 if young.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

In Table 4 we use growth in employees as dependent variable. For the full sample, presented in Column 1, we have no significant coefficients. The direct and regional treatment are both positive, however, the standard errors are too high to say anything definite about the treatment effect.

Neither the direct nor the regional treatment is significant for any of the subgroups. In Column 2, the linear combination for direct treatment has an estimated coefficient of -0.712, significant at a 5% level. Much of this difference is due to the differences in growth in general for large and mature firms. By comparing the constants in Column 2 and Column 5, we see that young and small firms on average experience negative growth, while large and mature firms experience growth. This is consistent with what we observed in our descriptive statistics.

Negative growth, and termination of employees might be an indicator of bankruptcy. This is consistent with empirical findings, that many young firms go bankrupt within a few years of establishing (Statistics Norway, 2018).

From our results, we observe that the effect of a bank withdrawal is only negative for young and small firms. However, the constant is only significant at a 10% level for young and small firms, and not significant at all for mature and small firms. This means that we cannot say something definite about growth for groups including small firms. Large firms, as illustrated in Column 3 and 5, have a significant constant at a 1% and 5% level, respectively. In both cases, the constant is positive, indicating that these subgroups in general experience growth. A change in the bank-borrower relationship does not seem to affect this growth significantly.

A bank withdrawal does not seem to have a significant impact on firms' growth. Our initial beliefs were that the impact on growth would be somewhat dependent on our findings for interest rate and credit availability. Since we observed an increase in interest ratio, and decreased debt ratio, one could assume that a firm's growth would be affected as well. However, the lack of effect on growth could suggest that firms are able to withstand the increased interest payments, and reduced credit, without affecting growth significantly.

## 7.2 Robustness Analysis: Using Bank Branch Closures as Treatment

We test the robustness of our analysis by conducting the similar regressions, only with bank branch closures instead of regional withdrawals. If the results are similar, it suggests that our results are robust. Bank branch closures are more frequent, but do not necessarily entail such a large loss of proximity, since branches can be left open in neighbouring municipalities in the same region. Stronger effects would imply that bank-borrower relationships are connected to the specific branch, while the opposite would suggest that relationships can be maintained if banks have some presence within the region. The following tables are constructed identically to the previous tables.

### 7.2.1 The Effect of Bank Branch Closures on Firms' Debt Ratio

**Table 5:** Two-way fixed effects regression with bank branch closures as treatment

| Variables | (1) Full | (2) Young and Small | (3) Young and Large | (4) Mature and Small | (5) Mature and Large |
|---|---|---|---|---|---|
| Direct treatment (D) | 0.083*** | 0.115*** | 0.063*** | 0.089*** | 0.052*** |
| | (0.004) | (0.008) | (0.008) | (0.006) | (0.005) |
| Municipality treatment | -0.006*** | -0.010*** | -0.003 | -0.009*** | 0.000 |
| | (0.001) | (0.002) | (0.003) | (0.002) | (0.002) |
| Age x Size x D | | 0.016 | -0.016 | -0.016 | 0.016 |
| | | (0.012) | (0.012) | (0.012) | (0.012) |
| Age x Size x M | | 0.002 | -0.002 | -0.002 | 0.002 |
| | | (0.003) | (0.003) | (0.003) | (0.003) |
| Size x D | | -0.052*** | 0.052*** | -0.036*** | 0.036*** |
| | | (0.010) | (0.010) | (0.007) | (0.007) |
| Size x M | | 0.007** | -0.007** | 0.009*** | -0.009*** |
| | | (0.003) | (0.003) | (0.002) | (0.076) |
| Age x D | | -0.026*** | -0.011 | 0.026*** | 0.011 |
| | | (0.009) | (0.009) | (0.009) | (0.009) |
| Age x M | | 0.001 | 0.004 | -0.001 | -0.004 |
| | | (0.002) | (0.003) | (0.002) | (0.003) |
| Size x Age | | 0.002 | -0.002 | -0.002 | 0.002 |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Size | | 0.008*** | -0.008*** | 0.010*** | -0.010*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Age | | -0.018*** | -0.016*** | 0.018*** | 0.016*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Return on Assets | | -0.177*** | -0.177*** | -0.177*** | -0.177*** |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Relationship | -0.008*** | -0.007*** | -0.007*** | -0.007*** | -0.007*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | 0.366*** | 0.383*** | 0.391*** | 0.366*** | 0.375*** |
| | (0.028) | (0.027) | (0.027) | (0.027) | (0.027) |
| *Lincom:* | | | | | |
| Age x Size x D | | -0.061*** | 0.024** | -0.028** | 0.065*** |
| | | (0.009) | (0.010) | (0.010) | (0.009) |
| Age x Size x M | | 0.012*** | -0.008** | 0.004 | -0.008*** |
| | | (0.004) | (0.004) | (0.003) | (0.003) |
| Observations | 669,088 | 669,088 | 669,088 | 669,088 | 669,088 |
| Number of firms | 73,732 | 73,732 | 73,732 | 73,787 | 73,787 |
| Firm Fixed Effects | YES | YES | YES | YES | YES |
| Year x Region | YES | YES | YES | YES | YES |
| Cohort Fixed Effects | YES | YES | YES | YES | YES |

Note: The dependent variable represents the debt ratio for firm *i* in year *t*. The explanatory variables are the direct (D) and municipality treatment (M), which shows share of loans for each firm directly affected by a bank branch closure, and effect on the entire municipality by a closure, respectively. Triple interactions between size, age and treatment are included to measure if the effect is bigger on small and newly established firms. Included for both treatments. Interaction terms between region and year, and cohort fixed effects, are included in all regressions, but excluded from the table. Explanation age- and size dummies: Column 2: Size=1 if large, Age=1 if mature. Column 3: Size=1 if small, Age=1 if mature. Column 4: Size=1 if large. Age=1 if young. Column 5: Size=1 if small, Age=1 if young.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

For the full sample, presented in Column 1, the estimated coefficient for the direct treatment is 0.083, and -0.006 for the municipality treatment, both significant at a 1% level. The overall effect of treatment is thus an increase in debt ratio. We observe the same pattern for all subgroups, however, the municipality treatment is only significant for subgroups containing small firms.

The linear combination in Column 2 suggests that mature and large firms, that are directly affected by a closure, receives a 0.061 lower debt ratio than young and small firms. In addition, the municipality treatment shows that mature and large firms receive a higher debt ratio relative to young and small firms. Both differences are significant at a 1% level. This means that if mature and large firms have all their loans in the closing bank, the overall effect on debt ratio is 0.049 lower than if the firm is young and small. When using municipality level, the sources of differences between subgroups is more obvious. From Column 3 and 4 we observe that size seem to be the contributing variable for the differences, while age only seem to have an impact when comparing small firms.

Our robustness test shows somewhat opposite results to our findings in 7.1.1. Bank branch closures leads to an increase in debt ratio, while the regional withdrawals lead to a decrease. However, the differences between subgroups are somewhat consistent to our findings in Table 2. This could suggest that the supply of credit is not as affected by a closure, since the municipality effect is quite small for all subgroups. This could in turn suggest that firms within the municipality can seek financing from neighbouring municipalities, much like our initial beliefs.

### 7.2.2 The Effect of Bank Branch Closures on Firms' Interest Rate

**Table 6:** Two-way fixed effects regression with bank branch closures as treatment

| Variables | (1) Full | (2) Young and Small | (3) Young and Large | (4) Mature and Small | (5) Mature and Large |
|---|---|---|---|---|---|
| Direct treatment | 0.022*** | 0.030*** | 0.024*** | 0.022*** | 0.016*** |
| | (0.002) | (0.003) | (0.004) | (0.002) | (0.003) |
| Municipality treatment | -0.002*** | -0.002** | 0.000 | -0.002*** | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Age x Size x D | | 0.000 | -0.000 | -0.000 | 0.000 |
| | | (0.006) | (0.006) | (0.006) | (0.006) |
| Age x Size x M | | -0.001 | 0.001 | 0.001 | -0.001 |
| | | (0.002) | (0.002) | (0.002) | (0.002) |
| Size x D | | -0.006 | 0.006 | -0.006 | 0.006 |
| | | (0.005) | (0.005) | (0.004) | (0.004) |
| Size x M | | 0.002 | -0.002 | 0.001* | -0.001* |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Age x D | | -0.008** | -0.008 | 0.008** | 0.008 |
| | | (0.003) | (0.005) | (0.003) | (0.005) |
| Age x M | | -0.000 | -0.001 | 0.000 | 0.001 |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Size x Age | | -0.003*** | 0.003*** | 0.003*** | -0.003*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Size | | 0.010*** | -0.010*** | 0.007*** | -0.007*** |
| | | (0.001) | (0.001) | (0.001) | (0.059) |
| Age | | 0.004*** | 0.001 | -0.004*** | -0.001*** |
| | | (0.001) | (0.001) | (0.001) | (0.083) |
| Return on Assets | | -0.013*** | -0.013*** | -0.013*** | -0.013*** |
| | | (0.001) | (0.001) | (0.001) | (0.001) |
| Relationship | -0.001*** | -0.001*** | -0.001*** | -0.001*** | -0.001*** |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) |
| Constant | 0.077*** | 0.073*** | 0.083*** | 0.077*** | 0.084*** |
| | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| *Lincom:* | | | | | |
| Age x Size x D | | -0.017*** | 0.001 | 0.005 | 0.010** |
| | | (0.004) | (0.005) | (0.005) | (0.004) |
| Age x Size x M | | -0.002 | 0.001** | 0.005*** | -0.005*** |
| | | (0.001) | (0.002) | (0.001) | (0.001) |
| Observations | 669,088 | 669,088 | 669,088 | 669,088 | 669,088 |
| Number of firms | 73,732 | 73,732 | 73,732 | 73,787 | 73,787 |
| Firm Fixed Effects | YES | YES | YES | YES | YES |
| Year x Region | YES | YES | YES | YES | YES |
| Cohort Fixed Effects | YES | YES | YES | YES | YES |

Note: The dependent variable represents the average interest rate for firm *i* in year *t*. The explanatory variables are the direct (D) and municipality treatment (M), which shows share of loans for each firm directly affected by a bank branch closure, and effect on the entire municipality by a closure, respectively. Triple interactions between size, age and treatment are included to measure if the effect is bigger on small and newly established firms. Included for both treatments. Interaction terms between region and year, and cohort fixed effects, are included in all regressions, but excluded from the table. Explanation age- and size dummies: Column 2: Size=1 if large, Age=1 if mature. Column 3: Size=1 if small, Age=1 if mature. Column 4: Size=1 if large. Age=1 if young. Column 5: Size=1 if small, Age=1 if young. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

For the full sample, as illustrated in Column 1, the estimated coefficient for the direct treatment is 0.022, and -0.002 for the municipality treatment, both significant at a 1% level. The overall effect of treatment is thus an increase in average interest rate of 2 percentage points. All subgroups experience an increase in interest rate after a closure, but the effect varies between subgroups.

When using bank branch closures, the linear combinations in Column 2 show that young and small firms receive a 1.5 percentage points higher interest rate increase relative to mature and large firms. The difference is significant at a 1% level. This is consistent with what we observe in Column 5, where mature and large firms receive an overall increase of 1.5 percentage points. However, the municipality treatment is not significant. Column 3 and 4 indicates that the effect of bank branch closures is greatest for young firms.

We observe several similarities between Table 3 and Table 6. First, the regressions show that age explains most of the differences between subgroups. This becomes clear when we compare the effect of direct treatment in Column 2 and 3, where the firms are young, relative to Column 4 and 5 where the firms are mature. Second, the linear combinations are significant when comparing young and small firms to mature and large firms.

Overall, our robustness test suggests that small and newly established firms are hit harder by a bank branch closure, similar to what we observe in our main regression. However, even though the effect is stronger in our robustness test, the difference between small and young firms relative to mature and large firms is less salient.

### 7.2.3 The Effect of Bank Branch Closures on Firms' Growth

**Table 7:** Two-way fixed effects regression with bank branch closures as treatment

| Variables | (1) Full | (2) Young and Small | (3) Young and Large | (4) Mature and Small | (5) Mature and Large |
|---|---|---|---|---|---|
| Direct treatment | 0.346*** | 0.179* | 0.147 | 0.022 | 0.746*** |
| | (0.111) | (0.097) | (0.343) | (0.092) | (0.286) |
| Municipality treatment | -0.122*** | -0.072 | -0.006 | 0.047 | -0.386*** |
| | (0.043) | (0.054) | (0.164) | (0.037) | (0.093) |
| Age x Size x D | | 0.757* | -0.757* | -0.757* | 0.757* |
| | | (0.451) | (0.451) | (0.451) | (0.451) |
| Age x Size x M | | -0.499*** | 0.499*** | 0.499*** | -0.499*** |
| | | (0.185) | (0.185) | (0.185) | (0.185) |
| Size x D | | -0.033 | 0.033 | 0.724** | -0.724** |
| | | (0.356) | (0.356) | (0.291) | (0.291) |
| Size x M | | 0.066 | -0.066 | -0.433*** | 0.433*** |
| | | (0.166) | (0.166) | (0.091) | (0.091) |
| Age x D | | -0.158 | 0.599 | 0.158 | -0.599 |
| | | (0.123) | (0.439) | (0.123) | (0.439) |
| Age x M | | 0.119* | -0.380** | -0.119** | 0.380* |
| | | (0.051) | (0.183) | (0.051) | (0.183) |
| Size x Age | | -0.861*** | 0.861*** | 0.861*** | -0.861** |
| | | (0.077) | (0.077) | (0.077) | (0.085) |
| Size | | 3.480*** | -3.480*** | 2.619*** | -2.619*** |
| | | (0.075) | (0.075) | (0.056) | (0.056) |
| Age | | -0.032 | -0.893*** | 0.032 | 0.893*** |
| | | (0.027) | (0.074) | (0.032) | (0.074) |
| Return on Assets | | 0.317*** | 0.317*** | 0.317*** | 0.317*** |
| | | (0.058) | (0.058) | (0.058) | (0.058) |
| Relationship | -0.010 | -0.006 | -0.006 | -0.006 | -0.006 |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| Constant | 0.327 | -1.048 | 2.433*** | -1.080 | 1.539** |
| | (0.710) | (0.671) | (0.672) | (0.669) | (0.671) |
| *Lincom:* | | | | | |
| Age x Size x D | | -0.295 | 0.736** | 0.986*** | -1.427*** |
| | | (0.315) | (0.353) | (0.369) | (0.310) |
| Age x Size x M | | -1.175*** | 0.914*** | 0.808*** | -0.547*** |
| | | (0.120) | (0.203) | (0.154) | (0.143) |
| Observations | 669,088 | 669,088 | 669,088 | 669,088 | 669,088 |
| Number of firms | 73,732 | 73,732 | 73,732 | 73,787 | 73,787 |
| Firm Fixed Effects | YES | YES | YES | YES | YES |
| Year x Region | YES | YES | YES | YES | YES |
| Cohort Fixed Effects | YES | YES | YES | YES | YES |

Note: The dependent variable represents the growth for firm *i* in year *t*. The explanatory variables are the direct (D) and municipality treatment (M), which shows share of loans for each firm directly affected by a bank branch closure, and effect on the entire municipality by a closure, respectively. Triple interactions between size, age and treatment are included to measure if the effect is bigger on small and newly established firms. Included for both treatments. Interaction terms between region and year, and cohort fixed effects, are included in all regressions, but excluded from the table. Explanation age- and size dummies: Column 2: Size=1 if large, Age=1 if mature. Column 3: Size=1 if small, Age=1 if mature. Column 4: Size=1 if large. Age=1 if young. Column 5: Size=1 if small, Age=1 if young.
Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

For the full sample, presented in Column 1, the estimated coefficient for direct treatment is 0.346, and -0.122 for the municipality treatment, both significant at a 1% level. The overall effect of treatment is thus an increase in growth of 0.224. We do however note that the constant is not significant, and the standard error is high. This suggests that there are substantial differences in growth between subgroups, as we observed in our main analysis. The significance of treatment varies greatly among subgroups, for both direct and municipality treatment.

For young and small firms, the estimated coefficient is 0.179, significant at a 10% level. The linear combination in Column 2 is not significant, but suggests a lower growth for mature and large firms. However, this does not coincide with what we observe in Column 5, where the estimated coefficient is 0.746, significant at a 1% level. The linear combination in Column 5 is significant, and suggests that the overall effect for young and small firms should be 1.974 lower than for mature and large firms. The estimated coefficients for treatments is not significant in either Column 3 or 4. The interaction between direct treatment and size in Column 4 does however suggest that there is a difference between small and large firms if the firm is mature.

Much like in our main analysis, the results are inconclusive for growth. Bank branch closures seem to cause an increase in growth for all subgroups. In our main analysis, treatment led to negative growth, while they in our robustness test is positive. These results suggest that bank branch closures do not have a significant impact on firms' growth.

# 8. Sources of Divergence

Several factors can cause divergence from the literature, and our hypotheses. First, the underlying market structure within a country is likely to affect how firms respond to a bank branch closure, or a bank withdrawal. Factors such as market concentration, a bank's portfolio and how the banks operate, will be important. We will in the following address some of the possible sources of divergence from our initial hypothesis and the current literature on the topic.

## 8.1 The Norwegian Banking Sector

Relationship lending is said to reduce problems of asymmetric information for banks, and possibly generate positive effects for SMEs, such as lower interest payments (Kysucky & Norden, 2016). However, the dependence of relationship lending may be contingent on a bank's size. Larger institutions can take advantage of economies of scale, and thereby evade issues of asymmetric information (Berger & Udell, 2006). This is important, since a large share of the Norwegian market in corporate lending is contributed to a few large banks.

The Norwegian banking market is characterized by a high market concentration, and the level of concentration is somewhat higher than the EU average. Mergers between large banks, like DNB and Gjensidige NOR in 2003, increased the concentration, and our sample period is characterized by multiple small, and larger, mergers. Berger and Udell (2006) find that the importance of the bank-borrower relationship is greatest for smaller banks. We do have a lot of small, local, savings banks in Norway, but a large share have merged or joined alliances, thereby enabling economies of scale. In our analysis, we do not differentiate between banks; we look at the effect of bank withdrawals, regardless of bank type or size. This means that bank withdrawals imposed by DNB, the largest bank in Norway, and withdrawals conducted by smaller savings banks, are equally treated.

Kim et al. (2003) find that banks may create a lock-in effect for firms, which can create value for both firm and bank. However, they find that for larger banks, this lock-in effect only contributes with 1 percent of a banks added value, relative to 32 percent for smaller banks. This supports the findings of Berger and Udell (2006), that the effect of a bank-customer relationship is strongest for smaller banks, in our case the smaller savings banks.

Most studies conducted on the importance of relationship lending uses data from American banks and firms. However, it is important to keep in mind that differences in market structure may also impact the effect a relationship will have. The banking sector in Norway is small relative to many other countries (Ulltveit-Moe, Grindaker, & Skancke, 2013). Numerous studies have been conducted to map the efficiency of the Norwegian, and especially Nordic, banks (Berg, Førsund, Hjalmarsson, & Suominen, 1993; Knutsen & Lie, 2010; Nyland & Fondevik, 2016). They find that Norwegian banks have grown significantly over the last decades, been cost efficient, and profitable. The robustness of the Norwegian banking sector may play an important role on the effects of relationship lending. The efficiency may entail that relationship lending is a less important lending technique for Norwegian banks.

The Norwegian banking sectors robustness, efficiency and the high concentration level around the largest banks, all suggest that the effects of bank branch closures may not be as great as thos found in similar studies. The Herfindahl-index, a measure of market concentration (Wilko & Humphrey, 2017), show that the Norwegian banking market has a much higher concentration level than e.g. our Nordic neighbours, and the US (The World Bank, 2018). The average HHI concentration in our sample period is 0.093 for Norway, while for Denmark, Sweden and US the average is 0.066, 0.046 and 0.065 respectively. Consequently, it is possible that the effect would be different in more low-concentrated markets such as Sweden or Denmark.

## 8.2 The Bank-Borrower Relationship

In addition to the more prominent potential sources of divergence, such as market structure, there may be other factors that can affect our results. One important factor is that we lack sufficient information to differentiate between branches that serve business customers, and those who do not. Consequently, we also measure closures for branches that do not provide services for corporate customers. For instance, Nordea, the second largest bank in Norway, only have two branches for corporate customers in 2018. If you want to talk to an advisor, you can schedule a video conference online (Nordea, 2018).

One important reasoning behind our analysis is that the bank-borrower relationship will be affected when a branch closes. However, we also need to question the foundation for the bank-borrower relationship. First, relationship lending is contingent on soft information, which is often collected by the personnel in the local bank branch. But what happens to the personnel,

and the information, after a branch closes? It is likely that some of the personnel will be kept within the bank, for instance working in a neighbouring municipality. However, by introducing regional withdrawals, which are based on workforce-flow, we believe we have eliminated some of the implications associated with keeping the soft information, and thereby the relationship, within the bank.

Some employments will also be terminated, and it is possible that customers will follow their personal link. This way, if the personnel seek employment in a competing bank, the relationship can be transferred. Thus, the effect may not be as strong, since the relationship is maintained through the connection to the employee, and not the branch itself. Since we only measure if a firm experience a closure, we will not be able to measure the difference in effects if a firm stays with the same bank, or if they switch banks.

# 9. Concluding Remarks

In this study, we aimed to provide empirical evidence on the topic of relationship lending, by analysing if small and newly established firms are hit harder by a regional bank withdrawal. We used comprehensive datasets provided by SNF and Skatteetaten, with information of Norwegian firms' accounting data and the loans provided by banks. This enabled us to analyse the relationship between 124 Norwegian banks and 73,787 firms. Several studies have been conducted on the Norwegian banking market, but to our knowledge, none have measured if small and newly established firms are hit harder by the loss of the physical relationship to their main bank.

To answer our research question, we performed an empirical analysis, by using linear regressions. With a difference-in-difference approach, we measured how a firm is affected by a bank withdrawing from a region. This allowed us to compare firms that are customers to a withdrawing bank, as opposed to other firms in the same region. We measured impact on three different variables; debt ratio, average interest rate and growth. We find that the strongest impact of the loss of bank proximity, or the physical relationship, is for variables directly connected to the bank-borrower relationship. The most salient effect is the increase in average interest rate, while the causes of the effect on debt ratio is more inconclusive. We find that small and newly established firms are in fact hit harder, however, this is not the case for all variables.

In contrast to the findings of Bonfim et.al. (2017), we find that the average interest rate for small and newly established firms increases by 2 percentage points for customers of a withdrawing bank. Our intensity level suggests that firms with multiple bank-relationships have a lower effect of a withdrawal. Relative to mature and large firms, small and newly established firms receive a substantially greater increase in interest rate. For mature and large firms, we find no significant evidence of an increase. However, we find that age is the most important explanation for the effect. Young firms experience the highest increase in interest rate, while size seem to be less important. This could suggest that young firms do in fact obtain better conditions because of their bank-relationships, and that the loss of this relationship will force them to accept higher interest rates. The robustness analysis shows similar results, but the difference between small and newly established firms and large and mature firms is less salient.

The overall effect of a withdrawal suggests a decrease in debt ratio for customers of the withdrawing bank. Small and newly established firms have a 0.013 lower decrease than mature and large firms, and the difference is caused by changes in both age and size. The decrease in debt ratio could be caused by decreased access to credit, but it could also relate to a decrease in demand. However, our robustness analysis, where we analyse bank branch closures, show a contradictory result. In this case, the debt ratio increases. Small and newly established firms have a higher increase, and the cause is also more obvious, size is the most important factor.

The results of our analysis of a firm's growth lack significant findings. We observe that large firms typically have a stronger growth than other firms, but we cannot draw conclusions to whether the subgroups suffer adverse effects of a bank withdrawal. Based on our findings for average interest rate and debt ratio, one would assume that firms could be affected in terms of growth. However, this might indicate that firms are able to withstand, and adjust to, the increased interest payments. The robustness analysis gives the same, inconclusive, results. In other words, we do not find that the loss of a physical bank-relationship impacts a firm's growth.

Our analysis is based on a dataset from 1997-2013. However, the digitalization of the banking sector we have observed in recent years is likely to affect the importance of a physical bank-relationship. Thus, it would be interesting to conduct a similar study on more recent observations.

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# Appendix 1: Economic Regions

| Regions: | Observations: | In pct: | Sum loans in MNOK: | In pct: | ALV [3] |
|---|---|---|---|---|---|
| Sør-Østfold: 11 | 28 419 | 4 % | 96 002 | 4.0 % | 3 378 083 |
| Vestfold: 13 | 43 687 | 7 % | 108 996 | 4.6 % | 2 494 928 |
| Kongsberg: 14 | 6 013 | 1 % | 13 711 | 0.6 % | 2 280 191 |
| Hallingdal: 15 | 5 807 | 1 % | 15 437 | 0.6 % | 2 658 333 |
| Valdres: 21 | 4 182 | 1 % | 8 193 | 0.3 % | 1 959 174 |
| Gudbrandsdalen: 22 | 6 626 | 1 % | 10 106 | 0.4 % | 1 525 184 |
| Lillehammer: 23 | 6 607 | 1 % | 17 917 | 0.8 % | 2 711 884 |
| Gjøvik: 24 | 11 161 | 2 % | 40 743 | 1.7 % | 3 650 472 |
| Hamar: 25 | 13 994 | 2 % | 45 503 | 1.9 % | 3 251 598 |
| Kongsvinger: 26 | 8 591 | 1 % | 15 300 | 0.6 % | 1 780 886 |
| Elverum: 27 | 6 775 | 1 % | 13 672 | 0.6 % | 2 017 981 |
| Tynset/Røros: 28 | 4 351 | 1 % | 10 702 | 0.4 % | 2 459 752 |
| Nordvest-Telemark: 31 | 5 235 | 1 % | 8 094 | 0.3 % | 1 546 215 |
| Øst-Telemark: 32 | 5 211 | 1 % | 9 903 | 0.4 % | 1 900 495 |
| Sør-Telemark: 33 | 21 254 | 3 % | 53 728 | 2.3 % | 2 527 901 |
| Arendal: 34 | 16 096 | 3 % | 52 075 | 2.2 % | 3 235 278 |
| Kristiansand: 35 | 30 641 | 5 % | 85 932 | 3.6 % | 2 804 484 |
| Lister: 36 | 7 311 | 1 % | 20 480 | 0.9 % | 2 801 325 |
| Stavanger: 41 | 54 296 | 8 % | 228 873 | 9.6 % | 4 215 274 |
| Haugesund: 42 | 20 291 | 3 % | 102 617 | 4.3 % | 5 057 262 |
| Sunnhordland: 43 | 9 004 | 1 % | 39 253 | 1.6 % | 4 359 500 |
| Bergen: 44 | 73 701 | 11 % | 381 547 | 16.0 % | 5 176 962 |
| Sunnfjord: 51 | 9 906 | 2 % | 38 236 | 1.6 % | 3 859 833 |
| Sognefjord: 52 | 5 230 | 1 % | 13 474 | 0.6 % | 2 576 283 |
| Nordfjord: 53 | 8 789 | 1 % | 33 896 | 1.4 % | 3 856 665 |
| Søndre Sunnmøre: 54 | 10 893 | 2 % | 69 469 | 2.9 % | 6 377 410 |
| Ålesund: 55 | 22 637 | 4 % | 160 583 | 6.7 % | 7 093 815 |
| Molde: 56 | 14 153 | 2 % | 64 319 | 2.7 % | 4 544 571 |
| Nordmøre: 57 | 3 949 | 1 % | 12 685 | 0.5 % | 3 212 094 |
| Kristiansund: 58 | 7 781 | 1 % | 28 593 | 1.2 % | 3 674 709 |
| Trondheim: 61 | 52 622 | 8 % | 198 819 | 8.3 % | 3 778 256 |
| Midt-Trøndelag: 62 | 12 133 | 2 % | 22 106 | 0.9 % | 1 821 979 |
| Namsos: 63 | 8 882 | 1 % | 22 091 | 0.9 % | 2 487 202 |
| Ytre Helgeland: 64 | 5 428 | 1 % | 21 956 | 0.9 % | 4 044 873 |
| Indre Helgeland: 65 | 8 715 | 1 % | 19 739 | 0.8 % | 2 264 956 |

[3] ALV: Average loan volume

| | Observations: | In pct: | Sum loans in MNOK: | In pct: | ALV |
|---|---|---|---|---|---|
| Bodø: 71 | 14 636 | 2 % | 65 613 | 2.8 % | 4 482 954 |
| Narvik: 72 | 5 488 | 1 % | 30 181 | 1.3 % | 5 499 535 |
| Vesterålen: 73 | 7 713 | 1 % | 28 629 | 1.2 % | 3 711 748 |
| Lofoten: 74 | 6 577 | 1 % | 23 292 | 1.0 % | 3 541 405 |
| Harstad: 75 | 6 444 | 1 % | 17 127 | 0.7 % | 2 657 841 |
| Midt-Troms: 76 | 6 738 | 1 % | 20 426 | 0.9 % | 3 031 462 |
| Tromsø: 77 | 16 259 | 3 % | 72 578 | 3.0 % | 4 463 887 |
| Alta: 81 | 5 125 | 1 % | 10 828 | 0.5 % | 2 112 689 |
| Hammerfest: 82 | 6 347 | 1 % | 17 450 | 0.7 % | 2 749 311 |
| Vadsø: 83 | 5 804 | 1 % | 12 492 | 0.5 % | 2 152 290 |

# Appendix 2: Methodology

Unlike cross-sectional and time-series data, panel data is two-dimensional. This allows us to utilize both cross-sectional and time dimensions in our regression analysis, which is necessary to answer our research question. Even though panel data provides us possibilities not available in cross-sectional or time-series data, it also causes some econometric issues or implications we needed to address to get an accurate portrayal of our results.

### Fixed effects

We wish to measure the impact on bank branch closures over time, and by using panel data, our error term contains a time invariant firm-specific effect in addition to the time- and firm varying component: *i*,

$$t = a_i + u_{i,t}$$

Some firm-specific factors are harder to observe and measure, for example management style or ownership structure. Evidently, they will be a part of the error term. We can measure these effects by using fixed effect estimation. "Within" estimation is the most efficient way to estimate the fixed effect model in our analysis, in comparison to the least squares dummy variable model (LSDV). Since the LSDV-model uses dummies, it is problematic when dealing with a multitude of groups, which we have in our case. If *T* is fixed, and $n \rightarrow \infty$, parameter estimates of the regressors are consistent but the coefficients of individual effects, $a_i + u_{i,t}$, are not (Baltagi, 2013). The "within" estimation does not require dummy variables, but uses deviations from group (or time-period) means:

$$(y_{it} - y_i) = (x - x_i)' + (i_t - i)$$

By using the "within" estimation, the incidental parameter problem is no longer an issue, however, it eliminates all time-invariant variables that do not vary within an entity. We can thus not measure the effect of for example different industries, since these are consistent over the lifespan of a firm.

### Random effects

There is also the question of using random effects estimation, where in contrast to fixed effects estimation, the method can be applied when one can argue that the unobserved factors are uncorrelated with the explanatory variables in all periods. This allows us to estimate the effect of time-invariant independent variables in addition to the time-variation within each individual group. One might thus argue that this method is more efficient, since it utilizes more of the variation in our explanatory variables (Wooldridge, 2014). Even so, the important question when making the choice between fixed- or random effects is whether our independent variables are likely to correlate with the unobserved factors. It is likely that factors as mentioned above will have an impact, and to confirm we conducted a Hausman-test. The Hausman specification test compares fixed and random effect models under the null hypothesis that individual effects are uncorrelated with any regressor in the model (Hausman, 1976). The test makes us certain that we can reject the null hypothesis of no correlation, which implies that the random effects estimator is not consistent.

We therefore feel comfortable with using fixed effects estimation as our estimation method. This coincides with our beliefs that correlation between unobserved factors and the independent variables is eminent, and that it violates the zero-conditional mean assumption of OLS.

## Model diagnostics

When dealing with a panel data, the main issues that may occur is heteroscedasticity and autocorrelation. Errors are generally serially correlated over *t* for a given *i*, and heteroskedastic over *i*.

### Heteroscedasticity and autocorrelation

The third core assumption for OLS says that disturbances have the same variances, i.e. no heteroscedasticity, and not related with one another, i.e. no autocorrelation. In our fixed effect regression, we test for group wise heteroscedasticity, modified for non-normality of the error by using the Wald-test for heteroscedasticity. The result suggests that we reject the null hypothesis of homoscedasticity. In addition, autocorrelation is normally not an issue when dealing with time series under 20-30 years (Torres-Reyna, 2007), but the inclusion of cluster-robust standard errors eliminates the problem of autocorrelation as well as heteroscedasticity. This is thus included in all regressions.

In this paper, we use an empirical approach to provide evidence on the topic of relationship lending, by analysing if small and newly established firms are hit harder by a regional bank withdrawal. We use comprehensive data from the Norwegian banking market, containing information on 127 banks and approximately 70,000 firms. We find that small and newly established firms receive an increase in average interest rate of 2 percentage points after a bank withdrawal. This is 1.7 percentage points higher than for large and mature firms. Small and newly established firms also experience a decrease in debt ratio of 0.027, while the decrease is even more substantial for large and mature firms. Our findings indicate that small and newly established firms are hit harder in terms of increased interest rate, while the decrease in debt ratio could be caused by changes in credit supply or demand. The effects imposed on small and newly established firms do not seem to affect the firms' growth, indicating that firms are able to withstand the increased interest rate.

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