

Credit supply shocks, financial constraints and investments for small and medium-sized firms*

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Abstract

In this paper, we find that reduced credit supply reduces firm investments in our sample of small private firms. The effect is strongest for the *least* financially constrained firms. We use a representative survey of identified Norwegian firms that is linked with financial, bank account and ownership data, and take advantage of the financial crisis in 2008–9 as a natural experiment. We examine several potential explanations for our findings, asking: (i) did the financially constrained firms hedge against potential

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future credit supply shocks? (ii) did they have better access to shareholder funding? or (iii) was the effect driven by past investment patterns? We find that access to shareholder funding during the crisis offset the differences in the effects of reduced credit supply on investments across conventional financial constraint categories. The findings suggest that only examining the correlation between credit supply and investments for the *ex ante* most financially constrained firms during economic downturns is unlikely to capture the full dynamics of the credit channel on the business cycle.

Keywords: Financial constraints, Corporate Investment, Bank credit, Private firms, Financial crisis

JEL Classification: G20, G32.

1 Introduction

The financial crisis of 2008–9 provides a unique opportunity to analyse the importance of credit in financing firms’ fixed asset investments. We use linked survey and register data from Norway to provide a representative, identified sample of mainly unlisted, small and medium-sized firms. We focus on two main questions: (1) Did reductions in credit supply during the crisis affect firms’ investments after controlling for changes in their creditworthiness? (2) At which *ex ante* level of financial constraint is reduced credit supply during the crisis more likely to affect firms’ investments? We use total assets, age, dividend payments and relationships with one or several banks as alternative indicators of financial constraints. In the final section, we investigate hedging, shareholder funding and past investment patterns as possible explanations for the observed variations across levels of financial constraints.

We find that only firms categorized as financially *unconstrained* before the crisis reduced their investments in fixed assets as a result of the reduced credit supply. In comparison, the investments of financially constrained firms were not affected. These findings are robust to alternative indicators of financial constraints. Our results are not explained by hedging or patterns in fixed asset investments. However, when we control for other sources of capital, in the form of funding from shareholders during the crisis or funding accessed by belonging to a business group, reduced access to credit also impacts the investments of those *ex ante* financially constrained firms that did not have access to such sources of capital.

We emphasize a distinction between the *level* and a *change* of financial constraints, which is a distinction that has not been thoroughly studied in the literature. For example, Gertler and Gilchrist (1994) and Duchin, Ozbas, and Sensoy (2010) implicitly make the assumption that more financially constrained firms are more negatively affected by adverse credit shocks, and use the correlations between credit and investments for such firms as evidence of a causal link from financial frictions to real investments. Bernanke, Gertler, and Gilchrist (1996) present a theory model, where the firms with the largest agency problems

receive a relatively lower share of aggregate credit when economic activity deteriorates. However, it is not obvious that more financially constrained firms *ex ante* would be more affected by a negative shock to credit supply when it is taken into account that they were already more constrained before the shock. That is, the *ex ante* most financially constrained firms are not necessarily the marginal borrowers that need to reduce investments most when faced with a credit supply shock.

Our analysis uses firm-level data from Norway. We combine proprietary survey data from a sample of randomly selected, representative firms, the managers of which were asked questions about their experience of the financial crisis of 2008-9, with an extensive dataset containing all Norwegian firms' bank accounts and financial accounts, as well as ownership data. The survey sample firms were selected based on random draws of firms from the complete population of Norwegian firms, which ensured that there was no selection bias in the sampling. In addition, a comparison of firms that responded to the survey with those that were sent surveys but did not respond suggests that there is no material selection bias in the dataset. In contrast to other surveys, the individual identification of the respondents enables the survey answers to be linked to the extensive Norwegian register data that include all private firms.

The survey asks the firms' general managers whether the firm's credit supply *changed* as a result of the financial crisis; that is, it does not ask about their absolute levels of credit supply or the perceived level of financial constraints *before* the crisis. Therefore, we can directly identify changes in credit supply. Note that any observed actual credit granted is determined by the interaction of both supply and demand. As our variable measures the experience of credit supply directly, we limit this simultaneity problem. The credit supply information distinguishes our study from most of the literature, which relies on indirect measures of credit supply obtained from sources such as accounting data. The ability to identify supply directly is particularly useful when analysing the credit market.¹

¹An extensive theoretical literature, starting with Stiglitz and Weiss (1981), has shown that credit supply is not generally a monotonically increasing function of the interest rate. This is because a higher interest rate can increase the riskiness of the pool of firms that apply for bank loans and, thus, it reduces the bank lenders' expected profitability from lending to these firms. In addition, other contract terms, such as collateral, seniority, covenants and maturity, imply that the price of a loan

The financial crisis of 2008–9 did not originate within the Norwegian economy. Instead, it was imported from abroad, primarily through the Norwegian banks' funding in the international interbank markets. The banks' situation was particularly challenging in October 2008, when even the largest Norwegian bank, DnB NOR,² had severe funding problems. At this stage, the Norwegian government decided to increase the banks' access to government bonds in order to improve their liquidity. However, declines in oil prices and global business confidence led to reduced export demand for the products of Norwegian firms, which meant that the crisis was not a pure, exogenous shock to credit supply. Therefore, we need to control for changes in firms' credit quality. We do this by including demand for the firms' products and services, as well as the return on assets, as control variables in our regressions.

When a firm reports reduced access to credit during the financial crisis, its bank may be more reluctant to lend to the firm because the firm's prospects have deteriorated or because the bank's own funding problems have reduced its ability to supply credit to the firm. In the first situation, the reduction in credit supply follows from firms having fewer projects available with positive net present values. This leads to a positive correlation between investments and reported credit supply, even though the causality goes from investments, as a function of investment opportunities, to credit, not the other way. The alternative story is that a *credit channel* exists, whereby the banks' difficulty in obtaining funding reduces their abilities to grant loans (Bernanke and Gertler, 1995). In this situation, a firm may experience reduced access to credit even if its investment opportunities are unchanged. Recent papers by Amiti and Weinstein (2013) and Amador and Nagengast (2016) use Japanese and Portuguese credit data, respectively, to show that credit supply shocks have large impacts on firms' investments at both the firm and the aggregate level. Our survey includes questions about how the demand for the firms' products and services was affected during the crisis. A reduction in demand for a firm's output (sales) is likely to have a negative effect on its

is multidimensional.

²DnB NOR is now called DNB. In 2008, its market share in domestic bank lending was 38%.

creditworthiness. We can use the answers to the output-related survey questions to control for changes in the firms' creditworthiness as a result of reduced demand and, thus, as a proxy for investment opportunities.

The extent to which firms are affected by an exogenous shock to credit supply depends on the firms' reliance on external financing, as well as on their dynamic financing and investment behaviour. In particular, firms that fear their ability to borrow to finance new projects will be reduced in states of the world where they are also experiencing cash flow shortfalls, will want to hedge this risk, for example, by holding more cash *ex ante* (Almeida, Campello, and Weisbach, 2004; Acharya, Almeida, and Campello, 2007) or by avoiding utilizing their financial resources or debt capacity to the limit. Almeida and Campello (2007) find that the cash flow sensitivity of external financing is significant for the subsample of financially unconstrained firms, but not for the subsample of financially constrained firms. An implication of their result is that the firms that must reduce investments during a crisis are those that, in normal periods, use external borrowing whenever a new investment opportunity arises. Our results are consistent with the findings of Almeida and Campello (2007), using a sample of unlisted, smaller firms.

1.1 Related Literature

The impact of bank credit and financial constraints on the real economy has been extensively studied. Claessens and Kose (2018) provides a systematic review of the literature on macrofinancial linkages, including the role of banks. One extensive body of work studies how banks change their lending behaviour following a funding shock. Another strand, to which we contribute, focuses on firms and how reduced access to credit impacts their investments. One extensive body of work studies how banks change their lending behaviour following a funding shock. Another strand, to which we contribute, focuses on firms and how reduced access to credit impacts their investments. An early empirical paper studying the effect of reduced credit on real investments is Gertler and Gilchrist (1994). They find that, following a tightening of monetary policy, both manufacturing activity and bank loans decline for small firms more than they

do for large firms, partly because the larger firms can increase their use of commercial paper debt. Peek and Rosengren (2000) show that loan supply shocks in Japan, which were transmitted to North America through the presence of Japanese banks there, impacted on real economic activity in the USA.

A challenge for early researchers in this field was the lack of detailed data at the level of individual firms. In recent years, increasing access to better quality data, combined with the occurrence of credit market shocks, has produced papers that study credit and financial constraints at the micro level. For instance, Gan (2007) uses the land price collapse in Japan in the early 1990s to investigate how a shock to firms' specific collateral values influences their debt capacity and investments. She finds that firms with greater collateral losses reduced investment more and obtained smaller amounts of credit after the collapse. Chava and Purnanandam (2011) show that borrowers at US banks who were exposed to the Russian default crisis in 1998 suffered reduced valuation and lower performance relative to other firms. Crisis-affected banks reduced the quantity of their lending and increased their interest rates after the crisis compared with unaffected banks. This led to reduced investments in firms that were dependent on banks. More recently, Ongena, Peydro, and van Horen (2015) find that firms that are dependent on internationally funded domestic banks and foreign banks experienced a greater reduction in credit and real performance during the recent financial crisis. Duchin et al. (2010) find that corporate investment declined following the start of the 2008–9 financial crisis. However, as they only observe actual credit volumes during the crisis, they cannot disentangle the effects of supply and demand for financing. In our paper, survey respondents are asked specifically about changes in credit supply and, therefore, we can test more directly the relationship between credit supply and investments. In another paper following the financial crisis, Campello, Graham, and Harvey (2010) survey 1,050 Chief Financial Officers (CFOs) in the USA, Europe and Asia on how credit constraints affected their firms during the 2008 crisis. They show that firms that reported being financially constrained also planned to cut technology, marketing and capital expenditures, and that constrained firms reduced their cash holdings more, drew more on their credit lines and sold assets. Our survey data include

firms' reported changes in credit supply resulting from the crisis. Our key survey question relates to *changes* in credit supply, rather than the *level* of credit supply, resulting from the crisis. Campello, Graham, and Harvey (2010) show that financially constrained firms must restrict investment because of being financially constrained both prior to and during the crisis. However, they do not directly test the effect of *changes* in credit supply on investment arising from the crisis. The effect of financial constraints on the business cycle is driven by the extent to which financial constraints change during the cycle. If financially constrained firms are equally constrained during booms and busts, their access to credit should not have a large effect on the business cycle. By focusing on this question, our paper explores how financing frictions are related to the aggregate business cycle through firms' real investments.

Other papers studying the consequences of the recent financial crisis include Carvalho, Ferreira, and Matos (2015) and Kahle and Stulz (2013). Whereas Carvalho et al. (2015) find a relationship between bank-specific shocks and firm borrowers, Kahle and Stulz (2013) argue that the behaviour of US firms during the crisis is better explained by demand factors than by a credit supply shock. These papers do not study private firms or control for firms' dependency on bank credit. Kuchler (2015) uses a comprehensive dataset on Danish firms and finds that high pre-crisis leverage predicts reduced investments during and following the crisis to a larger degree than does a supply shock alone. We find comparable results for firms that are otherwise categorized as less financially constrained, but not for the most financially constrained firms.

In addition to the previously mentioned contributions of our paper, we add to the knowledge concerning the effects of credit supply to small firms. Most existing studies focus on large, listed firms, whereas almost all firms in our sample are small and unlisted. Such firms constitute a major share of the economy and they have arguably less access to external funding compared with larger, listed firms.

1.2 The Financial Crisis in Norway

The financial crisis of 2008–9 had relatively mild effects on the Norwegian economy compared with the experience of other developed economies (NOU2011:1, 2011). Nevertheless, the financial system experienced problems in October 2008 because of its dependence on the international interbank market. The Norwegian economy was in recession from the third quarter of 2008 to the first quarter of 2009. The fall in GDP for mainland Norway³ from 2008 to 2009 was only about one per cent, compared with around four per cent for the EU and two per cent for the USA. From October 2008 to June 2009, Norges Bank, Norway’s central bank, reduced its key interest rate from 5.75% to 1.25%. This, together with an expansive fiscal policy, probably contributed to the downturn in Norway being relatively mild.

Figure 1 shows the development of the seasonally adjusted log GDP of mainland Norway from 1978 to 2016. The graph shows a clear reduction in GDP during late 2008 and early 2009. The GDP reduction is even more marked than that which occurred during the recession in 1990, which previously had been considered the biggest economic crisis in Norway since the Second World War. Figure 2 shows the results of Norges Bank’s survey of the actual and expected 12-month profitability of Norwegian companies for the years 2003–16. Both actual and expected profits fell monotonically during 2008 and 2009 to record lows.

Taken together, these two figures clearly show a marked turnaround in the business cycle in Norway during 2008 and support our presumption that this period constituted a significant, adverse economic event, providing a suitable experiment for our analysis.

1.3 Structure of the Paper

We structure the paper as follows. Section 2 describes our survey and register data. Section 3 presents our main results for the whole sample and for the sample categorized by financial constraints. In Section

³Mainland Norway GDP excludes the offshore oil and gas activities on the Norwegian continental shelf.

4, we investigate the effects of alternative explanations for our results by categories of financial constraints. Section 5 includes robustness tests, and Section 6 concludes the paper.

2 Data

2.1 Introduction to the Sample and Descriptive Statistics

Norwegian companies and institutions are required to report annual financial information to publicly available, government-operated registers. The registers include a central company registry, a collection of company accounts, commencing in 1987, a central bankruptcy registry and an integrated, online tax reporting structure, with data feeds including, for example, individual bank accounts from all banks and complete shareholder information. The reporting requirements are the same for all public and private incorporated companies. As the data are collected as a legal requirement, and are verified by external auditors, the databases can be considered as complete, reliable and free from selection biases. The unique firm identifier, the organization number that is included in all datasets as well as the responses from the Financial Crisis Survey, enables linking observations from the different sources. The variables used are described in Table 1 and their sources are introduced below.

2.2 The Financial Crisis Survey

2.2.1 Survey sample selection methodology

The financial crisis survey was conducted by the Department of Strategy and Management at the Norwegian School of Economics (NHH) as part of NHH's "Crisis, Restructuring and Growth Project".⁴ The general managers of 5,000 representative Norwegian firms received a letter including access codes to a web-

⁴We are grateful to Lasse Lien and Eirik S. Knudsen at NHH for making these data available to us.

based⁵ questionnaire during the autumn of 2010, asking them about how their firm was influenced by, and how it responded to, the financial crisis. The invitation letter was signed by well-known professors from NHH, including one former government minister. The execution of the survey was handled by Synovate Norway AS,⁶ a leading market research company. The questionnaire took a manager 20–25 minutes to fill in, and included 39 questions, covering the position of the firm and its market before the crisis, how the crisis affected the firm and the market, the firm’s crisis responses and its current outlook. Some of these questions were related to the firm’s business outlook, financing and investments, which are the questions that we study in this paper. The study defined a pre-crisis period from mid-2006 until mid-2008, and the respondents were asked to report when the crisis started and ended with respect to their own firm.

The selected firms were randomly drawn from register data of all Norwegian firms that satisfied the selection criteria. We believe that the ability to choose randomly from the population of all firms reduces selection bias relative to most survey papers. Responses were received from 1,248 firms (a 25% response rate). The selection criteria are revenues greater than NOK 10 million and personnel expenses greater than NOK 3 million in the year 2008.⁷ Only limited liability firms that filed financial accounts for the year 2008 are included. Firms in the following industries are excluded: agriculture, forestry, electricity generation, water management, financial services, insurance, the government sector, education, health care, waste management, political and religious groups, cultural services and international and non-governmental organizations. Firms with missing industry classification were also excluded. The motivation behind these criteria is to select active commercial companies and include a representative share of small and medium-sized companies in the economy. The exclusions based on industry classifications omit from the data pure financial holding companies, regulated firms, sectors with significant government involvement such as

⁵The respondents also had the opportunity to answer by using a paper form.

⁶www.ipsos-mmi.no

⁷Based on the average USD/NOK exchange rate for 2008 of 5.64, the criteria correspond to USD 1.77 million and USD 0.53 million, respectively.

farming and health care, and public services organized as limited companies.

Table 2 compares the characteristics of the firms included in the survey with the population of all Norwegian firms that satisfy the survey sample selection criteria. The summary statistics suggest that the population and survey sample firms are similar in most respects, as measured by mean values of the variables. The survey sample firms are, on average, slightly larger and more profitable and they are more likely to pay a dividend. When it comes to firm characteristics during the crisis, the differences seem slightly larger. This could be partly because the survey sample excludes firms that suffered bankruptcy or otherwise disappeared before the end of 2010. Thus, the survey sample selection procedure created an inherent survivorship bias, illustrated by the fraction of firms that went bankrupt. Of all the Norwegian firms in existence in 2007 that satisfied our sample criteria, 1.6% went bankrupt during 2008–10, whereas our survey sample contains no bankrupt firms. These characteristics are comparable with the survey sample in Campello et al. (2010), the respondents to which were slightly better performing than the average firm in general.⁸ As it is likely that we exclude those firms most severely affected by the crisis, the sample selection method may have a bias against finding firms experiencing distress during the crisis. This will most likely bias the estimated coefficients indicating adverse effects from the crisis towards zero.

The survey questions were collected solely for research purposes and the participants were explicitly promised that their individual responses would be treated confidentially. Norwegian Social Science Data Services⁹ oversaw the handling of sensitive information. The credibility of the sponsoring institution (NHH) and the overall execution of the survey lead us to believe that neither the decision to respond nor the specific answers to survey questions were biased in any particular direction.

⁸It is unlikely that many managers of failed firms would have allocated time to responding to such surveys, even if asked.

⁹www.nsd.uib.no

2.2.2 Answers to survey questions

Survey questions about how firms were affected by the crisis were answered on an integer scale from -3 to $+3$, including zero. Negative numbers indicate a reduction in the respective variable because of the crisis, whereas positive numbers indicate an increase. The respondents necessarily applied the scales subjectively because no precise, quantitative characterizations were given for each step of the scale. In addition, there was a “not relevant” category. The frequencies of each alternative answer to selected questions, which were later used in our regressions, are shown in Table 3.

Around two-thirds of the firms replied that they did not experience significant changes in their access to credit. However, the sample includes many firms that did not borrow before or during the crisis, and whose reported unchanged credit supply may stem from the fact that they did not require debt financing and, thus, did not approach a bank with a loan request during this period. These firms are unlikely to exhibit any correlation between credit supply and investment behaviour. Thus, their presence in the analysis may bias our coefficient estimates towards zero, reducing the likelihood of identifying any effects. We include the non-borrowing firms in our analysis because dropping them would result in the omission of some non-borrowing firms that wanted credit during the crisis, but did not get it, and which therefore report having no bank loans.¹⁰ For this reason, including non-borrowing firms may strengthen our analysis compared with studies that build primarily on data showing actual borrowing by firms.

Most of the firms experienced negative effects on the demand for their products and services as a result of the financial crisis. The descriptive statistics in Table 3 suggest that the crisis in Norway was a crisis of demand. The financial crisis originated abroad and was transmitted to Norwegian firms through reduced demand for products and services, as well as through financial channels such as the global interbank market. Of the survey firms, 68% experienced reduced demand following the crisis, and 45% of the firms experienced

¹⁰Running our analysis on a subsample of only those firms that have had bank loans at some point since 2002 did not alter our results. See Section 5.

reduced prices for their output.

The negative effects on investments were strong, as shown separately for investments into plant, machinery and equipment (PME) and buildings in Figure 3.

2.3 Register Databases

The register databases consist of the bank and financial accounts and a dataset on shareholders and raising of new capital.

2.3.1 Bank database

We use a dataset with detailed information on the end-of-year balances for all bank deposit and bank loan accounts, and for interest accrued to each account during the year, for all Norwegian firms for the years 1997–2015. The bank account data are collected annually by the Norwegian Tax Administration from the banks for tax purposes. The database is confidential, but has been made available to us by the Norwegian Tax Authority¹¹ under strict confidentiality conditions regarding data handling, access and the non-disclosure of the identities of the contracting parties.

2.3.2 Financial account database

The observations in the bank account database are linked via the unique organization number to a financial accounts database, which contains annual accounting data for all Norwegian private and public limited liability companies for the period 1993–2014. Norwegian firms are required to have an authorized auditor¹² and must file their annual financial accounts with the Register of Company Accounts¹³ by the

¹¹Approvals were gratefully received through sequential letters, the most recent of which was dated 23 June 2017.

¹²This requirement was lifted for the smallest firms from 2011. As this is after our sample period, it is unlikely to have any effect on our results.

¹³More information is provided at www.brreg.no.

end of July in the year following the accounting year. The accounting year, with few exceptions, follows the calendar year. The accounting database includes the income statement, the balance sheet, selected items from the notes to the accounts and other company-related information, such as five-digit industry codes and legal forms. The database is further described in Berner, Mjøs, and Olving (2017).

2.3.3 Ownership database

The Norwegian Tax Administration has also made available tax return files related to the ownership of all Norwegian limited companies.¹⁴ This dataset gives us information about ownership and new equity issues as well as firms' debts to shareholders and loans to shareholders.

2.4 Timeline

Figure 4 illustrates the timing of the variables that we use in the analysis. The survey was conducted in the autumn of 2010. The pre-crisis variables are from the year 2007, or the date 31 December 2007. These include most variables that describe firm and bank characteristics. We define the crisis as lasting for the years 2008 and 2009, with 31 December 2009 as the end of the crisis period; see also Section 1.2. For accounting and bank account variables that reflect performance and behaviour during the financial crisis, we use annualized changes in balance sheet variables from 31 December 2007 to 31 December 2009, or average values from the income statements of the firm in 2008 and 2009. Of the firms reporting in the survey that they had been affected by the crisis, 87% were first affected prior to the end of 2009. The remaining 13% were not affected until 2010. It is unclear whether most firms affected by the crisis during late 2008 to early 2009 were still affected during 2010. Therefore, we use end-of-year 2009 as the end of the financial crisis. The Norwegian economy had returned to positive GDP growth well before this date, as is shown in Figure 1.

¹⁴Approval was gratefully received in a letter dated 3 June 2016.

2.5 Descriptive Statistics

Table 2 describes the survey sample. The median firm had NOK 14 million in total assets and NOK 32 million in revenues in 2007.¹⁵ The median age of the firm is 14 years. Thus, the firms are relatively small, yet representative of commercial limited liability firms in Norway. The indicator variable for bank loans shows that about 54% of the firms borrow from a bank. Table 2 also shows that profitability was reduced during the crisis. Whereas the median annual return on assets (ROA) prior to the crisis was 17.6%, during the crisis it was only 12.1%. On average, during the crisis, firms increased their borrowing from banks by 0.5% of 2007 assets, whereas they increased their cash holdings by 1.4% of 2007 assets. The table shows that, whereas 52.9% of the survey sample firms paid ordinary dividends for the accounting year 2007, only 36.4% did so for the years 2008–9.

3 Real Economic Effects of Reduced Credit Supply

We study how changes in credit supply affect firms' real investments using the financial crisis of 2008–9 as an experiment. We employ survey data involving firms' answers to questions about the extent to which they changed real investments as a result of the crisis. We use these investment variables as the left-hand side variables and determine whether they were affected by changes in credit supply. We begin by investigating our first research question: Do changes in credit supply affect firms' investment?

An advantage of our survey data is that firm managers responded to a question asking whether their investments were negatively affected by the crisis. When answering these questions, we expect the manager to implicitly take into account the investment opportunities that the firm had at the time. Although accounting data contain the actual amounts invested, they do not show how large this amount is relative to

¹⁵Based on the average USD/NOK exchange rate of 5.86 in 2007, this is equivalent to USD 2.4 million and USD 5.5 million, respectively.

the firm's original plans or available projects. The earlier literature has struggled to find satisfactory proxy variables for investment opportunities because using actual investments is a poor alternative for this purpose. A firm with a high level of investment may still be investing below its first-best level, whereas a firm with a low investment level may not, when the former has more investment opportunities than the latter. A common approach has been to use the market-to-book ratio, or Tobin's Q , as a proxy for investment opportunities in investment regressions. This approach has been criticized by, among others, Erickson and Whited (2000), who argue that mismeasurement of Tobin's Q leads to biased estimates. As our sample primarily consists of unlisted firms, we do not have information about Tobin's Q . Thus, the fact that the survey questions reflect investment opportunities is particularly useful for our sample of private, small and medium-sized firms.

Changes in the demand for the firms' goods and services can cause changes in investments during the crisis. We use questions about changes in demand faced by the firm as control variables. Therefore, the coefficients on the change in the credit supply variable reflect the marginal effect of a changed credit supply on investments after controlling for the effect of changes in the demand for the firm's goods and services.

3.1 The Effect of Reduced Credit Supply on Investments

Table 4 documents the observed differences between firms that did not face reduced credit supply versus those that did during the financial crisis. We observe that firms with reduced credit supply also faced reduced demand and prices and that they reduced their investments on average. With respect to the other reported characteristics, firms that experienced reduced credit supply were less profitable as measured by ROA, but they do not otherwise appear to be different from the rest of the sample.

Table 5 shows the results of OLS regressions depicting the effect of credit supply and output demand on

firm investments in PME and buildings during the crisis. The dependent variable is the answer to survey questions related to investments, which follow a scale from -3 to $+3$. Answers to survey questions about credit supply and the demand faced by the firm are used to construct the variables on the right-hand side. The credit supply variable is equal to one if the firm reports a reduced credit supply; otherwise, it is equal to zero. The firm demand variables are equal to one in case of negative development and are otherwise equal to zero. Thus, 1 in both variables represents a negative outcome. We estimate the following equation.

$$\begin{aligned}
 \text{Change in investments} &= \beta_0 \text{I_credit supply reduced} \\
 &+ \beta_1 \text{I_output demand reduced} \\
 &+ \beta_2 \text{Return on assets during the crisis} \\
 &+ \beta_3 \text{Constant}
 \end{aligned}$$

A negative coefficient on reduced credit supply implies that this reduction leads to lower investments. Columns (1) and (4) in Table 5 show estimates of β_0 when we exclude the other control variables. The other columns include variables reflecting the change in demand for the firm’s products and services taken from the survey, and the return on assets during the crisis from the firm’s financial accounts. These variables control for changes in the firms’ creditworthiness, as well as the direct impact that changes in the firm’s product markets have on their investments. We use this specification to distinguish between changes in credit availability that stem from changes in the firm’s prospects and expected future ability to service its debts, and changes in credit supply that occur “outside” the firm and originate on the supply side of the credit market.

In columns (1)–(3), the dependent variable is based on the answer to the survey question about how the firm’s investment in PME was affected by the crisis. Columns (2) and (3) include variables that control for the creditworthiness of the firm. Credit supply is positively correlated with this type of investment,

both with and without controlling for firm creditworthiness. That is, a reduction in credit supply reduces investment. The magnitude of the coefficient is smaller when we include the control variables, which is as expected because some of the change in credit availability stems from reduced firm creditworthiness. Using the coefficients in the full specification in column (3), lower credit supply reduces the change in investments score by 0.329. In addition, in columns (2) and (3), we include the return on assets. As expected, the results show that firms that experienced positive changes in cash flow measured by the return on assets during the crisis had a more favourable trend in their investments.

Looking at investment in buildings in columns (4)–(6), we see that the coefficient on credit supply on investments in buildings remains negative when we control for the creditworthiness of the firm, although the effect is weaker in column (6) compared with that for the investments in PME in column (3). This could be related to fewer firms having indicated changes in investments in buildings during the crisis compared with investments in PME, which suggests that such investments may be relevant for a smaller number of firms. Investments in buildings are often larger and occur with a lower frequency compared with investments in PME. Thus, respondents for whom investments in buildings are not relevant may bias this coefficient towards zero to a larger extent than is the case for the PME equation. Finally, investments in buildings provide conventional collateral which itself facilitates debt financing through the *credit multiplier* (see, e.g., Almeida and Campello (2007)). Based on this, we choose to focus our analysis on investments in PME.

Taken together, Table 5 suggests that reductions in credit supply during the financial crisis of 2008–9 caused the firms’ investments to fall. However, adverse developments in the markets for the firms’ goods and services seemed to play a larger role than did changes in credit supply in explaining reductions in firm investment.

3.2 Effects of *ex ante* Financial Constraints on the Effect of Reduced Credit Supply on Investments

Our second research question addresses how the relationship between changes in credit supply and investment in fixed assets is determined by whether a firm may be categorized as financially constrained prior to the crisis. The global financial crisis of 2008–9 was an unexpected event to most firms and even some of the most creditworthy firms were affected. In this situation, it is possible that a sudden reduction in credit supply may have had more severe consequences for firms that were initially financially unconstrained, compared with those that were financially constrained before the crisis. That is, it is not clear from the theoretical literature which group of firms, when categorized by the level of financial constraints before the crisis, would be most affected by a financial crisis that resulted in reduced credit supply. As firms often borrow to fund investments, being affected in this context means that changes in credit supply affected the firms' real investments.

3.2.1 Measures of financial constraints

We apply four univariate measures commonly used in the literature as proxies for the level of a firm's financial constraints. This approach makes the analysis robust to the choice of measure, and independent of any capital market-based variables, compared with several of the multivariate indices of financial constraints used in the literature (see, e.g., Kaplan and Zingales (2000) and Hadlock and Pierce (2010)). Capital market-based variables such as Tobin's Q are not available for most of our sample of primarily unlisted firms. The measures we use are firm total assets before the crisis, firm age, an indicator of whether the firm declared a dividend for the last accounting year before the crisis (2007) and an indicator of whether the firm uses only one or several banks. We sort the sample into two groups for each of these measures and perform the analysis separately within each group.

The use of univariate indicators of financial constraints is preferable in our cross-sectional setting, where we do not have the variables used by the earlier papers, nor a given categorization of financial constraint status from text-based analyses or other sources, to re-estimate the coefficients of any of the multivariate indices of financial constraints. The coefficients of the indices in Kaplan and Zingales (2000) and Hadlock and Pierce (2010) were estimated using a subsample of US publicly listed firms for a given sample period and may not be applicable outside this market setting. Farre-Mensa and Ljungqvist (2016) analyse various measures of financial constraints, but state that private firms and firms close to default may always be deemed constrained. We primarily analyse private firms and how reduced credit supply affects investments within this category of firms depending on the levels of financial constraints before the crisis.

The first measure of financial constraints, firm size, is given by the firm's total assets at the end of 2007. Large firms have more alternative sources when obtaining external finance. For example, they could face lower informational asymmetries and have better opportunities to raise outside funds through the capital markets. For smaller firms, external financing is usually restricted to bank borrowing. The Whited–Wu (WW) index (Whited and Wu, 2006) includes size, measured as the log of total assets, with a negative coefficient, that is, it indicates a negative correlation with financing constraints. The same measure is included with a negative coefficient and also a positive coefficient on squared size in the size–age (SA) index (Hadlock and Pierce, 2010). The literature commonly assumes firm size as a relevant indicator of whether a firm is financially constrained, with smaller firms viewed as more constrained.

The second measure of financial constraints is firm age by the end of 2007, measured as the number of years since incorporation. Younger firms have a shorter documented performance history and are assumed to be more financially constrained than older firms, for which more information tends to be available. In addition, older firms have actually survived for a greater number of years and this could indicate lower risk, which is relevant to credit availability. Hadlock and Pierce (2010) includes firm age, measured in years, with a negative coefficient in explaining financial constraints in its SA index. Petersen and Rajan (1995)

show that access to external finance is more difficult for younger firms than for older firms.

The third measure of financial constraints is based on whether the firm declared a dividend to shareholders for 2007, the last year before the crisis. Although a financially unconstrained firm may or may not pay a dividend, it will usually not be optimal for a financially constrained firm to pay a dividend. By definition, the marginal value to financially constrained firms of keeping an extra krone within the firm is greater than one. Therefore, they prefer to use available funds to finance internal projects rather than paying out a dividend and subsequently having to seek external financing. Thus, dividing firms into categories based on the extent to which they pay dividends has been a common approach in the literature, following the seminal paper by Fazzari, Hubbard, and Petersen (1988) on the cash flow sensitivity of investment. Dividends also carry a negative coefficient, that is, indicating a negative correlation with financing constraints, in the Kaplan and Zingales (KZ) index (Kaplan and Zingales, 2000) and Baker, Stein, and Wurgler (2003)) and WW index (Whited and Wu, 2006).

The fourth measure of financial constraints is an indicator variable that is equal to one if the firm uses several banks and equal to zero if the firm only has bank accounts with a single bank. The data come from the bank database and include both deposit and lending accounts. Petersen and Rajan (1994) find that firms in a close relationship with one bank have easier access to credit. Despite this insight, many firms choose to develop multiple bank relationships. We interpret this choice as an indicator of a firm's relative attractiveness as a bank borrower and, thus, of its negotiating power with banks. A firm that has a relationship with several banks can be assumed to have access to a wider range of credit opportunities and to be less dependent on the credit provided by only one (relationship) bank. In our sample, 49% of the firms use more than one bank, compared with 73% of large, listed Norwegian firms in a survey used in Ongena and Smith (2001).

The extent to which these measures of financial constraints overlap is illustrated in Table 6. The table shows the number of firms that fall into the *least* constrained group of firms for two of the financial constraint

measures, measured on the horizontal and vertical axis. For example, the number of firms that fall into the least constrained group on both the size and the dividend measure is 335. This compares to 623 firms in the least constrained size group. In other words, of the least constrained firms as indicated by the size measure, around 54% are also in the least constrained group as indicated by the dividend measure. The fact that there is heterogeneity in the categorization between measures suggests that we are able to capture various dimensions of firm financial constraints. In addition, it suggests that any findings that appear to be consistent across all or most measures will be more robust.

Table 7 shows summary statistics for alternative indicators of financial constraints and separately reports on each measure for the constrained and unconstrained firm groups. We can see that the level of the pre-crisis cash-to-asset ratio is substantially lower for the large firms. However, the relationship between cash holdings and financial constraints is not straightforward. Profitable firms tend to be financially unconstrained, as well as cash rich, because of their large profits. Unprofitable firms, on the other hand, may strive to be cash rich to reduce their costs of being financially constrained. Therefore, interpreting differences in cash holdings between groups of firms with varying levels of financial constraints is not simple. The largest firms show a lower return on assets but have a larger equity ratio compared with smaller firms. There is no systematic difference in bank borrowing between large and small firms prior to the crisis. The largest firms seem to have been somewhat more affected by the crisis, both in terms of the demand variables and in their supply of credit. The investments in PME and buildings fell more among large firms. Firms do not differ significantly across age in their survey responses. Young firms were naturally smaller in 2007 and they had more bank loans and less equity financing compared with older firms. We observe that dividend-paying firms have more cash than non-dividend payers. This illustrates the above-mentioned endogeneity of cash holdings because a firm will typically hold cash prior to a dividend payment.¹⁶ At the same time, because

¹⁶Firms will usually declare a dividend as part of the annual accounts but only pay it out during the following year. Norwegian firms often pay annual dividends and these have to be confirmed at the annual general meeting within six months of the end of the reporting year. Our variable only considers such ordinary dividends as reported in the annual accounts and, thus, it does not take into account any extraordinary dividends that may be approved during the year.

non-dividend payers are more likely to be financially constrained, they want to hold cash to hedge against future cash flow shortfalls. In the data, the first effect dominates the second. In general, dividend payers also use fewer bank loans and less debt. Firms using more than one bank are somewhat larger and older than firms using only one bank, but these groups are otherwise very similar by accounting-based measures. Overall, across Table 7, the mean crisis survey responses do not show clear systematic differences across the alternative measures of financing constraints. This makes it less likely that any differences found between these groups are driven by a different interpretation of the survey scales by the respondents.

3.2.2 Results when sorting firms according to alternative measures of financing constraints

Table 8 shows OLS regressions using equation 3.1 for investments in PME. The regressions have been run on the subsamples defined by the measures of financial constraints discussed above. Panel A shows the results when we only regress on reduced credit supply. The coefficient on credit supply is significant for investments in PME for all firms, that is, a reduction in credit supply leads to a reduction in investments in PME. However, this specification does not separate between supply effects and any effects from firms' reduced creditworthiness. Panel B shows the results when regressing on reduced output demand and the return on assets during the crisis, but leaving out credit supply. Output demand and the return on assets are valid proxies for firm creditworthiness and are significant in explaining reduced investments for all firms in the sample. In Panel C, we combine all variables and show that, after controlling for firm creditworthiness in terms of output demand and the return on assets, credit supply has a significant effect on investments only for the *ex ante* financially unconstrained firms across all four measures. We find that the investments of the *least* financially constrained firms were most affected by a change in credit supply and this finding is consistent across all four measures of *ex ante* financial constraints. However, the alternative specifications show that these results are only present when we control for the firm's business prospects, proxied by output demand, and performance during the crisis, proxied by the return on assets.

Overall, these results suggest that a correlation between credit supply and investments of *ex ante* financially constrained firms during economic downturns should not be viewed automatically as evidence of a credit channel mechanism.

4 Why Financially Unconstrained Firms Appear to Be More Affected by Reduced Credit Supply

In this section, we investigate three possible explanations of our finding that the investments of financially unconstrained firms are most affected by reduced credit supply. We investigate the effect of any *ex ante* hedging activities, the use of other sources of capital and firms' prior patterns of fixed asset investments.

4.1 Hedging Activity

Firms with limited access to external capital are expected to preserve their internal cash resources, which are normally the main source of financing for investments and short-term liquidity needs. Owing to limited access to new capital, a financially constrained firm is expected to consider, in addition to a conventional investment analysis, the opportunity cost of investing today instead of undertaking potentially better investments in the future.

Duchin et al. (2010) show that firms with low cash reserves and/or high short-term debt prior to the crisis experienced larger declines in investment. The authors interpret this as evidence of a “precautionary savings motive” for cash to insure firms against unexpected liquidity shocks. This is consistent with Almeida et al. (2004), who argue that financially constrained firms save cash to hedge against potential future funding problems. Acharya et al. (2007) create a theoretical model where cash plays an important role in hedging future investment against income shortfalls. Holmberg (2013) uses firm-level data on Swedish public and private firms and finds that firms with low unused credit lines reduced their investments significantly more

compared with other firms during the financial crisis. This supports the argument that some form of hedging matters for the effect of a credit supply shock on firm investments. However, Holmberg (2013) is not able to attribute this effect to a credit supply shock and is necessarily limited to register data information. In a survey of CFOs, Lins, Servaes, and Tufano (2010) find that firms use cash to hedge against future cash flow shortfalls in bad times, whereas credit lines are used for financing business opportunities in good times. Campello, Giambona, Graham, and Harvey (2011) and Campello, Giambona, Graham, and Harvey (2012) show that cash and credit lines are used as substitutes when firms manage liquidity. The findings of both papers show that liquidity management strategies vary across firms and across time.

We study firms' liquid assets, measured as the sum of cash and short-term financial assets relative to assets as of the end of 2007, as an indicator of firms' past hedging activities.

Table 9, Panel A, shows the regressions across alternative measures of financial constraints, controlling for liquid assets and liquid assets interacted with credit supply. Our previous results remain and, in addition, the coefficients for reduced credit supply remain small and largely insignificant for the most financially constrained firms, with the exception of young and small firms. The coefficients on liquid assets are insignificant, except in the cases of dividend payers and firms with more than one bank. For these groups, hedging via liquid assets may compensate for the effect of reduced credit supply on investments. The finding that hedging does not fully explain why the investments of financially constrained firms are not reduced when the credit supply is reduced is consistent with the results of Rampini and Viswanathan (2010). They find that financially constrained firms generally undertake less risk management because of their overall collateral constraints.

Our results indicate a limited role for hedging via liquid assets and suggest that controlling for such hedging does not explain the original result, namely that a reduced credit supply decreases investments for the financially unconstrained firms.

4.2 Other Sources of Capital

An *ex ante* financially constrained firm will have costly and limited access to external financing, both from banks and other outside sources of capital. Therefore, the implication is that such firms depend on internally generated cash or funds from shareholders for investments. We conduct two analyses to test this assumption. First, we analyse whether raising new capital from shareholders during the crisis, either as equity or shareholder loans, could alleviate the impact of reduced credit supply. Second, we study whether being part of a business group and, thus, being majority-owned by a parent company before the crisis, had any impact on how reduced credit supply impacted investments. If a firm belongs to a larger business group, its financing needs could potentially be met by other group companies in an internal capital market, reducing the effect of the individual firm's credit supply on its investments.

We measure new capital from shareholders during the period 2008–9 as the sum of capital raised from new equity issues and changes in the firm's debt to its shareholders (net of any lending *to* shareholders), normalized by total assets.

Table 9, Panel B, shows that controlling for a firm's receipt of new capital from shareholders during the crisis effectively explains any differences in the effects of reduced credit supply between financially constrained and unconstrained firms. This result is robust across all alternative measures. We find that for both financially constrained and unconstrained firms that did not receive new capital from shareholders, reduced credit supply significantly reduces investments. The coefficients on the credit supply/capital from shareholders interaction term vary in size and significance. With the exceptions of firms using multiple banks and firms that did not pay dividends, across all remaining categories, firms that received capital from shareholders did not reduce investments following a reduced credit supply. Table 10 provides an analysis of firms that did not belong to a consolidated group. For small non-group firms, reduced access to credit appears to have had some effect on investments. This indicates that small firms that belong to a

business group are shielded from credit supply shocks to some extent. For non-dividend payers, we see a similar effect. This indicates that lack of parent company support increased the dependency on bank credit for some financially constrained firms.

These results show that access to funding from shareholders generally provided an important financing alternative to bank credit and, thus, alleviated the effect of reduced credit availability on firm investments. Firms that belong to a group appear to be more protected from the impact of reduced credit supply on investments in PME. Our results are consistent with Amador and Nagengast (2016), who find that bank shocks, in particular, impair investments for firms with no access to alternative financing sources.

4.3 Past Investment Patterns

We expect that companies that regularly invest in new fixed assets are more likely to decrease such investments when credit supply is reduced, whereas other firms may invest less frequently and, thus, be less affected by reduced access to credit during a specific time period. Early evidence of the lumpiness of firm investments is provided by Doms and Dunne (1998), who use longitudinal US plant data and find that 25% to 40% of an average plant's cumulative investment over 17 years is concentrated in a single year. Covas and Haan (2011) find a firm-size variation in the cyclicity of both financing and investment, and that smaller firms invest less and undertake less debt financing in an economic downturn. We do not find any significant variation in reported investment activity between more or less financially constrained companies sorted by our financial constraint categories, as shown in Table 7.

Suppose that each firm operates a single machine with a technical lifespan of 10 years and that it will only invest, therefore, in new equipment every 10th year. During a one-year financial crisis, only the investments of 10% of the population of such firms would potentially be affected by a uniform reduction in credit supply. If this is the case, we will find effects of reduced credit supply on investments only for frequent investors,

even when they are *ex ante* financially unconstrained.

We study this explanation by controlling for patterns in fixed asset investments, measured as prior investment frequency. Prior investment frequency is calculated by counting, for the period 2004–7, the number of years when the nominal book value of a firm’s fixed assets changed by no more than $\pm 2.5\%$ from the previous year (adjusted for depreciations, amortizations and impairments). Firms with such stable nominal book asset values may be interpreted as limiting investments to maintain current fixed assets and not investing for growth. We exclude firms that were established after 2004 in this analysis. Firms investing infrequently will get a high value on this measure, that is, they will on average have many years with no significant net investments in fixed assets.

Table 9, Panel C, shows the effect of controlling for the number of no investment years. The positive coefficients on the interaction terms between number of no investment years and reduced credit supply show that reduced credit supply has less effect on investments for firms that invest infrequently. These coefficients are significant in explaining investments for the least financially constrained firms across all measures. In the case of small firms and firms using only one bank, controlling for this variable also results in a reduced credit supply decreasing investments for *ex ante* financially constrained firms that invest frequently.

Overall, these results provide no conclusive evidence regarding the effect of patterns in fixed asset investments on the importance of reduced credit supply for investments. Therefore, there seems to be a more general effect that modifies the effect of reduced credit supply on investments and applies to both financially constrained and unconstrained firms. Thus, the effect of past patterns in fixed asset investments cannot fully explain our findings in Section 3.

5 Robustness

We conduct several robustness analyses.

We obtain similar results when we run the regressions with observations at the firm–bank level (i.e., the individual banking relationship level) rather than the firm level. Running the regressions at the firm–bank level enables us to include bank characteristics as control variables. The inclusion of bank nationality and loan loss provisions as control variables does not alter our main findings.

We run several other robustness tests. First, we leave out all firms without bank loans *ex ante*, to see if non-borrowers drive the results. In one specification, we keep only the firms that borrow from a bank in at least one of the years in the period 2005–7, whereas in another, we drop all firms that do not borrow from a bank in 2007. Our findings largely remain unaltered. However, whether a firm invests (proxied by the past investment patterns) appears to have even less effect when we exclude non-borrowers for the period 2005–7.

Next, we leave out firms that answer *not relevant* to the survey question on reduced credit supply, without any significant effects on our results. Third, we leave out firms in the services industries. Many papers in the literature focus on manufacturing firms and, therefore, we perform this test and confirm that our results remain valid for a more conventional industry sample.

6 Conclusion

In this paper, we show how the investments of unlisted, small and medium-sized firms are affected by changes in credit supply using the financial crisis in 2008–9 as an experiment. We first show that changes in credit supply affect investments in fixed assets after controlling for the firm’s output demand and return on assets during the crisis, even though the effect is reduced when including these firm credit quality control variables. In our second research question, we find that changes in credit supply affect investments in PME to the greatest degree for the *ex ante* least financially constrained firms, categorized by alternative indicators of financial constraints. This effect does not appear to be fully explained by hedging, as our

results largely remain unaltered after controlling for firms' liquid reserves prior to the crisis, or by patterns of fixed asset investment in the past. When we control for a capital injection from shareholders, reduced credit supply has a large and significant effect on investments for all firms, including financially constrained firms. We find that being part of a business group shields a firm's investments from the effect of reduced credit supply to some extent, and that this is particularly the case for the most financially constrained firms. Our findings suggest that focusing exclusively on the correlation between credit supply and the investments of the *ex ante* most financially constrained firms during economic downturns is unlikely to capture the full dynamics of the credit channel on the business cycle. In particular, financially constrained firms' access to shareholder funding suggests that the dynamics of financial constraints and their effects on real investments are more complex than has generally been assumed in the literature.

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A Tables and Figures

Figure 1: Quarterly log GDP of Mainland Norway 1978–2016. Source: Statistics Norway.

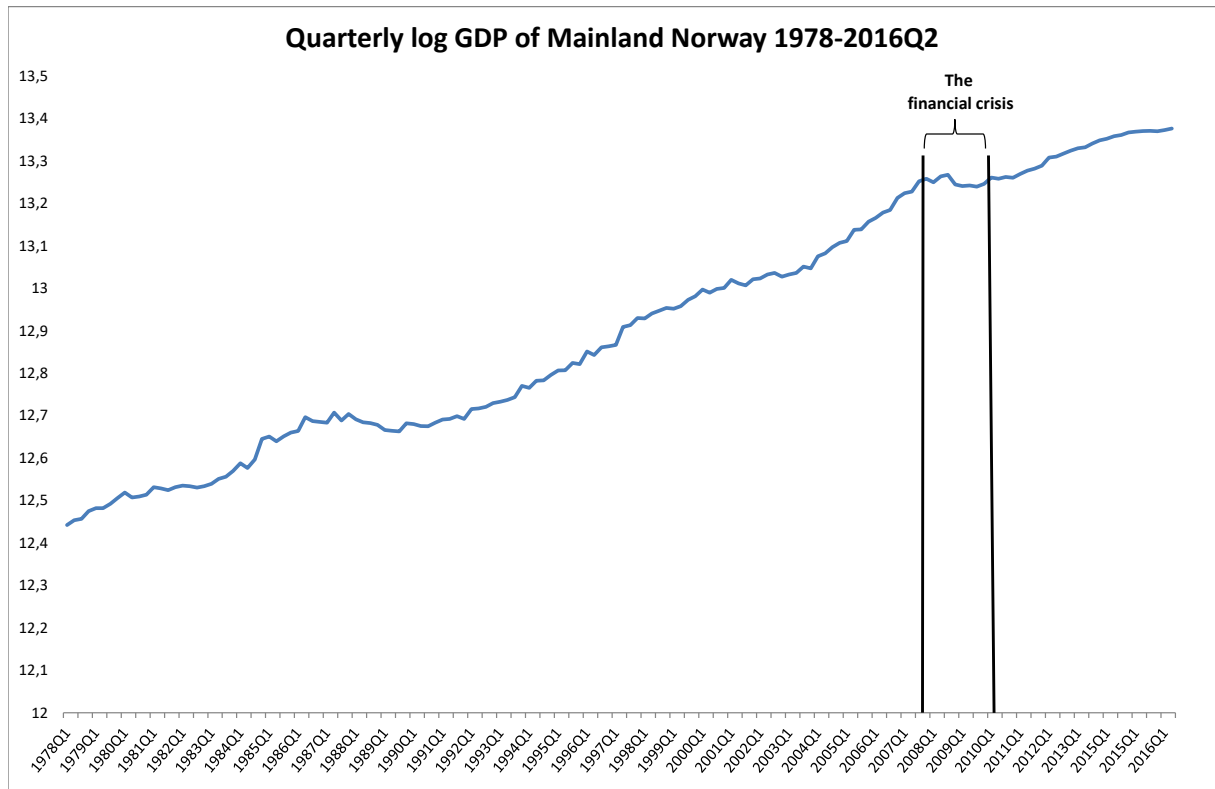


Figure 2: Norwegian companies' 12-month past and expected profitability 2003–16. Survey data. Quarterly and 12-monthly moving averages. Source: Norges Bank's quarterly survey.

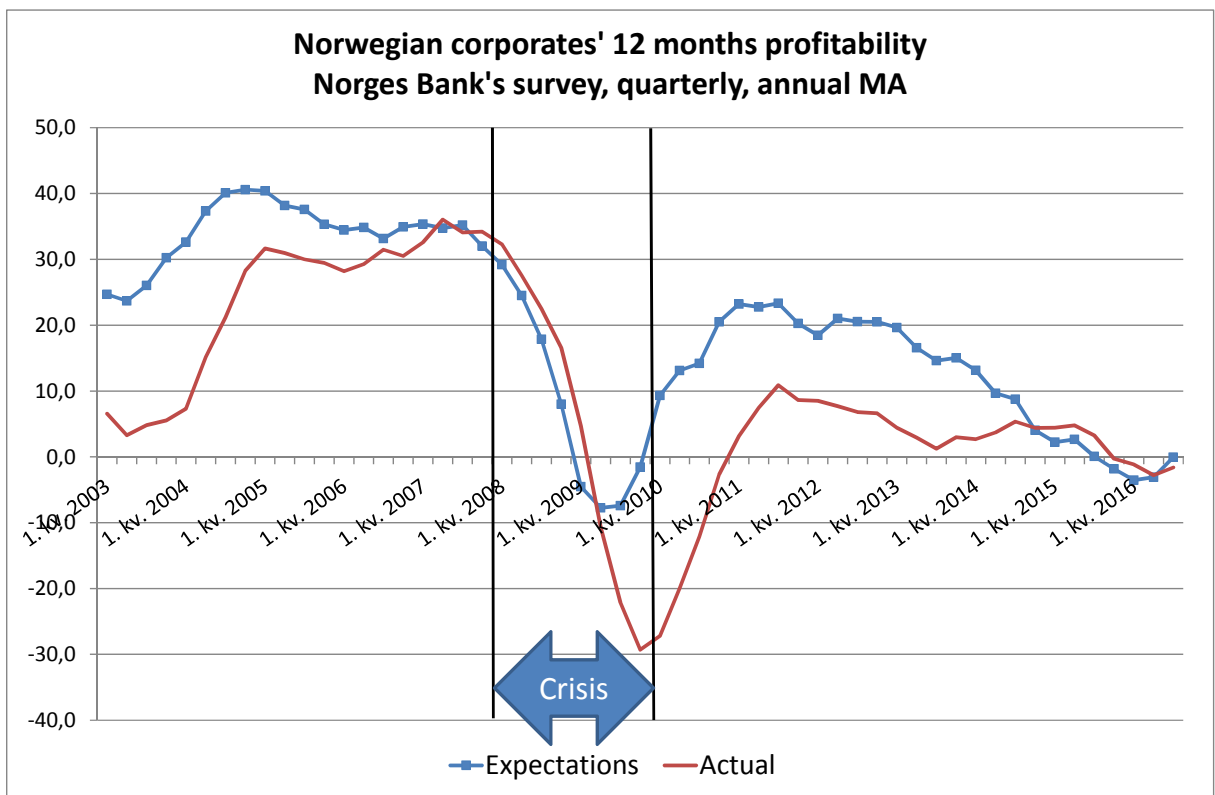


Table 1: Description of variables used.

<i>Pre-crisis firm characteristics</i>	
Log(assets), or assets	Logarithm of firm total assets, or firm total assets
Log(revenues), or revenues	Logarithm of firm revenues, or firm revenues
Firmage	Age of the firm since incorporation, in years
Profitability (ROA)	Earnings before financial costs and taxes (EBIT) divided by total assets
Fixed assets_assets	Fixed assets to total assets ratio
Bank loan indicator	Indicator variable equal to one if the firm has a bank loan (>NOK100,000)
Bank loan_assets	Bank loan divided by total assets
Bank cash_assets	Bank deposit divided by total assets
Dividend indicator	Indicator variable equal to one if firm paid ordinary dividends for the year
No investment years	Number of years with net investments in fixed assets within +/-2.5% of previous year's fixed assets
Liquid assets	Sum of cash and short-term financial assets divided by net assets
<i>Crisis performance comparison</i>	
Profitability (ROA)	2008–9 average of earnings before financial costs and taxes (EBIT) divided by total assets
Δ Cash flow	Average cash flow in 2008 and 2009 minus cash flow in 2007, divided by total assets
Δ Bank loan_assets	Change in bank loan from 2007 to 2009 divided by 2007 assets
Δ Bank cash_assets	Change in bank cash from 2007 to 2009 divided by 2007 assets
Dividend indicator	Average dividend indicator dummy for 2008 and 2009
Bankruptcy frequency	Indicator equal to one if firm went bankrupt during 2008–10
New shareholder funds	Sum of new equity and net increase in debt to shareholders for 2008–9, divided by total assets

Table 2: Survey sample vs. all firms. The table reports the sample mean of the firm characteristics for all firms that satisfy the sample selection criteria, and for the survey sample firms. Crisis performance variables are averages for the years 2008–9. Most variables are normalized by firm assets. The variables are described in Table 1.

	<i>All firms</i>	<i>Survey sample firms</i>
<i>Pre-crisis firm characteristics</i>		
Log(assets)	9.746	9.832
Log(revenues)	10.398	10.585
Firmage	17.592	16.102
Profitability (ROA)	0.177	0.190
Fixed assets_assets	0.176	0.180
Bank loan indicator	0.514	0.538
Bank loan_assets	0.123	0.118
Bank cash_assets	0.192	0.184
Dividend indicator	0.467	0.529
<i>Crisis performance comparison</i>		
Profitability (ROA)	0.099	0.133
Δ Cash flow	-0.070	-0.071
Δ Bank loan_assets	0.011	0.005
Δ Bank cash_assets	0.019	0.014
Dividend indicator	0.345	0.364
Bankruptcy frequency	0.016	0.000
<i>N</i>	21,548	1,189

Table 3: Survey answers to the question: How was the firm affected by the crisis? The table reports the distribution of responses to the survey question about how firms were affected by the financial crisis in 2008–9.

Q: How was your firm affected by the crisis?

	<i>Credit supply</i>		<i>Demand</i>		<i>Prices</i>	
	Frequency	%	Frequency	%	Frequency	%
-3 Reduced	65	5.6%	210	17.9%	72	6.2%
-2	81	7.0%	278	23.8%	178	15.3%
-1	122	10.5%	303	25.9%	275	23.7%
0	631	54.3%	203	17.4%	451	38.8%
1	28	2.4%	42	3.6%	36	3.1%
2	19	1.6%	27	2.3%	43	3.7%
3 Increased	24	2.1%	33	6.3%	9	0.8%
Not relevant	191	16.5%	74	6.3%	97	8.4%

Figure 3: Survey answers to the question: How did the firm change its investments as a result of the crisis? The figure reports the distribution of responses to the survey question about how firms changed investments in PME and buildings because of the financial crisis of 2008–9.

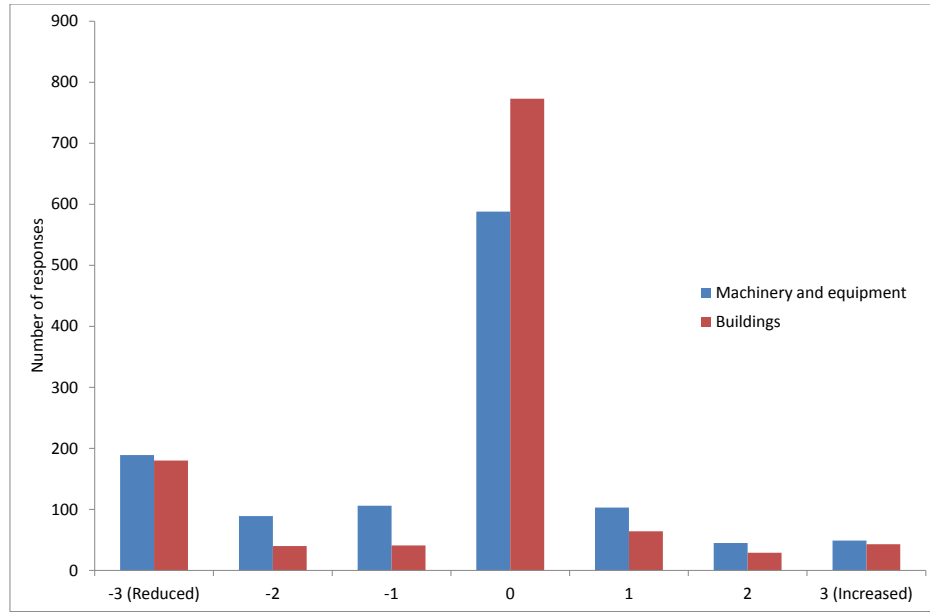


Figure 4: Timeline of data.

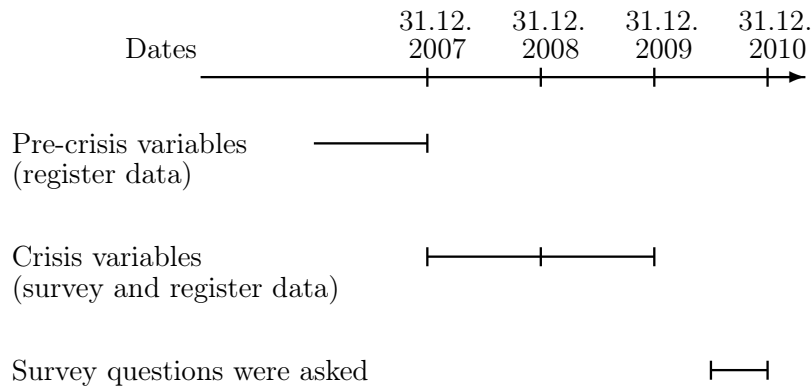


Table 4: Descriptive comparison: Firms with or without reduced access to credit. The table reports the means of the analytically relevant variables separately for firms without reduced access to credit, with reduced access and the whole sample. The variables are described in Table 1.

Variable	No reduction	Reduced access	Sample
<i>Survey responses</i>			
Reduced credit (1/0)	0.000	1.000	0.232
Reduced demand (1/0)	0.628	0.819	0.672
Investments in PME	-0.298	-0.845	-0.424
Investments in buildings	-0.287	-0.548	-0.347
<i>Indicators of financing constraints</i>			
Log(assets)	9.766	10.132	9.851
Firmage	16.21	15.14	15.97
Dividend (1/0)	0.543	0.482	0.529
Multibank (1/0)	0.471	0.572	0.494
<i>Firm characteristics, end of 2007 except ROA</i>			
Log(revenues)	10.560	10.792	10.614
ROA <i>pre-crisis</i>	0.163	0.143	0.158
ROA <i>crisis</i>	0.143	0.085	0.130
ROA <i>post-crisis</i>	0.119	0.091	0.112
Bank loan indicator	0.562	0.670	0.587
Bank loan/assets	0.116	0.154	0.125
Intangible/assets	0.029	0.046	0.033
Current financial assets	0.066	0.076	0.069
Long-term financial assets	0.009	0.011	0.009
Net working capital	0.323	0.399	0.341
Cash/assets	0.334	0.217	0.307
Equity/assets	0.378	0.350	0.372
Interest bearing debt/assets	0.242	0.294	0.254
Other current liabilities	0.357	0.327	0.350
No investment years	1.656	1.337	1.582
New shareholder funds	0.034	0.078	0.045
<i>N</i>	913	276	1,189

Table 5: Firm investments. The table reports OLS regression results. The dependent variables are based on the following: for columns (1)–(3), the answer to the survey question about how the crisis affected the firm’s investment in PME; and for columns (4)–(6), the answer to the survey question about how the crisis affected the firm’s investment in buildings. The dependent variables use a scale of $-3, -2, -1, 0, 1, 2, 3$ or not relevant, where negative numbers indicate a decline in investment and “not relevant” responses are categorized as “0.” The explanatory variables that are based on survey question responses are equal to one if the response indicated a reduction in the variable and zero otherwise. Accounting variables are normalized by the firm’s total assets. The observations are at the firm level. Standard errors are robust to heteroscedasticity. The variables are described in Table 1.

	(1)	(2)	(3)	(4)	(5)	(6)
	Investment in PME			Investment in buildings		
Reduced credit supply	-0.546*** (0.107)		-0.329*** (0.107)	-0.253*** (0.104)		-0.123 (0.107)
Reduced output demand		-0.659*** (0.086)	-0.624*** (0.087)		-0.341*** (0.079)	-0.338*** (0.080)
ROA in crisis		2.190** (0.383)	2.059*** (0.399)		1.351*** (0.350)	1.326*** (0.360)
Constant	3.703** (0.049)	3.734** (0.087)	3.811*** (0.092)	3.714*** (0.044)	3.713*** (0.078)	3.748*** (0.081)
N	1,173	1,173	1,157	1,175	1,174	1,159
R^2	0.024	0.077	0.089	0.006	0.028	0.032

Effects of a discrete change of the dummy variable from zero to one. Marginal effects for continuous variables. Standard errors are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Overlap of financially unconstrained firms between sorting criteria. The table shows the number of sample firms in each financially unconstrained category as indicated by the horizontal and vertical categories. The financially unconstrained groups are the largest firms as measured by total assets, the oldest firms by firm age, the dividend payers, and those with more than one bank relationship.

Categories	Size	Firm age	Dividend payment	Multibank(> 1)
Size	623			
Firm age	333	591		
Dividend payment	335	318	654	
Multibank (> 1)	338	315	329	599

Table 7: Analytical statistics by *ex ante* financial constraint categories. The table reports the means for the sample grouped by total asset, firm age, dividend payment (0/1) and one or multiple banks, as well as the whole sample. The variables are described in Table 1.

Variable	Total assets		Firm age		Dividend		Multibank		Full Sample	
	Small	Large	Young	Old	No	Yes	One	> 1		
<i>Survey responses</i>										
Reduced demand (1/0)	0.611	0.729	0.651	0.691	0.644	0.693	0.658	0.686	0.675	
Reduced prices (1/0)	0.412	0.498	0.450	0.461	0.450	0.460	0.439	0.470	0.455	
Reduced credit (1/0)	0.611	0.729	0.651	0.691	0.644	0.693	0.658	0.686	0.670	
Investments in PME	-0.326	-0.531	-0.449	-0.405	-0.444	-0.414	-0.363	-0.496	-0.428	
Investments in buildings	-0.269	-0.434	-0.370	-0.331	-0.372	-0.333	-0.274	-0.426	-0.351	
<i>Indicators of financing constraints</i>										
Log(assets)	8.913	10.772	9.666	10.036	9.792	9.886	9.590	10.054	9.841	
Firm age	13.62	18.38	7.76	25.15	15.86	16.13	14.73	17.29	15.97	
Dividends (1/0)	0.511	0.538	0.512	0.538	0.000	1.000	0.504	0.549	0.524	
Multibank (1/0)	0.425	0.563	0.445	0.547	0.470	0.515	0.000	1.000	0.495	
<i>Firm characteristics, end of 2007, except ROA</i>										
Log(revenues)	9.895	11.322	10.476	10.755	10.527	10.682	10.416	10.754	10.608	
ROA <i>pre-crisis</i>	0.168	0.149	0.166	0.152	0.119	0.190	0.163	0.155	0.158	
ROA <i>crisis</i>	0.138	0.121	0.134	0.125	0.093	0.163	0.135	0.126	0.130	
ROA <i>post-crisis</i>	0.120	0.104	0.119	0.105	0.091	0.131	0.117	0.108	0.112	
Bank loan/assets	0.123	0.122	0.127	0.118	0.151	0.097	0.489	0.725	0.124	
Intangible/assets	0.020	0.046	0.035	0.031	0.046	0.022	0.034	0.033	0.033	
Tangible/assets	0.265	0.220	0.250	0.224	0.275	0.213	0.220	0.268	0.243	
Long-term financial assets	0.055	0.083	0.058	0.080	0.077	0.061	0.050	0.088	0.009	
Net working capital	0.274	0.406	0.300	0.384	0.314	0.364	0.358	0.310	0.340	
Liquid assets	0.359	0.240	0.321	0.277	0.264	0.333	0.331	0.278	0.306	
Equity/assets	0.335	0.404	0.323	0.420	0.358	0.380	0.404	0.333	0.369	
Int. bearing debt/assets	0.233	0.271	0.259	0.244	0.314	0.197	0.222	0.284	0.255	
Other current liabilities	0.396	0.285	0.373	0.305	0.273	0.402	0.349	0.332	0.352	
No investment years	1.655	1.494	1.441	1.724	1.531	1.615	1.652	1.503	1.575	
New shareholder funds	0.048	0.040	0.047	0.029	0.065	0.024	0.041	0.045	0.044	
Non-group fraction	0.503	0.233	0.387	0.347	0.406	0.333	0.402	0.341	0.371	

Table 8: Effect of credit supply on investments by *ex ante* financial constraints. The table reports OLS regression results, where the sample has been split based on the pre-crisis financial constraints criteria. For total assets, the sample has been split into two halves based on the book value of the firm's assets in 2007. Firms are divided into young and old based on whether the firm age is below or above the sample's median age. For the dividend and multibank categories, the sample has been split based on whether a firm paid dividends for 2007 or had bank accounts at multiple banks at the end of 2007, respectively. The dependent variable is the answer to the survey question about how the crisis affected the firm's investment in PME. The dependent variable uses a scale of -3, -2, -1, 0, 1, 2, 3 or not relevant, where negative numbers indicate a decline in investment and "not relevant" responses are categorized as "0." The explanatory variables that are based on survey question responses are equal to one if the response indicated a decline in the variable, and zero otherwise. Accounting variables are normalized by the firm's total assets. The observations are at the firm level. Standard errors are robust to heteroscedasticity. The variables are described in Table 1.

Variable Categories	Total assets		Firm age		Dividend		Multibank	
	Small	Large	Young	Old	No	Yes	One	> 1
<i>Panel A</i>								
Reduced credit supply	-0.479*** (0.167)	-0.581*** (0.137)	-0.476*** (0.140)	-0.641*** (0.167)	-0.450*** (0.150)	-0.641*** (0.153)	-0.372** (0.161)	-0.668*** (0.144)
Constant	3.791*** (0.067)	3.608*** (0.070)	3.684*** (0.067)	3.722*** (0.071)	3.668*** (0.075)	3.732** (0.064)	3.711*** (0.066)	3.694*** (0.072)
R^2	0.017	0.029	0.020	0.028	0.016	0.032	0.010	0.038
<i>Panel B</i>								
Reduced output demand	-0.711*** (0.120)	-0.558*** (0.124)	-0.689*** (0.115)	-0.633*** (0.130)	-0.751*** (0.126)	-0.550*** (0.118)	-0.629** (0.117)	-0.693*** (0.127)
Return on Assets in Crisis	1.802*** (0.538)	2.574*** (0.536)	2.032*** (0.503)	2.439*** (0.595)	2.236*** (0.616)	2.481** (0.535)	2.631*** (0.533)	1.702*** (0.551)
Constant	3.887*** (0.119)	3.544*** (0.125)	3.731*** (0.116)	3.733*** (0.130)	-3.843*** (0.113)	3.563** (0.137)	3.705*** (0.116)	3.768*** (0.129)
R^2	0.078	0.068	0.084	0.071	0.084	0.073	0.087	0.067
<i>Panel C</i>								
Reduced credit supply	-0.186 (0.164)	-0.446*** (0.139)	-0.218 (0.141)	-0.453*** (0.167)	-0.236 (0.147)	-0.419*** (0.155)	-0.189 (0.154)	-0.459*** (0.151)
Reduced output demand	-0.702*** (0.120)	-0.504*** (0.126)	-0.658*** (0.117)	-0.606*** (0.130)	-0.740*** (0.126)	-0.492*** (0.121)	-0.613** (0.118)	-0.635*** (0.129)
Return on Assets in Crisis	1.863*** (0.562)	2.253*** (0.560)	2.014*** (0.523)	2.172*** (0.627)	2.315*** (0.630)	2.214** (0.561)	2.631*** (0.548)	1.371*** (0.587)
Constant	3.921*** (0.127)	3.662*** (0.132)	3.777*** (0.124)	3.845*** (0.138)	3.899*** (0.121)	3.660** (0.143)	3.738*** (0.122)	3.902*** (0.138)
R^2	0.090	0.084	0.094	0.086	0.098	0.087	0.092	0.089

Effects of a discrete change of dummy variable from zero to one. Marginal effects for continuous variables. Standard errors are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Effect of credit supply on investments by *ex ante* financial constraints and additional explanatory variables. The table reports OLS regression results, where the sample has been split based on pre-crisis financial constraints criteria. For the total assets category, the sample has been split in two halves based on the book value of the firm's assets in 2007. Firms are split into young and old based on whether the firm age is below or above the sample's median age. For the dividend and multibank categories, the sample has been split based on whether a firm paid dividends for 2007 and whether it had bank accounts at multiple banks at the end of 2007, respectively. The dependent variable is the answer to the survey question about how the crisis affected the firm's investment in PME. The dependent variable uses a scale of -3, -2, -1, 0, 1, 2, 3 or not relevant, where negative numbers indicate a decline in investment and "not relevant" responses are categorized as "0." The explanatory variables that are based on survey question responses are equal to one if the response indicated a decline in the variable, and zero otherwise. Liquid assets are calculated as the pre-crisis ratio of (cash + other short-term marketable securities) / net assets. New shareholder funds measure the ratio of new funding from shareholders during the crisis to the pre-crisis total assets. The variable No investment years is equal to the number of years during the period 2005-7 in which a firm did not change its fixed assets by more than +/-2.5% of total assets. Accounting variables are normalized by the firm's total assets. The observations are at the firm level. Standard errors are robust to heteroscedasticity. The variables are described in Table 1.

Variable Categories	Total Assets		Firm age		Dividend		Multibank	
	Small	Large	Young	Old	No	Yes	One	> 1
<i>Panel A: Hedging using liquid assets</i>								
Reduced credit supply	-0.446* (0.245)	-0.564*** (0.181)	-0.417** (0.196)	-0.665*** (0.223)	-0.252 (0.201)	-0.818*** (0.215)	-0.218 (0.226)	-0.790*** (0.193)
Liquid assets	-0.237 (0.234)	-0.099 (0.229)	-0.184 (0.219)	-0.044 (0.249)	0.154 (0.252)	-0.308 (0.216)	0.097 (0.210)	-0.428 (0.261)
Liquid assets X Reduced credit supply	0.837 (0.585)	0.626 (0.587)	0.723 (0.505)	1.069 (0.715)	0.167 (0.646)	1.394*** (0.537)	0.143 (0.637)	1.440*** (0.542)
Reduced output demand	-0.706*** (0.119)	-0.507*** (0.126)	-0.656*** (0.117)	-0.616*** (0.130)	-0.735*** (0.126)	-0.504*** (0.120)	-0.608*** (0.118)	-0.654*** (0.129)
Return on Assets in Crisis	1.908*** (0.578)	2.231*** (0.571)	2.023*** (0.527)	2.113*** (0.652)	2.273*** (0.631)	2.273** (0.582)	2.578*** (0.559)	1.465** (0.602)
Constant	4.008*** (0.148)	3.694*** (0.144)	3.840*** (0.146)	3.873*** (0.149)	3.855*** (0.150)	-3.768*** (0.149)	3.708*** (0.142)	4.032*** (0.151)
R^2	0.094	0.085	0.098	0.090	0.099	0.098	0.093	0.101
<i>Panel B: New funding from shareholders</i>								
Reduced credit supply	-0.348* (0.172)	-0.530*** (0.147)	-0.372* (0.144)	-0.556*** (0.179)	-0.340* (0.154)	-0.569*** (0.162)	-0.384* (0.157)	-0.530*** (0.161)
New shareholders' funds	-0.308 (0.226)	-0.251 (0.221)	-0.431* (0.222)	-0.105 (0.223)	-0.144 (0.218)	-0.448* (0.230)	-0.328 (0.203)	-0.229 (0.248)
New shareholder funds X Reduced credit supply	0.946** (0.461)	0.886** (0.411)	1.151** (0.457)	0.773* (0.438)	0.687 (0.435)	1.336*** (0.477)	1.219*** (0.460)	-0.648 (0.427)
Reduced output demand	-0.697*** (0.120)	-0.511*** (0.127)	-0.660*** (0.117)	-0.605*** (0.131)	-0.745*** (0.126)	-0.488*** (0.121)	-0.619*** (0.118)	-0.635*** (0.130)
Return on Assets in Crisis	1.840*** (0.562)	2.230*** (0.567)	1.944*** (0.525)	2.199*** (0.632)	2.327*** (0.633)	2.161*** (0.559)	2.607*** (0.547)	1.361** (0.594)
Constant	3.958*** (0.126)	3.698*** (0.136)	3.841*** (0.124)	3.851*** (0.141)	3.920*** (0.124)	3.710** (0.142)	3.783*** (0.122)	3.928*** (0.142)
R^2	0.099	0.089	0.108	0.091	0.103	0.101	0.107	0.093

Effects of a discrete change of the dummy variable from zero to one. Marginal effects for continuous variables. Standard errors are presented in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effect of credit supply on investments by *ex ante* financial constraints and additional explanatory variables. (Continued) The table reports OLS regression results, where the sample has been split based on pre-crisis financial constraints criteria. For total assets, the sample has been split into two halves based on the book value of the firm's assets in 2007. Firms are divided into young and old categories based on whether the firm age is below or above the sample's median age. For the dividend and multibank categories, the sample has been split based on whether a firm paid dividends for 2007 or had bank accounts at multiple banks at the end of 2007, respectively. The dependent variable is the answer to the survey question about how the crisis affected the firm's investment in PME. The dependent variable uses a scale of -3, -2, -1, 0, 1, 2, 3 or not relevant, where negative numbers indicate a decline in investment and "not relevant" responses are categorized as "0." The explanatory variables that are based on survey question responses are equal to one if the response indicated a decline in the variable, and zero otherwise. Liquid assets are calculated as the pre-crisis ratio of (cash + other short-term marketable securities) / net assets [def.]. Accounting variables are normalized by the firm's total assets. The observations are at the firm level. Standard errors are robust to heteroscedasticity. The variables are described in Table 1.

Variable	Total assets		Firm age		Dividend		Multibank	
	Small	Large	Young	Old	No	Yes	One	> 1
<i>Panel C: Past investment patterns</i>								
Reduced credit supply	-0.569** (0.278)	-0.761*** (0.218)	-0.341 (0.230)	-1.169*** (0.254)	-0.365 (0.241)	-1.025*** (0.249)	-0.482* (0.265)	-0.848*** (0.232)
No investment years	-0.079 (0.054)	0.038 (0.052)	-0.013 (0.050)	-0.029 (0.055)	0.004 (0.059)	-0.039 (0.048)	0.023 (0.050)	-0.070 (0.056)
No investment X Reduced credit supply	0.270** (0.130)	0.199** (0.099)	0.096 (0.102)	0.460*** (0.120)	0.167 (0.124)	0.331*** (0.104)	0.175 (0.117)	0.302*** (0.109)
Reduced output demand	-0.643*** (0.125)	-0.506*** (0.130)	-0.592*** (0.125)	-0.636*** (0.131)	-0.716*** (0.131)	-0.451*** (0.125)	-0.565** (0.124)	-0.614*** (0.132)
Return on Assets in Crisis	1.866*** (0.599)	2.020*** (0.587)	1.862*** (0.578)	2.140*** (0.620)	2.501*** (0.696)	1.880*** (0.577)	2.520*** (0.608)	1.373*** (0.585)
Constant	4.010*** (0.176)	3.649*** (0.168)	3.761*** (0.166)	3.922*** (0.178)	3.830*** (0.185)	3.774*** (0.168)	3.687*** (0.167)	3.984*** (0.177)
R^2	0.089		0.097		0.098		0.099	

Effects of a discrete change of the dummy variable from zero to one. Marginal effects for continuous variables.

Standard errors are presented in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Effect of credit supply on investments by *ex ante* financial constraints. Firms outside consolidated groups. The table reports OLS regression results for companies that were not part of a group, where being part of a group is defined as being owned and controlled by a parent company. The sample has been split based on pre-crisis financial constraints criteria. For total assets, the sample has been split in two halves based on the book value of the firm's assets in 2007. Firms are split into young and old categories based on whether the firm age is below or above the sample's median age. For the dividend and multibank categories, the sample has been split based on whether a firm paid dividends for 2007 or had bank accounts at multiple banks at the end of 2007, respectively. The dependent variable is the answer to the survey question about how the crisis affected the firm's investment in PME. The dependent variable uses a scale of -3, -2, -1, 0, 1, 2, 3 or not relevant, where negative numbers indicate a decline in investment and "not relevant" responses are categorized as "0." The explanatory variables that are based on survey question responses are equal to one if the response indicated a decline in the variable, and zero otherwise. Accounting variables are normalized by the firm's total assets. The observations are at the firm level. Standard errors are robust to heteroscedasticity. The variables are described in Table 1.

Variable	Total assets		Firm age		Dividend		Multibank	
	Small	Large	Young	Old	No	Yes	One	> 1
Reduced credit supply	-0.449* (0.245)	0.113 (0.254)	-0.214 (0.228)	-0.326 (0.296)	-0.427* (0.229)	-0.238 (0.292)	-0.314 (0.249)	-0.325 (0.274)
Reduced output demand	-0.492*** (0.164)	-0.678** (0.269)	-0.739*** (0.183)	-0.388* (0.200)	-0.445** (0.191)	-0.599*** (0.192)	-0.476*** (0.173)	-0.646*** (0.226)
Return on Assets in Crisis	1.380* (0.813)	2.896*** (1.082)	1.875** (0.790)	2.095* (1.150)	2.923*** (0.914)	1.737* (1.003)	2.353*** (0.854)	1.274 (1.023)
Constant	3.929*** (0.163)	3.780*** (0.283)	3.806*** (0.181)	3.915*** (0.223)	3.841*** (0.175)	3.800*** (0.232)	3.736*** (0.189)	4.034*** (0.210)
<i>N</i>	292	136	235	193	215	213	234	194
<i>R</i> ²	0.078	0.110	0.121	0.060	0.108	0.080	0.089	0.086

Effects of a discrete change of the dummy variable from zero to one. Marginal effects for continuous variables. Standard errors are presented in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$