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Discussion Papers

No. 22
October 2019

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IWH Discussion Papers are indexed in RePEc-EconPapers and in ECONIS.

Editor

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ISSN 2194-2188

Spillovers of Asset Purchases Within the Real Sector: Win-Win or Joy and Sorrow?*

Abstract

Events which have an adverse or positive effect on some firms can disseminate through the economy to firms which are not directly affected. By exploiting the first large sovereign bond purchase programme of the ECB, this paper investigates whether more lending to some firms spill over to firms in the surroundings of direct beneficiaries. Firms operating in the same industry and region invest less and reduce employment. The paper shows the importance to consider spillover effects when assessing unconventional monetary policies: Differences between treatment and control groups can be entirely attributed to negative effects on the control group.

Keywords: asset purchase programmes, small and medium enterprises, investments

JEL classification: D22, E58, G21, G28

* I thank Tobias Berg, Steffen Müller, Francesco Vallasacas, Martin Goetz, Sascha Steffen, Rainer Haselmann, Jan Pieter Krahnen, Michael Koetter and Felix Noth for their valuable comments and suggestions. I am greatful for valuable comments from visitors to the AFA PhD poster session, the participants of the IWH-DPE, the IWH-Goethe University Riezlern Winter school, the WIMFEH workshop at the DIW, the Spanish Finance Forum PhD consortium, the EEA meeting in Manchester and participants at the Norges Bank brown bag seminar. All errors are mine.

1 Introduction

Total effects of unconventional monetary policy (UMP) might go beyond direct effects. Market participants are interconnected via (local) demand, benefit from each other due to positive agglomeration spillovers, and rival each other in competitive environments. If a shock affects one firm, these relationships might come into play and disseminate the shock throughout the economy. To gain a comprehensive understanding of the effect of UMP, spillover effects to non-treated firms operating in the same region or industry should be taken into account. In particular, Berg and Streitz (2019) show the importance of allowing spillover effects, also when estimating direct effects of policy measures. Spillover effects to the control group, but also to the treatment group, implies that the stable unit treatment value assumption (SUTVA) is violated. Hence, neglecting spillover effects to firms operating in the same group, such as a region or industry, might lead to biased estimates of direct effects.

This paper asks the question whether there are spillover effects of the ECB's first sovereign debt purchase program, the securities markets program (SMP), on peer firms. To identify spillover effects of asset purchases, I assess investments and employment of firms which are linked to banks which benefit from the SMP and compare them to firms which are linked to banks which do not benefit from the SMP while taking spillover effects between the two groups into account. Firms with different shares of treated firms in their surroundings are compared. On the one hand, peer firms of directly treated firms could benefit from the positive liquidity shock to their neighbors because of technology or knowledge spillovers, or lower transportation costs (Combes and Gobillon, 2015). On the other hand, they could be crowded-out by their peer firms which benefit from relatively lower financing costs (Benoit, 1984). The results show negative spillover effects on firms operating in the surroundings of directly treated firms. Firms which do not enjoy extra lending from their bank invest less and reduce employment compared to the pre period and compared to firms which do not have peers which received more lending from SMP banks.

There are several methodological challenges when modeling spillover effects, as described by Berg and Streitz (2019). They point to difficulties when spillover effects are ignored in individual or firm level analyses, and warn against identifying spillovers in a two-step procedure – measuring direct effects on a firm level analysis and total effects on aggregated variables and then interpreting the difference between the two. This paper tries to accommodate their recommendations and models direct treatment effects and spillover effects simultaneously on the firm level. In order to find out which firms are mostly affected, this paper then simplifies their model and focuses on the sample of non-directly treated firms.

As a prerequisite to the study of spillover effects, this paper corroborates findings from the literature that banks change their lending behavior as a response to loose monetary policy. Among others, Jiménez et al. (2014) show a change in lending behavior as a response to low interest rates; Acharya et al. (2019) similarly show a change in lending behavior as a response to the announcement of the Outright Monetary Transaction program (OMT), and

Koetter (2019) as a response to the SMP. This study replicates the latter and shows details on the increase in lending of regional banks. In particular weakly capitalized banks increase lending to medium to highly indebted borrowers after they benefited from the SMP. My paper then contributes by showing that negative spillover effects to the control group is the main driver for a positive wedge between investments and employment of treatment and control group.

The results are driven by high-leveraged firms. Directly treated high leveraged firms receive more lending from their SMP bank, and high-leveraged firms in their surroundings invest less and reduce employment. This is in line with Benoit (1984) who predicts in a theoretical framework that financially constrained firms will be pressured by their peers as soon as the latter can afford it. Low leveraged firms, on the contrary, are not affected by a crowding-out. Also, the results do not hold for regions which previously have low unemployment rates: here the effect turns around and high leveraged firms employ and invest even more.

There are two papers which consider spillover effects of UMP. Grosse-Rueschkamp et al. (2019) find that as a response to the corporate sector purchase program, large firms issued more bonds and took out fewer bank loans. Banks responded by channeling the freed up capital to smaller, bank dependent firms. Small firms thereby benefit from positive spillover effects via their bank. Acharya et al. (2019) consider spillover effects on real outcomes from the presence of weak firms within an industry. They indirectly connect that to an UMP shock by providing first evidence that due to the announcement of the OMT, banks increase lending to weak firms. Second, they investigate the effect of the existence of weak firms on the investment and employment behavior of strong firms. They find that a larger share of zombie firms prevents healthy firms from investing and employing more. My study can contribute to these papers by making directly use of an UMP shock and estimating its effect on both - weak and strong firms - operating in the same surroundings.

Several papers show intended and unintended effects of the SMP. Researchers agree on that the SMP was successful in lowering government bond yields (Doran et al., 2013; Casiraghi et al., 2016; Gibson et al., 2016; Eser and Schwaab, 2016; Ghysels et al., 2016; De Pooter et al., 2018). Concerning effects on banks and firms, Koetter (2019) shows that regional banks increased lending as a response to the program, Cycon and Koetter (2015) find that corporate refinancing costs decreased, and Cycon et al. (2018) show that firms linked to a beneficiary bank reduce employment, but mildly increase their investments. To the best of my knowledge, my paper is the first to study spillover effects of the SMP on surrounding firms.

2 Levels of spillovers and hypotheses

According to Greenstone et al. (2010), "economic activity is spatially concentrated by industry". This paper aims at capturing spillover effects within this industry–spatial cluster. Modeling spillovers between firms solely within industry might neglect the regional focus of many SMEs, which make up the sample of this paper. They might not compete nationally within their industry.[1] Modeling spillovers solely on the regional level, on the other hand, makes it difficult to distinguish between changes to local aggregate demand versus agglomeration spillovers and competitive crowding-out effects. Local aggregate demand effects could either happen across industries – the manufacturer employs more labor which increases demand for the bakery – or across and within industries simultaneously, which might affect all industries. To stay with the example, the manufacturer in turn also experiences higher demand.

To capture the spatial dimension, this paper uses the NUTS-3 definition for regions ("Kreise") as Brakman et al. (2005) shows that agglomerations manifest especially on this granular regional level. Industries are identified with the NAICS code. To rule out that changes in local aggregate demand drive the results, I include region–time fixed effects, which capture region wide time varying dynamics. In the example above, this corresponds to the equal increase in local demand for all firms. To rule out cross-industrial effects of changes in local demand, I model spillovers within industries. Previous studies pursue various strategies to distinguish the local demand channel from the agglomeration spillover channel. When assessing spillovers of a lending contraction shock, Huber (2018) argues to find both – local demand and agglomeration spillovers – by distinguishing between different groups of firms which should be differently affected. Lerche (2018) measures effects of a tax cut on several levels and finds that spillovers within industry is strongest, concluding that it is mainly agglomeration spillovers and less so

[1] The impact of spillovers on investment and employment is close to zero when modeling spillovers on the industry level. Results are not reported here, but are available upon request.

local aggregate demand effects.

When assessing the effect on employment, however, it is important to note that firms from different industries share local labor markets rather than specific labor markets serving only specific industries (Lindley and Machin, 2014, e.g.). To employ the most narrow identification strategy to rule out confounding factors and to assess spillovers also across industries is hence a trade-off. In the following, I will show results for both levels, region and region–industry, when assessing employment behavior of firms.

This paper tests the following hypotheses. Firms linked to a bank which held SMP eligible assets experienced a positive liquidity shock and increased their borrowings. For these firms, relative factor costs have changed and capital has become relatively cheaper. They might react in different ways: expanding in size, employing new technologies, decrease product market prices, or they do not show a change in behavior and retain earnings. Further, according to the Slutsky decomposition of price changes into an income and substitution effect, I cannot rule out that firms even substitute capital for labor, and as a result demand less labor.

If some firms increase in size or employ new technologies, there might be agglomeration spillovers on peer firms due to lower transportation costs as well as knowledge and technology spillovers (Combes and Gobillon, 2015). Greenstone et al. (2010) show theoretically that total factor productivity increases for incumbent firms if there is a new plant opening in their neighborhood. Peer firms benefit from new technology employed and knowledge disseminated by workers. Benefits to one firm then positively spill over to firms in the surroundings. Also, if firms substituted capital for labor, labor becomes cheaper for peer firms.

Hypothesis: There are positive spillover effects on firms which operate in areas where many other firms benefited from a positive UMP shock in terms of investment and employment.

However. there can also be crowding-out effects. Firms might use their relative advantage in capital costs and oust competitors from their position in the market. Benoit (1984) develops a theoretical model in which he shows that firms which can afford it have incentives to prey on their competitors by lowering product market prices to drive their competitors out of the market. In his model, the financially constrained competitors do not endure and leave the market. In an empirical analysis Donohoe et al. (2018) examine competitive externalities of a tax cut and find that firms which enjoy lower tax payments pressure their peers and depress their performance. The effect is strongest for peers which are financially constraint and which have similar products.

Further, Caballero et al. (2008) argue that subsidized firms lock-up labor and thereby drive up labor input costs. Peer firms then not only are faced with relatively higher capital, but also higher labor costs. Allcott and Keniston (2017) also argue that higher labor costs might crowd-out firms when examining a possible Dutch disease phenomenon in the United States, though they only find limited evidence for that. As a consequence, firms in the surrounding invest less and reduce employment.

Alternative Hypothesis: There are negative spillovers on firms which operate in areas where many other firms benefited from a positive UMP shock in terms of investment and employment.

3 Data and Identification

3.1 Monetary policy shock and bank data

The SMP was the first large scale asset purchase program (APP) that was conducted in the Eurozone. The ECB implemented the program in May 2010 and it lasted until September 2012. The ECB started purchasing Portuguese, Greek and Irish sovereign bonds and extended the program in 2011 to Spanish and Italian sovereign debt. They also purchased marketable debt of private entities incorporated in the Euro area, however, as will be described in Section 3.2, this does not affect firms in the sample of this paper which comprises only small and medium enterprises (SMEs). In total, the program had a notional volume of 218 Billion Euro.

The SMP provides a good testing ground for establishing causal links between APPs and lending to leveraged firms and further spillover effects. First, in contrast to the Fed, the ECB was hesitating to intervene into financial markets until the SMP was established. Hence, the program was not expected by market participants (Stolz and Wedow, 2010). This condition is crucial to avoid self-selection into treatment group of especially risk-prone banks which loaded up with crisis bonds. Second, the SMP was a response to the sovereign debt crisis in Southern European countries and Ireland, and not to events in Germany. Third, the program aimed at lowering government bond yields and not to stimulate credit growth. The ECB confirms this in their announcement of the program, and shows actions to keep aggregate reserves holdings stable by implementing sterilization measures. If there are changes in lending behavior in Germany as a response to the SMP, they are unintended side effects as they were neither the aim nor the reason for the program.

Data on the SMP purchases comes from the ECB and is combined with Bundesbank data on sovereign bond holdings and is taken from Koetter (2019) and Antoni et al. (2019). The data provides information on whether a bank held SMP eligible assets on a yearly basis. A bank is defined as treated if it held SMP eligible assets in all three program years 2010, 2011 and 2012. The sample covers 1,033 German savings and cooperative banks of which 6.87% are treated. Information on the bank level comes from Bureau van Dijk's bankscope dataset. To reduce the probability of a selection bias, i.e., to rule out that banks and thereby also firms selected themselves into the group of the directly treated banks and firms, banks must have hold SMP eligible assets in 2010. Banks which purchased assets only from 2011 or 2012 onwards are excluded from the sample. The sample comprises only savings and cooperative banks to rule out that they are specialized in securities trading. To verify, I follow Abbassi et al. (2016) to approximate a bank's proficiency in trading. They assume that banks which are members of the German trading platform Eurex Exchange have a trading desk. There are four savings banks in Germany which are members of the Eurex[2]. They

[2]Kreissparkasse Ludwigsburg, Sparkasse Pforzheim, Kreissparkasse Köln and Ham-

are excluded from my sample. 69.05% of bank links in the final sample are to savings or cooperative banks, which shows the strong reliance of SMEs on regional banks. In case of duplicates, bank-year observations which are consolidated are dropped to avoid double reporting.

Following other authors, this paper makes use of the equity ratio of the bank as a proxy for the bank's weakness (Jiménez et al., 2014; Schivardi et al., 2017; Acharya et al., 2019; Peek and Rosengren, 2005). In contrast to the previous literature, I define a bank as weak if it was among the lower 10% of the distribution of banks' equity ratios in the pre crisis and pre treatment year 2007. The threshold is chosen as the margins of the distribution are of interest. 15.95% of firm-year observations are linked to a weak bank, as can be seen in Table 1, i.e., weak banks are slightly larger in terms of customer base.

3.2 Firm data

The following analysis is conducted on the firm level. The Dafne dataset by Bureau van Dijk provides information on firms' bank links. To approximate lending of the bank to the firm, this paper only makes use of firms with a single bank relationship and assumes that loans on the firms' balance sheets originate from their only bank. 59.05% of firms in the dataset have a single bank link. Firm balance sheet data is added from Amadeus by Bureau van Dijk. In the analysis, only SMEs are included due to their pivotal role as an engine of economic growth, employment and economic stability in Germany

burger Sparkasse

(BMWi, 2018). Further, it is essential to rule out confounding factors such as other purchases of securities of the ECB at the same time. SMEs do not tap capital markets and usually do not issue bonds but are bank reliant.

Further, SMEs often maintain relationship lending, i.e., repeated business relationships with the same bank (Sparkassen and Giroverband e. V., 2016). For instance Behr et al. (2013) find that relationship lending is less prone to business cycles, and Elsas and Krahnen (1998) find that relationship lenders support troubled borrowers in liquidity needs. Only firms are included which do not change their bank relationship in the sample period. Tests within these stable relationships are conservative and results meaningful. In robustness checks, also firms which change their bank during the sample period are included. To identify SMEs, the definition of the European Commission (EC) is employed: Firms must have less than 250 employees, and either their turnover is less or equal to 50 Million Euro, or their total assets are less or equal to 43 million Euros (European Commission, 2018). Further, industry sectors that are highly subsidized are excluded (agriculture, fishing and forestry), or which are closely linked to the state (health industry, education, and public administration).

The dataset comprises 396,908 firms, and 1,325,087 firm-year observations of which 9.67% are defined as treated. For detailed description of data cleaning, see Section C in the Appendix. The analyses are pursued on a sample for which the dependent variable of the prerequisite estimation on bank lending, namely loan holdings, is available. The more balanced sample comprises 73,703 firms, or 331,872 firm-year observations.

To measure firm weakness, I use firms' leverage ratio in the pre crisis and pre treatment years 2006 and 2007 following Schivardi et al. (2017). They claim to measure firms' default risk according to their leverage ratio. The degree of indebtedness of market participants plays an important role for financial and economic stability and economic development. Highly leveraged firms react more sensitive to decreased demand by reducing their labor force more quickly and thereby contributing to a propagation of adverse shocks (Sharpe, 1994). They performed worse in and after the great recession in terms of poorer sales growth, investment behavior and employment (Altunok and Oduncu, 2013; Kuchler, 2015; Giroud and Mueller, 2015). According to Traczynski (2017), firm leverage is one of the main explanatory variable for default risk. Cathcart et al. (2018) even claim it is the most important explanatory variable for default risk of SMEs.

Leverage is defined as current liabilities plus non-current liabilities over total assets. If the leverage ratio is larger than one, the observation is dropped as this must be due to reporting errors. Still, the share of firms with leverage ratio equal to one is very large (9.56% of firm-year observations show a leverage ratio of one). To avoid that outliers drive my results due to reporting errors, all analyses are conducted without firms with leverage ratio equal to one in the pre crisis and pre treatment year 2007. If a highly leveraged firm is defined as one belonging to the highest 10% percentile in the distribution of leverage ratios, then 5.85% of firms linked to strong banks and 5.72% of firms linked to weak banks are highly leveraged.

In Appendix D, previous results from the literature that banks change their lending behavior as a response to UMP measures are replicated. Dependent variable is the log change of loan holdings at the firm level. In the following analyses, the sample is restricted to observations which are included in the lending analyses. Table 1 reports summary statistics on all variables in levels and in changes. Financials are winsorized at 1% and 99% of the distribution before they are log transformed.

– Insert Table 1 around here –

Table 1 shows summary statistics for variables used in the following analyses. First, variables used in the lending analysis are reported, which encompasses 331,872 firm-year observations. The median firm in the sample has a leverage ratio of 66.8%, which is similar to what others find (e.g, Storz et al. (2017) show for their sample of SMEs in several Euro countries a median leverage ratio of 61.5%). The median firm has total asset size of 374,214 Euro (not reported in the Table), reflecting that the analysis is on the very small firms, and has a median age of 14 years.

The focus of this paper is the assessment of investment and employment of firms. Investment is measured as log change of fixed assets less depreciation. Employment is defined the log of total numbers of employees. The sample is reduced due to availability of the investments variable. Many firms reports tangible assets, however, fewer firms report depreciation. When assessing the investment behavior of firms, the sample comprises of 34,507 firm-year observations. The analysis on employment again is a subsample of the investments sample, to ensure that all observations were included in all previous analyses, and hence comprises 24,500 firm-year observations. 11.5% of firms are directly treated, and the mean treatment share within region–industry, $SMPshare$, as well as within region, $SMPshare\_region$, is 10.6% and 10.7%, respectively.

3.3 Identification

To assess the effect of the SMP on firms operating in the same market in close proximity, I estimate the following model which is in the vein of Berg and Streitz (2019):

$$\begin{aligned} Y_{it} = \gamma_1 \times \text{SMP}_i \times Post_t \\ + \gamma_2 \times \text{SMP}_i \times Post_t \times \text{SMPshare}_{rk} \\ + \gamma_3 \times (1 - \text{SMP}_i) \times Post_t \times \text{SMPshare}_{rk} \\ + \alpha_i + \alpha_{rt} + \alpha_{kt} + \epsilon_{it}. \end{aligned} \tag{1}$$

Dependent variables Y_{it} are investments, defined as log differences of fixed assets less depreciation of firm i in year t, and employment, defined as log number of employees. SMP is a binary variable which equals 1 if the firm's bank held SMP eligible assets in all three treatment years 2010–2012. $Post_t$ is an indicator which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. γ_1 shows the direct effect of the treatment on firms linked to a bank which benefited from the SMP. $SMPshare_{rk}$ is the share of treated firms in the same region–industry of firm i, excluding firm i. Analyses on the employment behavior of firms will analyze spillover effects on the region level also, then $SMPshare$ is the share of treated firms within the same region, excluding firm i. γ_2 shows spillover effects on directly treated firms. γ_3 finally shows the effect of the share of treated firms in the surroundings on non-directly treated firms. To control for unobserved heterogeneity across firms, firm fixed effects (α_i) are included. Region–time fixed effects (α_{rt}) and industry–time fixed effects (α_{kt}) control for region or industry demand shocks. Standard errors are clustered on the region–industry level, as the treatment variable varies on the region–industry level, but for robustness checks also other levels of clustering will be used. In regressions modeling spillovers on the region level, region–time fixed effects have to be excluded, and standard errors are clustered on the region level.

Further, this paper investigates which firms are mainly affected by spillovers. I simplify Berg and Streitz (2019)'s estimation strategy and focus only on firms which are not directly treated. This eases interpretation of results and prevents models to become too complex. I will show that spillover effects modeled in this way are similar to results from estimating Equation 1 and estimate the following simplified model with only non-directly treated firms:

$$Y_{it} = \gamma \times Post_t \times \text{SMPshare}_{rk} + \alpha_i + \alpha_{rt} + \alpha_{kt} + \epsilon_{it}. \tag{2}$$

Similarly to γ_3 in Equation 1, γ captures spillover effects to non-directly treated firms. Medium to high leveraged firms were the ones which benefited the most from increased lending by lowly capitalized banks. This paper tests whether it is also the high leveraged firms which are most affected by spillover effects by estimating the following regression estimation which augments Equation 2:

$$Y_{it} = \gamma \times Post_t \times \text{SMPshare}_{rk} \times \text{Leverage}_i + \cdots + \alpha_i + \alpha_{rt} + \alpha_{kt} + \epsilon_{it}. \quad (3)$$

$Leverage_1$ is the average leverage ratio of firm i in the pre-crisis and pre-treatment years 2006–2007. γ captures whether higher leveraged firms show different behavior in response to treated firms in their surroundings. The estimation also includes all compositional terms of the interaction term.

In the following, t-tests show that the parallel trend assumption for treatment and control group is fulfilled, which is one necessary assumption of a differences-in-differences analysis. Treatment and control group must show parallel trends in the dependent variables in the pre period. Table 2 reports results from t-tests on levels as well as changes of variables used as dependent variables in the regression analyses. The tests encompasses all observations as used in the main analysis where I apply the full model as suggested by Berg and Streitz (2019). It shows tests on the differences between directly treated and not-directly treated firms for the pre and the post period respectively, as well as the differences-in-differences. In order for the parallel trend assumption to be fulfilled, treated and control firms may differ in outcomes in levels, but they must not differ in trends, i.e. in changes of the outcome variables.

– Insert Table 2 around here –

Directly treated firms and non-directly treated firms are similar in terms of loans they have taken out and also in terms of investments during the pre and during the post period. Differences are economically very small, and also not statistically significantly different from zero. Treated firms have slightly less employees in the pre as well as in the post period. The difference is statistically significant at the 1% level. For the parallel trend assumption to hold, firms must not differ in changes of the outcome variable in the pre period. In fact, treated and control groups are very similar in the pre period. Differences are very small in size and t-tests show that they are not statistically significantly different from zero. The number of observations when considering changes is reduced as the first year drops out, and when considering employment as dependent variable as t-tests are based on the observations used in the regression analyses.

4 Results

Previous literature finds a change in lending behavior of banks which benefit from UMP. Appendix D shows the change in lending of regional banks as a response to the SMP. Weak banks, according to their capital ratio, increased lending to medium and high leveraged borrowers. A change in lending behavior vis-à-vis highly leveraged firms can be viewed problematic in itself. However, it is of a concern if there are adverse consequences for firms which do not benefit from eased access to lending. In the following, spillover effects from increased borrowing of directly treated firms on non-directly treated firms will be analysed.

4.1 Investments

Table 3 shows the result for investments as dependent variable.

– Insert Table 3 around here –

Results are based on estimating Equation 1. In column I, the analysis includes firm and time fixed effects. There is a small positive direct effect on firms which are linked to banks which benefit from the SMP. Meanwhile, these firms are also faced with a negative indirect effect on investments. However, the relationships are statistically not significantly different from zero. γ_3 is negative and statistically significantly different from zero. Firms which are not directly treated, i.e. SMP equals 0, show lower investments the higher the share of treated firms in their region–industry during the post period compared to the pre period. The results remain robust and become even larger when I control for region–time fixed effects (column II) and also when I add industry-time fixed effects (column III). Then the coefficient is statistically significantly different from zero at the 5% level. In terms of economic relevance, a firm which is not directly treated and which operates in an averagely affected region–industry cluster in which 10.6% of firms are treated, reduces investments from the pre to the post period by -0.428*0.106=-0.045, i.e. by 4.5%.

Columns I-III in Table 4 show results from estimating Equation 2. Columns IV-VI show results from the augmented model as in Equation 3.

– Insert Table 4 around here –

Columns I - III show that in case the researcher is interested only in spillover effects and not direct effects, results from estimating Equation 2 with non-directly treated units only instead of applying the whole model as in Equation 1 renders similar results. The coefficient γ is also negative and ranges between -0.309 and -0.420, depending on the underlying fixed effect structure. The coefficient is statistically significantly different from zero in all three specifications at least at the 10% level. In terms of economic relevance, a firm which is not directly treated and which operates in an averagely affected region–industry cluster in which 10.6% of firms are treated, and for which I control for region–time and industry–time fixed effects, reduces investments from the pre to the post period by -0.364*0.106=-0.039, i.e. by 3.9%, which is slightly less than results from the full model. For robustness checks, I reestimate the model and cluster on firm level, region level and industry level, respectively. Results remain robust.[3]

Columns IV-VI in Table 4 report results from estimating Equation 3 in which the continuous variable *Leverage* is included. The negative relationship between share of treated firms and investments is driven by firms which are leveraged. As the triple interaction term consists of two continuous variables – $SMPshare$ and *Leverage* – it is necessary to consider marginal effects and they can be easier interpreted graphically. Figure 1 shows the marginal effects of the binary variable *Post* on investments, conditional on two leverage levels – in light gray the lowest 10% decile, and in dark gray the highest 10% decile – and conditional on the share of treated firms in the surroundings. Firms which belong to the highest 10% decile in terms of leverage have a

[3] Results not shown here, but available upon request.

leverage ratio that is equal or higher than 96.6%.

– Insert Figure 1 around here –

There is no change in investment behavior for firms with a low leverage ratio, as the light gray area shows no difference from zero, independent of the share of treated firms in the surroundings. High leveraged firms show lower investments the higher the share of treated firms in their surroundings. A firm with a high share of treated firms in its surroundings of 10.6% and which is very high leveraged has a marginal effect of -0.191. That is, such an example firm decreases investments by 19.1% from the pre to the post period. Leary and Roberts (2014) show that weak firms follow their peers and react more to changes in behavior of other firms than strong firms. My results matches their findings; the high leveraged and therefore rather weak firms react to the increased lending to their peer firms. Also, my findings are in line with Benoit (1984), who shows theoretically that firms pressure their financially constraint peers to drive them out of the market.

Further, I use Delgado et al. (2014)'s identification of sectors which produce rather tradeable products. They classify a sector as tradeable if more than fifty percent of products are traded. The classification is based on U.S. firms and hinges on the industry structure of the U.S. Hence, interpretation of results when using German data has to be treated with care. 59% of firms in the sample are defined as producing tradeables. I do not find any differential effects for sectors which are defined as tradeable.[4] This supports the assumption that this analysis does not capture local demand effects as

[4]Results not shown here, but available upon request.

then firms producing tradeables should not be affected.

4.2 Employment

Table 5 reports results for employment as the dependent variable. As before, first I estimate the full model as suggested by Berg and Streitz (2019) according to Equation 1.

– Insert Table 5 around here –

Columns I-III analyze spillovers on the region–industry level. Column I shows that there is a small positive direct effect, and a negative indirect effect on firms which are not directly treated. The coefficient γ_3 is statistically significantly different from zero at the 10% level. However, when including region–time fixed effects and industry–time fixed effects, γ_3 becomes very small and close to zero. It seems that there are no spillover effects on the region–industry level for employment. When estimating spillover effects on the region level, results look different. Columns IV and V show spillover effects for firms within the same region across all industries. γ_3 is negative and statistically significantly different from zero at the 5% level, also when including industry–time fixed effects. As the treatment is on the region level, region–time fixed effects cannot be included in this specification. For a firm which is not directly treated and which operates in a region in which 10.6% of firms are treated shows lower log employment in the post period of -0.139*0.107=-0.015, i.e. it decreases employment by 1.5%.

As before, I estimate the reduced model as described in Equation 2 and extend it as described in Equation 3 with the mean leverage ratio of firms in the years 2006–2007. Table 6 reports results for spillovers modeled on the region–industry level.

– Insert Table 6 around here –

Column I shows that with only a basic set of fixed effects, there is a negative spillover effect on the region–industry level on the employment behavior of non-directly treated firms. As before in the full model, however, the effect becomes indistinguishable from zero with the use of an extensive set of fixed effects. The results pertains also when clustering on different levels such as firm, region or industry, respectively.[5] When including the continuous variable *Leverage* it can be seen that there is actually a negative effect also on the region–industry level: the higher the leverage ratio of the firm previously, the more negative is the change of employment from the pre to the post period if the firm was not treated and is surrounded by treated firms. However, the more fixed effects are included, the weaker is the statistical significance. As the interaction terms contains two continuous variables it is necessary to consider marginal effects. Figure 2 shows marginal effects of the variable *Post* for the lowest and highest decile in terms of *Leverage* conditional on the share of treated firms in the same region–industry cluster.

– Insert Figure 2 around here –

[5] Results not shown here, but available upon request.

Low leveraged firms (light gray area) do not show a change in the number of employees from the pre to the post period, independent of the share of treated firms in their surroundings. High leveraged firms (dark gray area) reduce employment more the higher the share of treated firms in close proximity. A firm with a high share of treated firms in its surroundings of 10.7% and which is high leveraged has a marginal effect of -0.091. That is, such an example firm decreases employment by 9.1% from the pre to the post period. As the results on the region–industry level are not robust when including fixed effects, and labor markets are considered to be rather regional markets than industry specific (e.g., Lindley and Machin (2014)), I also model spillovers on the region level and reestimate the reduced model. Results can be seen in Table 7.

– Insert Table 7 around here –

Column I shows that the coefficient of interest, γ, is very similar to previous results when using the full model which includes direct and spillover effects simultaneously. In contrast to estimations which model spillovers on the region-industry level, the coefficient still remains strong when industry–time fixed effects are included as in column II, and the effect is also still statistically significantly different from zero. When conditioning on the leverage ratio of firms, as in Equation 3, results are again stronger the higher the leverage ratio of the firm. Regressions on the region level with investments as dependent variable do not render any results,[6] confirming the observation that labor markets are regional markets, but this does not hold for capital.

[6]Results not reported here, available upon request.

As before, I also test whether there are differential effects for firms which produce tradeable goods. Similarly to results on investments, there is no differential effect if a firm produces tradeable goods.[7] This further strengthens the argument that I do not capture local demand effects.

To sum up, there are negative spillover effects of asset purchases, such as the SMP, for German SMEs. Therefore, the hypothesis of beneficial agglomeration spillovers can be rejected. Instead, there is evidence for a crowding-out effect. Non-treated firms, which are faced with many treated firms invest less and employ less workers in the post period. The effect is driven by firms which are highly leveraged. Meanwhile, I do not observe a direct effect. Directly treated firms seem not to use their relative advantage in refinancing costs to invest or employ more. Instead, this might hint at the possibility that they pressure their peer firms with lowering product market prices, as suggested by Benoit (1984). Similar firms, which are high leveraged and operate in the same region–industry, are crowded-out.

The findings contradict evidence from the spillover literature: For instance, a lending cut was accompanied by worse performance of surrounding firms (Huber, 2018), and a tax cut translated into a positive effect for surrounding firms (Lerche, 2018). In both cases, as it is described in studies on agglomeration spillover, effects are commutated, whereas in this paper I show opposing effects of UMP on indirectly treated firms. Nevertheless, results are in line with Leary and Roberts (2014) who find that weak firms are more influenced by peers than strong firms.

[7] Results not reported here, available upon request.

4.3 Economic condition as a moderator

Schivardi et al. (2017) suggest that they do not find adverse effects of the presence of weak firms on the performance of surrounding strong firms due to the time period chosen in their analysis, a period of economic downturn. They argue that during a phase of economic downturn all firms benefit if some firms receive a subsidy as local aggregate demand strengthens. They cannot test their hypothesis as the data they are using covers only a period of economic downturn and they cannot make use of variations in terms of business cycles. This paper tests whether the link between many treated firms in the surroundings and lower investments and employment varies for different economic conditions. To proxy for the economic condition, the regional unemployment rate provided by Destatis will be used. Equation 3 is further augmented with the binary variable UR:

$$Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma \times Post_t \times \text{SMPshare}_{rk} \times \text{Leverage}_i \times \text{UR}_r + \cdots + \epsilon_{it}. \quad (4)$$

UR_r equals one if a region r has an average unemployment rate below or equal to 5% during the pre period, which applies to 10% of the regions and hence is in line with previous indicator variables which always compare lowest or highest deciles of distributions with the rest of the sample, and zero otherwise. The estimation includes also all compositional terms of the interaction term. γ captures whether the link between the share of treated firms in the surroundings and (high leveraged) firms' investment and employment behavior is different in periods of economic upturn compared to all other periods. Table 8 reports the results.

– Insert Table 8 around here –

Column I in Table 8 shows the results for investments as the dependent variable. The coefficient γ for the quadruple interaction term is positive and statistically significant at the 5% level, indicating that there is a difference between regions which had low unemployment rates in the pre period compared to regions with higher unemployment rates. Column II reports results for the log of number of employees as the dependent variable. Here, also, γ is positive and statistically significant at the 1% level. Due to the interaction terms and their compositional terms, it is necessary to interpret marginal effects. I derive for the post period ($Post$) for regions with low unemployment rates ($UR = 1$), and condition on the $SMPshare$ and distinguish between lowly and highly leveraged firms. The effects on investments can be seen in Figure 3.

– Insert Figure 3 around here –

The light gray area shows firms which are in the lowest decile in terms of average leverage in the years 2006–2007. The dark gray area shows firms in the highest decile in terms of average leverage in the years 2006–2007. The previously established effect that low leveraged firms do not show a reaction, but high leveraged firms decrease investments, turns around. High leveraged firms show higher investments the larger the share of treated firms in their surroundings compared to the pre period. The effect becomes statistically significant at the 10% level from a SMPshare of 20% onwards. Low leveraged firms show lower investments the higher the share of treated firms in their surroundings, but the effect remains statistically insignificant. If labor markets in the region the firm operates in are tight, i.e., the unemployment rate is low, there are positive spillover effects of increased lending to high leveraged firms on high leveraged peers in the same industry. The crowding-out effect turns into a positive spillover effect. The finding is contrary to Schivardi et al. (2017)'s hypothesis, that there is a positive spillover effect on periods of economic downturn.

Figure 4 shows marginal effects of *Post* on employment as dependent variable.

– Insert Figure 4 around here –

Figure 4 shows marginal effects of the post period on employment for firms in regions with low unemployment rates, conditional on the share of treated firms in the surroundings and on the leverage status of the firm. The light gray area shows firms which are in the lowest decile in terms of average leverage in the years 2006–2007. The dark gray area shows firms in the highest decile in terms of average leverage in the years 2006–2007. Similarly to effects on investments, the effects on employment turn around: High leveraged firms employ more compared to the pre period the higher the share of treated firms in their surroundings. The effect becomes statistically significant from a SMPshare of 10% onwards. High leveraged firms experience positive spillovers from peer firms which operate in the same industry and region. Low leveraged firms, on the contrary, show lower employment compared to the pre period the higher the share of treated firms in their surroundings.

This matches with the fact that only high leveraged firms which are directly treated enjoy higher borrowings.

To sum up, I find that the economic condition of the region the firm operates in matters for the direction of the spillover effect. When the region is in a thriving economic condition, measured according to the unemployment rate in the pre period, there is a positive spillover effect on high leveraged firms. The reason could be that in an upturn period, investment projects are abundant, and competing firms, which are directly treated and benefit from higher borrowings, do not crowd-out untreated firms, but pull them up. In periods of economic upurn, there might be enough demand such that firms cannot crowd out competitors via lowering product market prices. Low leveraged firms, on the contrary, are not affected in terms of investments, and even reduce employment. For spillover effects of UMP, the hypothesis of Schivardi et al. (2017) does not hold.

5 Robustness

5.1 Leads and lags estimations

Additionally to t-tests as described in Section 3.2, I estimate leads and lags models to test the assumption of parallel trends of the dependent variables in the pre period. The following model is estimated:

$$Y_{it} = \alpha_i + \alpha_t + \sum_{t=2008}^{2013} \gamma_t \, D_t \times SMPshare_i + \cdots + \epsilon_{it}. \quad (5)$$

Dependent variables are investments, defined as log differences of fixed assets less depreciation of firm i in year t, and employment, defined as log number of employees. D_t are year indicators, leaving out 2007. $SMPshare$ is the share of treated firms in the same region–industry or region. The sample encompasses only firms which are not directly treated. The estimation includes firm and time fixed effects. Standard errors are clustered on the region–industry or region level, respectively.

– Insert Table 9 around here –

Table 9 reports results. Column I shows the effect of the $SMPshare$ in different years compared to base year 2007 on investments. All interaction terms in the pre period are statistically insignificant. Whereas interaction terms of the $SMPshare$ and years 2012 and 2013 in the post period are statistically significantly different from zero. Column II shows effects on employment. $SMPshare$ captures the share of treated firms in the same region. Again, interaction terms in the pre period are statistically insignificant, whreas the interaction term of $SMPshare$ and year 2013 is negative and statistically significantly from zero at the 10% level. The model indicates that the parallel trend assumption is fulfilled.

5.2 Placebo estimations

Placebo estimations with different time periods and random treatment assignment show no effects. I estimate two variants of Equation 2. First, I vary the estimation period and only use observations from the previous pre period 2007-2009. The variable *Post_placebo* equals 0 in the years 2007 and 2008 and 1 in 2009. Second, I use the distribution of the previous variable *SMP_share* and assign it randomly anew across region-industry clusters.

– Insert Table 10 around here –

Table 10 shows the results. If I use solely the pre period and define 2009 as the new treatment year, the effect of the SMP_share on investments and employment becomes statistically insignificant, as can be seen in column I and II. Column III and IV show results for the actual time period but with randomly assigned treatment shares across region-industries. Also here, the effect is statistically insignificant.

5.3 Confounding factors

Results might be driven by the specific selection of sample. The analysis only includes firms which do not change their banking relationship during the sample period. However, it is possible that the more productive and more agile firms change bank if they see an advantage with banking with a treated bank. I reestimate Equation 1 including firms which changed their bank during the sample period. The treatment variable *SMP* may now change within firm over time and hence has to be included itself as well. The share of treated firms in the same region–industry or region, respectively, is calculated anew as the average share of treated firms on the respective level. Table 11 shows the results.

– Insert Table 11 around here –

Results do not change when including firms which change their bank. γ_3, the coefficient which captures the spillover effect on the non-directly treated firms is very similar to previous results. Also estimations for employment on the region level do not change meaningfully.

Added to this, there might be concerns that the sample encompasses only single-bank firms. Hence, an estimation strategy in vein of Khwaja-Mian which controls for borrower–time fixed effects is not possible. So far, region–time fixed effects and industry-time fixed effects capture regional and industry demand shocks. As a robustness check, I include Industry–Location–Size–Time fixed effects or Industry–Size–Time fixed effects in the vein of Degryse et al. (2019) to control for firm demand shocks.

– Insert Table 12 around here –

In column I Industry–Location–Size–Time fixed effects as suggested by Degryse et al. (2019) based on the two digit NAICs code, the first two digits of the firm's postal code and size bins according to deciles of total assets are included. However, the number of observations is dramatically reduced. In column II, I adjust the Industry–Location–Size–Time fixed effects and base them on quantiles of size bins, as the very granular fixed effect structure forces many observations to leave the sample. The results are quantitatively similar to previous results, however, the statistical significance has dropped. In columns III and IV, log of employment is the dependent variable. Here, as before, the $SMPshare$ is based on the region level. Hence, I cannot make use of regional areas in the fixed effect structure and use merely Industry–Size–Time fixed effects, first based on deciles and then on quintiles of total assets. The results remain robust in terms of magnitude, but also in terms of statistical significance.

Further, results might be driven by a selection of specific firms to specific banks. It might be that some banks are more risk prone, host more high-leveraged firms and meanwhile bought risky government bonds which were purchased during the SMP. Table 13 provides information on the composition of firms which are linked to treated or non-treated banks.

– Insert Table 13 around here –

The distribution of average leverage ratios of firms linked to non-treated banks does not differ significantly from firms linked to treated banks. There is no clustering of highly leveraged borrowers at weak banks. Table 14 shows the correlation in a cross-section of the binary variable SMP, which indicates whether a bank is treated, and the average leverage ratio of firm i in the pre treatment years 2006–2007.

– Insert Table 14 around here –

The correlation is even negative, which implies that the higher the leverage ratio of the firm, the lower the probability that its bank got treated. However, the association is not statistically significant. I do not find a relationship of the composition of borrowers at banks and the fact whether banks held SMP eligible assets.

– Insert Table 15 around here –

Also, results might be driven by systematically lower or higher leverage ratios in certain industries. Table 15 shows the mean leverage across industries based on the two-digit NAICS code. Regressions are based on the full four-digit NAICS code, but this list would extend the page. The table indicates that leverage ratios do not systematically differ across industry.

6 Conclusion

This paper makes use of the first sovereign bond purchase program of the ECB, the securities markets program (SMP) and investigates whether firms change their investment and employment behavior depending on the share of directly treated firms in their surroundings. The higher the share of firms in the surroundings which received a subsidy on their capital costs, the less untreated firms invest and the fewer employees they have in the post period compared to the pre period and compared to firms which do not have neighbors which benefited from the program.

The effect is especially pronounced for high-leveraged firms, which matches the fact that also the high leveraged directly treated firms increase their borrowings as a response to the SMP. My results are in line with previous findings by Benoit (1984) who predicts that as soon as they have the means to do so, firms will pressure their financially constraint peers to drive them out of the market.

Economically it is not clear how to evaluate the results. If it is weak firms which are driven out of the market then this can be overall productivity enhancing. However, if it is due to other weak firms gaining market shares the implications are not clear. However, the paper shows that researchers which merely study direct effects of asset purchases might interpret a positive differential effect between treatment and control group as a positive direct effect. Instead, I show that there is a negative spillover effect.

This paper does not directly test the channels through which spillovers occur: whether directly treated firms lower product market prices, or whether spillovers even occur on the bank level remains to be explored by future research.

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A Tables

Table 1: Summary Statistics

This table reports summary statistics for a sample of 71,874 small and medium German firms according to the definition of SMEs by the European Commission (2018). *Loans* is loan holdings in logs (EUR). Δ *Loans* is the first difference of *Loans*. *Leverage* is the average leverage ratio in 2006-2007 defined as current liabilities plus non-current liabilities over total assets. *Weak_bank* is a binary variable and equals 1 if the bank was among the lowest decile of the equity ratio of all banks in the sample in the year 2007 (reported on firm level), and 0 otherwise. *Age* is firm age calculated as the current year minus the year of incorporation. *SMP* is the binary treatment variable and equals 1 if the bank, the firm is linked to, held eligible SMP assets in all three treatment years 2010, 2011 and 2012. It equals 0 for banks that never held any SMP eligible asset. The following variables are based on the sample for the analysis of spillover effects: *Investments* defined as log change of fixed assets less depreciation. *SMPshare* is the share of treated firms in the same region–industry. *Post* equals 0 in pre period 2007-2009 and 1 in period 2010-2013. *Employment* is the log number of employees. *SMPshare_region* is the share of treated firms in the same region and *UR* is a binary variable which equals 1 if the firm's region has an average unemployment rate below or equal 5% in the pre period and 0 otherwise. All continuous firm and bank level variables are winsorized at the 1% and 99%.

	N	mean	p50	sd	min	max
Lending						
Loans	370,282	0.885	0.000	3.098	0.000	15.494
Δ Loans	370,282	0.011	0.000	2.253	-15.494	15.494
Leverage_0607	331,951	0.622	0.668	0.278	0.000	1.000
Weak_bank	370,282	0.154	0.000	0.361	0.000	1.000
Age	369,593	17.448	13.000	18.201	0.000	423.000
SMP	370,282	0.103	0.000	0.304	0.000	1.000
Spillovers						
Investments	34,507	11.024	11.090	2.165	-5.940	24.523
SMP	34,507	0.115	0.000	0.319	0.000	1.000
SMPshare	34,507	0.106	0.000	0.250	0.000	0.996
Post	34,507	0.662	0.473	1.000	0.000	1.000
Employment	24,400	3.116	3.219	1.376	0.000	5.517
SMPshare_region	24,400	0.107	0.016	0.224	0.000	0.939
Leverage_0607	26,704	0.687	0.736	0.241	0.000	1.000
UR	26,704	0.095	0.000	0.293	0.000	1.000

Table 2: Test on parallel trend assumption

This table shows t-tests on mean levels and mean changes of firm level variables within the pre and post period between treated and control groups. The last two columns report the differences-in-differences tests between the means of the two groups over both periods. The sample covers the years 2007-2009 in the pre period and 2010-2013 in the post period. The table reports tests on the following firm-level variables: *Loans* is the log of loan holdings (in EUR) of firm i, *Investments* is the log differences of fixed assets minus depreciation (in EUR), *Employment* is log of number of employees, $\Delta Loans$ is log difference of loans (in EUR), $\Delta Investments$ is the log difference of investments, and $\Delta Employment$ is the log differences of number of employees. All variables are winsorized before transformed into logs at the top and bottom 1% percentile. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

		Pre-period				Post-period					
	N	Non-treated	Treated	Diff	SE	Non-treated	Treated	Diff	SE	DiD	SE
Loans	34,507	5.715	5.652	-0.063	0.060	5.626	5.619	0.043	-0.007	0.056	0.216
Investments	34,507	11.150	11.170	0.021	0.021	10.960	10.930	0.015	-0.030	-0.051	0.076
Employment	24,218	3.647	3.455	-0.192	0.020***	2.976	2.866	0.010	-0.110***	0.082	0.064
ΔLoans	34,507	-0.298	-0.258	0.040	0.045	-0.409	-0.353	0.032	0.056	0.017	0.162
ΔInvestments	24,786	-0.034	-0.029	0.005	0.017	0.054	0.047	0.010	-0.007	-0.012	0.056
ΔEmployment	20,931	0.023	0.012	-0.011	0.003	0.037	0.037	0.002	0.000	0.011	0.011

Table 3: Direct and spillover effects on investments

This table reports results from estimations in the vein of Berg and Streitz (2019): $Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma_1 \times \text{SMP}_i \times Post_t + \gamma_2 \times \text{SMP}_i \times Post_t \times \text{SMPshare}_{rk} + \gamma_3 \times (1 - \text{SMP}_i) \times Post_t \times \text{SMPshare}_{rk} + \epsilon_{it}$. Dependent variable is investments, defined as log differences of fixed assets less depreciation of firm i in year t. SMP is a binary variable which equals 1 if the firm's bank held eligible SMP assets in all three treatment years 2010–2012. $Post$ is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. $SMPshare$ is the share of treated firms in the same region–industry, excluding firm i. The sample encompasses firms which are directly treated, and firms which are not directly treated. Standard errors are clustered on the region–industry level and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I)	(II)	(III)
SMP*Post	0.031	-0.047	-0.043
	(0.133)	(0.144)	(0.151)
SMP*Post*SMPshare	-0.021	-0.035	-0.020
	(0.176)	(0.225)	(0.238)
(1-SMP)*Post*SMPshare	-0.288*	-0.484**	-0.428**
	(0.163)	(0.210)	(0.198)
Observations	34,507	34,507	34,507
R-squared	0.872	0.884	0.890
Firm FE	Yes	Yes	Yes
Time FE	Yes	No	No
Region-Time FE	No	Yes	Yes
Industry-Time FE	No	No	Yes

Table 4: Spillover effects on investments: leveraged firms

This table reports results from a differences-in-differences estimation as in the following: $Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma \times Post_t \times \text{SMPshare}_{rk} + \cdots + \epsilon_{it}$. Dependent variable is investments, defined as log differences of fixed assets less depreciation of firm i in year t. $Post$ is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. $SMPshare$ is the share of treated firms in the same region–industry. The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). In columns V-VI, the interaction term is augmented with $Leverage$, which is defined as average firm leverage for the years 2006/2007 and is winsorized at the 1% and 99%. Standard errors are clustered on the region–industry level and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I)	(II)	(III)	(IV)	(V)	(VI)
Post*SMPshare	-0.309**	-0.420*	-0.364*	0.678*	0.587	0.444
	(0.146)	(0.239)	(0.221)	(0.367)	(0.395)	(0.412)
Post*Leverage				-0.068	-0.053	-0.115
				(0.071)	(0.073)	(0.080)
Post*SMPshare*Leverage				-1.544**	-1.552**	-1.240*
				(0.677)	(0.708)	(0.638)
Observations	26,704	26,704	26,704	26,704	26,704	26,704
R-squared	0.874	0.889	0.896	0.874	0.889	0.896
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	No	Yes	No	No
Region*Time	No	Yes	Yes	No	Yes	Yes
Industry*Time FE	No	No	Yes	No	No	Yes

Table 5: Direct and spillover effects on employment

This table reports results from estimations in the vein of Berg and Streitz (2019): $Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma_1 \times \text{SMP}_i \times Post_t + \gamma_2 \times \text{SMP}_i \times Post_t \times \text{SMPshare}_{(k)r} + \gamma_3 \times (1 - \text{SMP}_i) \times \text{SMPshare}_{(k)r} \times Post_t + \epsilon_{it}$. Dependent variable is employment, defined as log of employees of firm i in year t. SMP is a binary variable which equals 1 if the firm's bank held eligible SMP assets in all three treatment years 2010–2012. $Post$ is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. In columns I-III, $SMPshare$ is the share of treated firms in the same region–industry, excluding firm i. In columns IV and V, $SMPshare$ is the share of treated firms in the same region, also excluding firm i. The sample encompasses firms which are directly treated, and firms which are not directly treated. Standard errors are clustered on the region–industry level in columns I-III and on the region level in columns IV and V, and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I)	(II)	(III)	(IV)	(V)
SMP*Post	0.086	0.080	0.040	0.031	0.056
	(0.070)	(0.080)	(0.090)	(0.046)	(0.054)
SMP*Post*SMPshare	-0.141	-0.106	-0.0152		
	(0.107)	(0.121)	(0.141)		
(1-SMP)*Post*SMPshare	-0.191*	-0.071	-0.009		
	(0.114)	(0.155)	(0.158)		
SMP*Post*SMPshare_region				-0.083	-0.118
				(0.075)	(0.090)
(1-SMP)*Post*SMPshare_region				-0.169**	-0.139**
				(0.071)	(0.066)
Observations	24,218	24,218	24,218	24,218	24,218
R-squared	0.974	0.977	0.979	0.974	0.976
Firm FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	No	Yes	No
Region-Time FE	No	Yes	Yes	No	No
Industry-Time FE	No	No	Yes	No	Yes

Table 6: Spillover effects on employment: leveraged firms

This table reports results from a differences-in-differences estimation as in the following: $Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma \times Post_t \times \text{SMPshare}_{rk} + \cdots + \epsilon_{it}$. Dependent variable is employment, defined as log number of employees of firm i in year t. *Post* is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. $SMPshare$ is the share of treated firms in the same region–industry. The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). In columns V-VI, the interaction term is augmented with *Leverage*, which is defined as average firm leverage for the years 2006/2007 and is winsorized at the 1% and 99%. Standard errors are clustered on the region–industry level and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I)	(II)	(III)	(IV)	(V)	(VI)
Post*SMPshare	-0.174*	-0.027	-0.010	0.326	0.420	0.442
	(0.104)	(0.137)	(0.148)	(0.202)	(0.277)	(0.307)
Post*Leverage				-0.043	-0.066	-0.080*
				(0.039)	(0.041)	(0.046)
Post*SMPshare*Leverage				-0.820**	-0.724*	-0.718
				(0.360)	(0.438)	(0.468)
Observations	18,481	18,481	18,481	18,481	18,481	18,481
R-squared	0.974	0.978	0.980	0.974	0.978	0.980
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	No	Yes	No	No
Region*Time	No	Yes	Yes	No	Yes	Yes
Industry*Time FE	No	No	Yes	No	No	Yes

Table 7: Spillover effects on employment on regional level: leveraged firms

This table reports results from a differences-in-differences estimation as in the following: $Y_{it} = \alpha_i + \alpha_{kt} + \gamma \times Post_t \times \text{SMPshare}_r + \cdots + \epsilon_{it}$. Dependent variable is employment, defined as log number of employees of firm i in year t. *Post* is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. $SMPshare$ is the share of treated firms in the same region. The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). In columns V-VI, the interaction term is augmented with *Leverage*, which is defined as average firm leverage for the years 2006/2007 and is winsorized at the 1% and 99%. Standard errors are clustered on the region level and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I)	(II)	(III)	(IV)
Post*SMPshare	-0.207***	-0.167**	0.132	0.200
	(0.069)	(0.069)	(0.172)	(0.193)
Post*Leverage			-0.041	-0.068
			(0.042)	(0.048)
Post*SMPshare*Leverage			-0.538*	-0.584*
			(0.294)	(0.328)
Observations	18,481	18,481	18,481	18,481
R-squared	0.974	0.976	0.974	0.977
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Industry*Time FE	No	Yes	No	Yes

Table 8: Economic condition as a moderator

This table reports results from a differences-in-differences estimation as in the following: $Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma \times Post_t \times \text{SMPshare}_{rk} \times \text{UR}_r + \cdots + \epsilon_{it}$. Dependent variables are investments, defined as log differences of fixed assets less depreciation of firm i in year t, and employment, defined as log number of employees. *Post* is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. $SMPshare$ is the share of treated firms in the same region–industry. *Leverage* is defined as average firm leverage for the years 2006/2007 and is winsorized at the 1% and 99%. UR_r is a binary variable which equals 1 for regions in which the unemployment rate was on average below 5% in the pre period (corresponds to 10% of all regions), and 0 otherwise. The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). Standard errors are clustered on the region–industry level and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I) Investments	(II) Employment
Post*SMPShare	0.489	0.445
	(0.417)	(0.313)
Post*Leverage	-0.144*	-0.0801
	(0.0848)	(0.0496)
Post*SMPshare*Leverage	-1.302**	-0.739
	(0.643)	(0.470)
Post*SMPshare*UR	-2.966*	-3.668***
	(1.591)	(1.313)
Post*Leverage*UR	0.284	-0.0175
	(0.235)	(0.143)
Post*SMPshare*Leverage*UR	5.496**	7.822***
	(2.489)	(2.664)
Observations	26,704	18,481
R-squared	0.896	0.980
Firm FE	Yes	Yes
Time FE	No	No
Region-Time FE	Yes	Yes
Industry-Time FE	Yes	Yes

Table 9: Leads and lags model

This table reports results from leads and lags estimations from the following regression: $Y_{it} = \alpha_i + \alpha_t + \sum_{t=2008}^{2013} \gamma_t \; D_t \times SMPshare_i + \cdots + \epsilon_{it}$. Dependent variables are investments, defined as log differences of fixed assets less depreciation of firm i in year t, and employment, defined as log number of employees. D_t are year indicators, leaving out 2007. $SMPshare$ is the share of treated firms in the same region–industry in column I and the share of treated firms in the same region in column II. The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). Standard errors are clustered on the region–industry level in column I and clustered on the region level in column II, depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I) Investments	(II) Employment
year2008*SMPshare	-0.138	-0.023
	(0.364)	(0.079)
year2009*SMPshare	-0.593	0.093
	(0.405)	(0.104)
year2010*SMPshare	-0.536	-0.092
	(0.333)	(0.123)
year2011*SMPshare	-0.425	-0.170
	(0.340)	(0.115)
year2012*SMPshare	-0.703*	-0.184
	(0.422)	(0.116)
year2013*SMPshare	-0.906***	-0.250*
	(0.344)	(0.136)
Observations	26,704	18,481
R-squared	0.874	0.974
Firm FE	Yes	Yes
Time FE	Yes	Yes

Table 10: Placebo estimations

This table reports results from placebo estimations from the following differences-in-differences estimation: $Y_{it} = \alpha_i + \alpha_t + \gamma \times Post_t \times \text{SMPshare}_r + \epsilon_{it}$. Dependent variables are investments, defined as log differences of fixed assets less depreciation of firm i in year t, and employment, defined as log number of employees. In column I and II, *Post* equals 0 in the years 2007 and 2008, and 1 in the year 2009. The sample hence encompasses only observations in the previous pre period and does not cover the actual treatment period. In columns III and IV, *Post* equals 0 in the years 2007-2009 and 1 in the years 2010-2013. In columns I and II, $SMPshare$ is the share of treated firms in the same region- industry cluster. The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). In columns III and IV, I use the distribution of the actual SMPshares and assign the treatment randomly over region–industry clusters anew. Standard errors are clustered on the region-industry level and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I) Investments	(II) Employment	(III) Investments	(IV) Employment
Post_placebo*SMPshare	-0.473	0.084		
	(0.386)	(0.067)		
Post*SMP_placebo			-0.153	0.100
			(0.133)	(0.073)
Observations	8,442	3,915	26,704	18,481
R-squared	0.885	0.982	0.874	0.974
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Table 11: Direct and spillover effects including firms which changed the bank

This table reports results from estimations in the vein of Berg and Streitz (2019): $Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma_0 \times SMP_{it} + \gamma_1 \times \text{SMP}_{it} \times Post_t + \gamma_2 \times \text{SMP}_{it} \times Post_t \times \text{SMPshare}_{rk} + \gamma_3 \times (1 - \text{SMP}_{it}) \times Post_t \times \text{SMPshare}_{rk} + \epsilon_{it}$. Dependent variable is investments, defined as log differences of fixed assets less depreciation of firm i in year t, or employment defined as log of employment of firm i in year t. SMP is a binary variable which equals 1 if the firm's bank held eligible SMP assets in all three treatment years 2010–2012. If the firm changed bank, it changes treatment status accordingly. $Post$ is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. $SMPshare$ is the average share of treated firms in the same region–industry in columns I-III, and the average share of treated firms in the same region in columns IV and V, excluding firm i. The sample encompasses firms which are directly treated, and firms which are not directly treated. Standard errors are clustered on the region–industry level in columns I-III and on the region level in columns IV and V, and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I) Investments	(II) Investments	(III) Investments	(IV) Employment	(V) Employment
SMP	-0.118	-0.169	-0.162	-0.099*	-0.109
	(0.246)	(0.305)	(0.329)	(0.0543)	(0.075)
SMP*Post	0.022	-0.035	-0.025	0.045	0.069
	(0.129)	(0.139)	(0.144)	(0.046)	(0.051)
SMP*Post*SMPshare	-0.012	-0.080	-0.111	-0.105	-0.140
	(0.173)	(0.221)	(0.233)	(0.085)	(0.092)
(1-SMP)*Post*SMPshare	-0.284*	-0.480**	-0.490***	-0.195**	-0.168**
	(0.148)	(0.199)	(0.182)	(0.078)	(0.082)
Observations	37,322	37,322	37,322	26,140	26,140
R-squared	0.868	0.880	0.885	0.974	0.976
Firm FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	No	Yes	No
Region-Time FE	No	Yes	Yes	No	Yes
Industry-Time FE	No	No	Yes	No	Yes

Table 12: Alternative fixed effect structure

This table reports results from estimations in the vein of Berg and Streitz (2019): $Y_{it} = \alpha_i + \alpha_{ILST} + \gamma_1 \times \text{SMP}_i \times Post_t + \gamma_2 \times \text{SMP}_i \times Post_t \times \text{SMPshare}_{rk} + \gamma_3 \times (1 - \text{SMP}_i) \times Post_t \times \text{SMPshare}_{rk} + \epsilon_{it}$. Dependent variable is investments, defined as log differences of fixed assets less depreciation of firm i in year t, or employment defined as log of employment of firm i in year t. SMP is a binary variable which equals 1 if the firm's bank held eligible SMP assets in all three treatment years 2010–2012. $Post$ is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. $SMPshare$ is the average share of treated firms in the same region–industry in columns I and II, and the average share of treated firms in the same region in columns III and IV, excluding firm i. The regression includes firm fixed effects and Industry–Location–Time–Size fixed effects in the vein of Degryse et al. (2019) in columns I and II, and Industry–Time–Size fixed effects in columns III and IV. Industry is based on the two-digit NAICS code, location is based on the first two digits of the firm's postal code, time is based on years and size bins are based on deciles of log total assets of firms in columns I and III, and on quintiles of log total assets of firms in columns II and IV. The sample encompasses firms which are directly treated, and firms which are not directly treated. Standard errors are clustered on the region–industry level in columns I and II and on the region level in columns III and IV, and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I) Investments	(II) Investments	(III) Employment	(IV) Employment
SMP*Post	0.149	-0.027	0.009	0.018
	(0.323)	(0.242)	(0.046)	(0.047)
SMP*Post*SMPshare	-0.114	0.112	-0.033	-0.062
	(0.453)	(0.346)	(0.063)	(0.071)
(1-SMP)*Post*SMPshare	-0.138	-0.311	-0.141**	-0.162***
	(0.329)	(0.385)	(0.058)	(0.061)
Observations	13,830	20,948	24,108	24,185
R-squared	0.958	0.943	0.977	0.976
Firm FE	Yes	Yes	Yes	Yes
Industry-Location-Time-Size FE	Yes	Yes	No	No
Industry-Time-Size FE	No	No	Yes	Yes

Table 13: Distribution of firms' leverage ratios within non-treated and treated banks

This table reports the distribution of firms' leverage ratio as a mean of the years 2006–2007 within non-treated banks (SMP=0) and treated banks (SMP=1).

	p1	p10	p25	p50	p75	p90	p99
SMP=0	0.092	0.337	0.514	0.728	0.890	0.966	0.999
SMP=1	0.056	0.340	0.477	0.713	0.873	0.959	0.999

Table 14: Correlation of treatment of banks and leverage ratio of firms

This table reports results from the following regression estimation $SMP_i = \alpha + \beta Leverage_i$. SMP is a binary variable which equals 1 if the firm's bank held eligible SMP assets in all three treatment years 2010–2012. *Leverage* is defined as average firm leverage for the years 2006/2007 and is winsorized at the 1% and 99%. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(1) SMP
Leverage	-0.032
	(0.022)
Constant	0.148***
	(0.016)
Observations	3,884
R-squared	0.001

Table 15: Distribution across industries

This table shows the distribution across industries according to the two-digit NAICS code of firms from the baseline regressions in Table 3. Industries in the regressions are based on the full four-digit NAICS codes, but the list would extend the page. The sample comprises 9,775 small and medium German firms according to the definition of SMEs by the European Commission.

NAICs code, twodigit	Name	Frequency	Average Leverage ratio
21	Mining	26	0.757
22	Utilities	252	0.567
23	Construction	1501	0.753
31	Manufacturing	200	0.680
32	Manufacturing	378	0.683
33	Manufacturing	1058	0.693
42	Wholesale Trade	1543	0.721
44	Retail Trade	486	0.741
45	Retail Trade	143	0.728
48	Transportation and Warehousing	581	0.735
49	Transportation and Warehousing	25	0.678
51	Information	107	0.672
53	Real Estate Rental and Leasing	936	0.655
54	Professional, scientific and technical services	991	0.637
55	Management of companes and enterprises	227	0.559
56	Administrative support and waste management and remediation services	615	0.690
71	Arts, entertainment and recreation	181	0.617
72	Accomodation and food services	178	0.718
81	Other services (except public administration)	347	0.642
Total / Unweighted average		9,775	0.680

Table 16: Variable Descriptions

Variable	Unit	Description
Firm level		
Loans, log	EUR	Log of loans in EUR. Loans are winsorized at lower and upper 1%. Source: Amadeus.
Δloans	%	Log difference of loans.
Age	Years	Current year minus year of incoporation. Source: Amadeus.
Leverage	Ratio	Mean of current plus non-current liabilities over total assets of firms in 2006-2007. Source: Amadeus.
Investments	EUR	Log differences of fixed assets less depreciations. Winsorized at lower and upper 1%. Source: Amadeus. Own calculations.
Employment		Log of number of employees. Source: Amadeus.
Indicators		
Weak_bank	0/1	Equals 1 if a bank's equity ratio was among lowest 10% of distribution in 2007. Source: Bankscope.
UR	0/1	Equals 1 if region in which firm is located has an average unemployment rate below 5% in the pre period. Source: Destatis.
Post	0/1	Equals 0 in pre period 2007-2009 and equals 1 in post period 2010-2013.
Treatment		
SMP	0/1	Equals 1 if bank held an SMP assets in all three treatment years 2010, 2011 and 2012. Source: Bundesbank and ECB.
SMPshare	Ratio	Share of firms in same region–industry which are treated by SMP, or share of firms in same region which are treated by SMP, excluding firm i.

B Figures

Figure 1: Marginal effects of Post on investments for lowest and highest decile in firm leverage

This figure shows marginal effects of the Post period of firms on investments, measured according log differences in fixed assets less depreciation, conditional on the share of firms in the same region–industry which are treated ($SMPshare$). The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). Light gray shows the marginal effects for firms in the lower decile in terms of leverage measured in the years 2006–2007. Dark gray shows marginal effects for firms in the upper decile in terms of leverage. Results of the underlying regression analysis are shown in Table 4 in column IV. The gray area indicates confidence intervals at the 10% level. The histogram shows the distribution of the SMP share during the post period for the underlying sample.

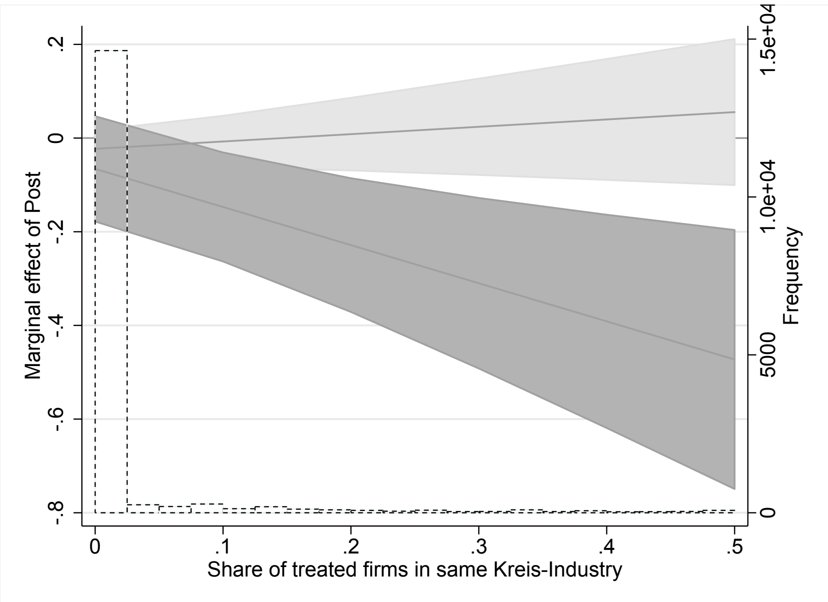


Figure 2: Marginal effects of Post on employment for lowest and highest decile in firm leverage

This figure shows marginal effects of the Post period of firms on employment, measured according log of number of employees, conditional on the share of firms in the same region–industry which are treated ($SMPshare$). The sample encompasses only firms which are not directly treated (a firm is defined as directly treated if the firm's bank held eligible SMP assets in all three treatment years 2010–2012). Light gray shows the marginal effects for firms in the lower decile in terms of leverage measured in the years 2006–2007. Dark gray shows marginal effects for firms in the upper decile in terms of leverage. Results of the underlying regression analysis are shown in Table 6 in column IV. The gray area indicates confidence intervals at the 10% level. The histogram shows the distribution of the SMP share during the post period for the underlying sample.

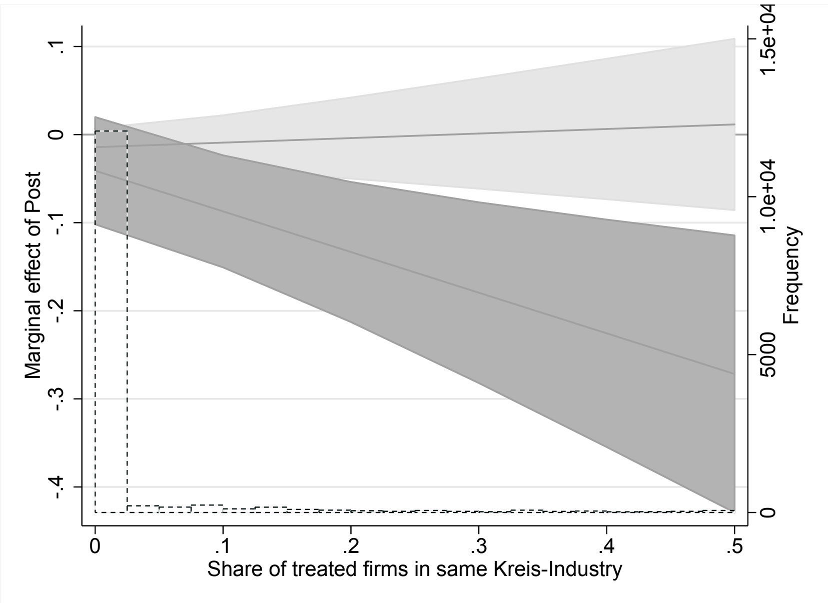


Figure 3: Marginal effect of Post on investments and low unemployment rate
This figure shows marginal effects of firms which are non-treated on investments, conditional on the share of firms in the same region which are treated ($SMPshare$) only for regions with an average unemployment rate below 5% in the pre period. The underlying regression analysis is a quadruple differences-in-differences model. The pre period covers the years 2007-2009, the post period covers the years 2010-2013. Standard errors are clustered on the region-industry level. The light gray area shows firms in the lowest decile in terms of leverage 2006–2007, the dark gray area shows firms in the highest decile in terms of leverage. The histogram shows the distribution of the SMP share during the post period for the underlying sample. Results of the underlying regression analysis are shown in Table 8 in column I.

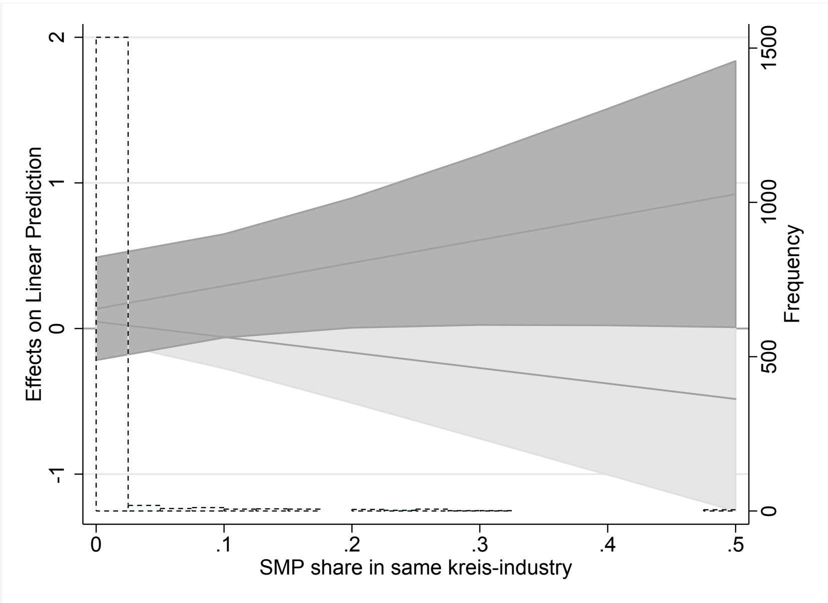
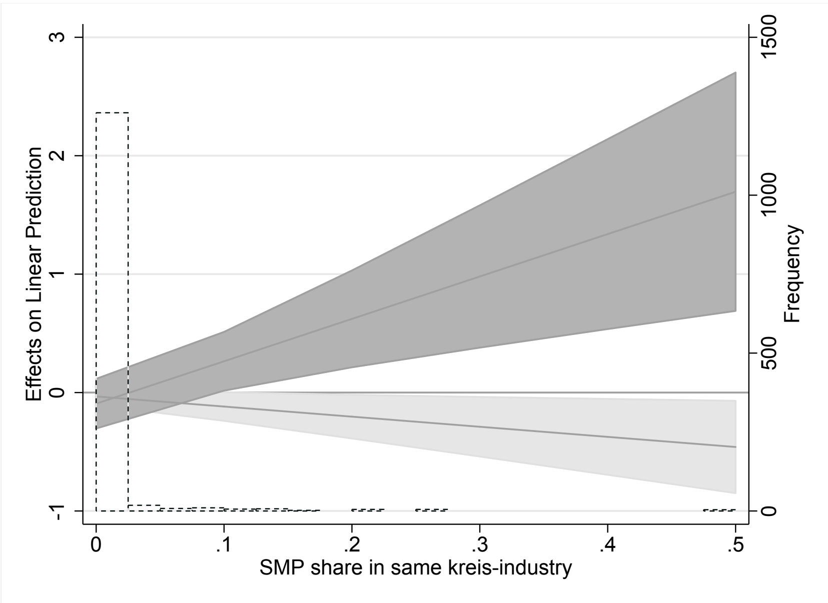


Figure 4: Marginal effect of Post on employment and low unemployment rate
This figure shows marginal effects of firms which are non-treated on employment, conditional on the share of firms in the same region which are treated ($SMPshare$) only for regions with an average unemployment rate below 5% in the pre period. The underlying regression analysis is a quadruple differences-in-differences model. The pre period covers the years 2007-2009, the post period covers the years 2010-2013. Standard errors are clustered on the region-industry level. The light gray area shows firms in the lowest decile in terms of leverage 2006–2007, the dark gray area shows firms in the highest decile in terms of leverage. The histogram shows the distribution of the SMP share during the post period for the underlying sample. Results of the underlying regression analysis are shown in Table 8 in column II.



C Firm level data cleaning

The Dafne dataset comprises more than 1.6 million firms during the period 2007-2013. After merging with Amadeus, the dataset covers 1,019,047 firms. To derive a consistent dataset, further data cleaning on the Amadeus firm financial dataset is necessary: If there are firm-year duplicates, I keep the unconsolidated balance sheet informations and drop consolidated data. Some firms have the same name but different IDs at Buerau van Dijk. This can be due to mergers. If name of firm, zip code and year is the same, but ID and consolidation code is different, the observations are dropped as I can assume that it is the same firm, but I do not know which report is the correct one. Further, observations with negative total assets are dropped. The age of the firm is calculated as the current year minus the year of incorporation and firms with negative age are dropped.

D Lending

As a prerequisite to the study on spillovers, this paper corroborates findings from the literature that asset purchases induce weak banks to increase lending to risky borrowers. Exposure to SMP eligible assets (sovereign debt securities from five crisis countries, Italy, Portugal, Ireland, Spain and Greece) is low among German savings and cooperative banks. On first sight, it is not clear why there should be a change in lending activity to firms, and further spillover effects. A bank that held an eligible SMP asset could benefit in various ways. Either it sold the asset to the ECB and thereby obtained liquid reserves. Or it could benefit from a valuation effect.

There are two building blocks why there could be a change in lending behavior for a specific group of banks: First, according to the zombie lending literature, lowly capitalized banks have an incentive to continue lending to troubled borrowers and thereby bet on the borrower's revival to avoid a loss to the own balance sheet (Caballero et al., 2008). An unexpected windfall gain might enable the bank to do so. Second, according to Diamond (2001), the size of the recapitalization is decisive to a change in behavior of a bank. It is especially these *small* windfall gains which lead to a gamble for resurrection instead of a healthy consolidation of banks' balance sheets (Keuschnigg and Kogler, 2017; Giannetti and Simonov, 2013).

Hypothesis: There is an increase in lending from lowly capitalized banks to highly leveraged firms as a response of the SMP.

On the other hand, it is possible that exposures are very small, and that therefore the effect is so small that it is not perceivable.

Null Hypothesis: There is no change in lending behavior of banks with exposure the SMP.

In the following, findings from Koetter (2019) are replicated that regional banks increase lending as a response to the SMP. The analysis will be extended by showing which banks lend and which firms borrow more and hence drive the effect. I estimate the following model:

$$Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma\, SMP_i \times Post_t + \cdots + \epsilon_{it}. \tag{6}$$

The dependent variable is the log difference of loans on firm i's balance sheet. Time series are collapsed on the firm level on the mean of pre and mean of post period for firm i to avoid serial correlation (Bertrand et al., 2004). The estimation includes a differences-in-differences term, where SMP is a binary variable and indicates whether firm i is linked to a bank that held SMP eligible assets during all three treatment years 2010, 2011 and 2012. The dummy variable $Post$ equals 0 in the pre period 2007-2009, and 1 in the post period 2010-2013.

To ensure that results are not driven by demand shocks on the regional or industry level, as well as by time invariant unobservables on the firm level, an extensive set of fixed effects are included. Firm fixed effects α_i, region-time fixed effects α_{rt} based on two-digit zip codes which renders 95 regions in the baseline sample, and industry-time fixed effects α_{kt}, based on two-digit NAICS codes, which renders 19 different industries in the baseline sample, control for region specific or industry specific demand shocks. Table 15 in the Appendix shows the distribution of firms across industries. Bank fixed effects are nested within firm fixed effects as solely firms which do not change their bank are included in the estimation. The bank level is the highest level of variation on the right-hand side, because the treatment variable varies on the bank level. Therefore, standard errors are clustered on the bank level. Column I in Table 17 shows the result.

– Insert Table 17 around here –

Firms connected to a bank that benefited from the program show on average higher loan growth in the post period than other firms; γ is positive and statistically significant on the 10% level. The zombie lending literature predicts a change in lending activities especially by weak banks. To test whether weakly capitalized banks drive the increased lending activity in the post period to firms connected to treated banks, the model is augmented as shown in equation 7:

$$\begin{aligned} Y_{it} = \gamma_1\, SMP_i \times Post_t + \gamma_2\, SMP_i \times Post_t \times \text{Weak bank}_i \\ + \cdots + \alpha_i + \alpha_{rt} + \alpha_{kt} + \epsilon_{it}. \end{aligned} \tag{7}$$

The differences-in-differences term is interacted with an indicator *Weak bank*, which equals 1 if firm i is connected to a weakly capitalized bank and equals 0 if firm i is connected to a strongly capitalized bank measured in the pre crisis and pre treatment year 2007. The estimation equation includes also all compositional terms of the triple differences-in-differences term.

Column II in Table 17 shows the result. γ_2 is positive and statistically significant at the 5% level, whereas γ_1 loses its statistical significance and cannot be distinguished from zero. The results confirm conjectures from the zombie lending literature. The increase in lending activities from the SMP program can be attributed to weakly capitalized banks. The model is further augmented to test who is benefiting from increased lending activities by weak banks by estimating a quadruple differences-in-differences estimation as shown in Equation 8:

$$
\begin{aligned}
Y_{it} = &\gamma\, SMP_i \times Post_t \times \text{Weak bank}_i \times \text{Weak firm}_i \\
&+ \alpha_i + \alpha_{rt} + \alpha_{kt} \cdots + \epsilon_{it}.
\end{aligned} \tag{8}
$$

Weak firm is the continuous leverage ratio of firm i in the pre crisis and pre treatment years 2006/2007. I derive the marginal effects of SMP conditional on the post period and on a continuum of firm leverage ratios for the group of firms connected to weak banks as well as the group of firms connected to strong banks separately. For sake of completeness, I estimate first a triple differences-in-differences estimation in which the differences-in-differences term $SMP_i \times Post_t$ is interacted with *Weak firm* to find out whether there are differences in lending activities vis-a-vis weak firms on average. Results in column III show that this is not the case. There is only a marginal difference for the averagely leveraged firm, which Figure A.1 confirms for different levels of firm leverage. Column IV finally shows the results from estimating Equation 8. From first sight, regression results do not show effects for the averagly leveraged firm. However, Figure A.2 and A.3 show the results for the impact of the SMP on loan growth for strong and weak banks separately conditional on the leverage ratio of firms pre treatment and pre crisis.

– Insert Figure A.2 around here –

Figure A.2 shows the marginal effect of the treatment in the post period on firms linked to a strong bank. A histogram with the distribution of average leverage ratios of firms in years 2006/2007 is included. The treatment has no effect on the loan growth of firms connected to strong banks independent of their leverage ratio. This is in line with theory which suggests that small windfall gains do not lead to change in behavior of strong banks.

– Insert Figure A.3 around here –

Figure A.3 shows a strong positive effect of the SMP on firms linked to weak banks in the post period. The effect is positive and statistically significant especially for medium to highly leveraged firms, though the effect vanishes for firms at the very top of the leverage distribution. For the average firm with a leverage ratio of 0.621 in 2006/2007, the marginal effect of the treatment in the post period equals 0.141, that implies a higher loan growth of

14.1%. The results indicate that it is the weak banks which make use of their windfall gains and support especially their medium and highly leveraged borrowers. Though the highest leveraged borrowers do not show a statistically significantly higher loan growth.

Estimation equations are estimated using collapsed data in the vein of (Bertrand et al., 2004). For robustness checks, Figure A.4 and Figure A.5 show results for estimation Equation 8 for non-collapsed data. The results are very similar – lending activities of strong banks does not change after the treatment, but lending growth of weak banks does increase. Now medium, highly and also very highly leveraged firms seem to be mostly affected by the increase in lending activity.

E Lending: Table and figures

Table 17: Results from differences-in-differences analyses: Effects on lending

This table reports results from differences-in-differences estimations. The model builds up from a standard differences-in-differences model in column I to a quadruple differences-in-differences estimation in column IV as in the following: $Y_{it} = \alpha_i + \alpha_{rt} + \alpha_{kt} + \gamma SMP_i \times Post_t \times \text{Weak bank}_i \times \text{Leverage}_i + \cdots + \epsilon_{it}$. Dependent variable is $\Delta Loan$, which is the log differences in loans (in EUR). SMP is the binary treatment variable and equals 1 if the bank, the firm is linked to, held eligible SMP assets in all three treatment years 2010, 2011 and 2012. It equals 0 for banks that never held any SMP eligible asset. *Post* is a binary variable which equals 0 in the years 2007-2009 and 1 in the years 2010-2013. *Weak_bank* is a binary variable and equals 1 if the bank was among the lowest decile of the equity ratio of all banks in the sample in the year 2007, and 0 otherwise. *Leverage* is average firm leverage for the years 2006/2007. All continuous variables are winsorized at the 1% and 99%. The data is collapsed to one single observation in the pre and one single observation in the post period per firm. The regressions include further firm fixed effects, region*period fixed effects, industry*period fixed effects. Standard errors are clustered on the bank level and depicted in parentheses. *, **, *** indicate significant coefficients at the 10%, 5%, and 1% level, respectively.

	(I) Δloan	(II) Δloan	(III) Δloan	(IV) Δloan
SMP*Post	0.051*	0.015	0.050	0.055
	(0.030)	(0.036)	(0.057)	(0.066)
Post*Weak_bank		-0.017		-0.043
		(0.024)		(0.049)
SMP*Post*Weak_bank		0.127**		0.037
		(0.060)		(0.137)
Post*Leverage			0.052*	0.046
			(0.031)	(0.034)
SMP*Post*Leverage			0.001	-0.064
			(0.091)	(0.104)
Post*Weak_bank*Leverage				0.043
				(0.074)
SMP*Post*Weak_bank*Leverage				0.145
				(0.233)
Observations	115,446	115,446	115,446	115,446
R-squared	0.405	0.405	0.405	0.405
Firm FE	Yes	Yes	Yes	Yes
Region*Period FE	Yes	Yes	Yes	Yes
Industry*Period FE	Yes	Yes	Yes	Yes

Figure A.1: Marginal effects of treatment for all firms

This figure shows marginal effects of the treatment (SMP) conditional on the post period on the log differences of loans (in EUR) for firms connected to strong or weak banks. Time series are collapsed on the firm level into one observation in the pre (2007-2009) and post (2010-2013) period, respectively. A bank is defined as weak if it was among the lowest decile of the distribution of the equity ratios of all banks in the sample in the year 2007, and strong otherwise. The sample covers 57,723 small and medium German firms according to the definition of SMEs by the European Commission, or 115,446 firm-year observations (two observations per firm). The underlying regression analysis is a triple differences-in-differences model, including firm fixed effects, industry-period and region-period fixed effects. Standard errors are clustered on the bank level. The gray area indicates confidence intervals at the 10% level. The histogram shows the distribution of leverage ratios during the years 2006/2007 for the underlying sample.

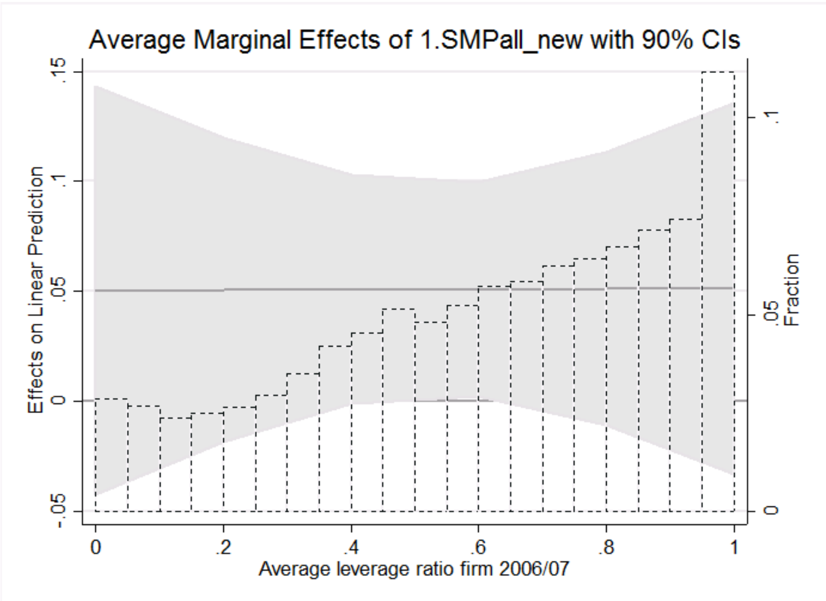


Figure A.2: Marginal effects for firms linked to strong banks

This figure shows marginal effects of the treatment (SMP) conditional on the post period on the log differences of loans (in EUR) for firms connected to strong banks. Time series are collapsed on the firm level into one observation in the pre (2007-2009) and post (2010-2013) period, respectively. A bank is defined as weak if it was among the lowest decile of the distribution of the equity ratios of all banks in the sample in the year 2007, and strong otherwise. The sample covers 57,723 small and medium German firms according to the definition of SMEs by the European Commission, or 115,446 firm-year observations (two observations per firm). The underlying regression analysis is a quadruple differences-in-differences model, including firm fixed effects, industry-period and region-period fixed effects. Standard errors are clustered on the bank level. The grey area indicates confidence intervals at the 10% level. The histogram shows the distribution of leverage ratios during the years 2006/2007 for the underlying sample.

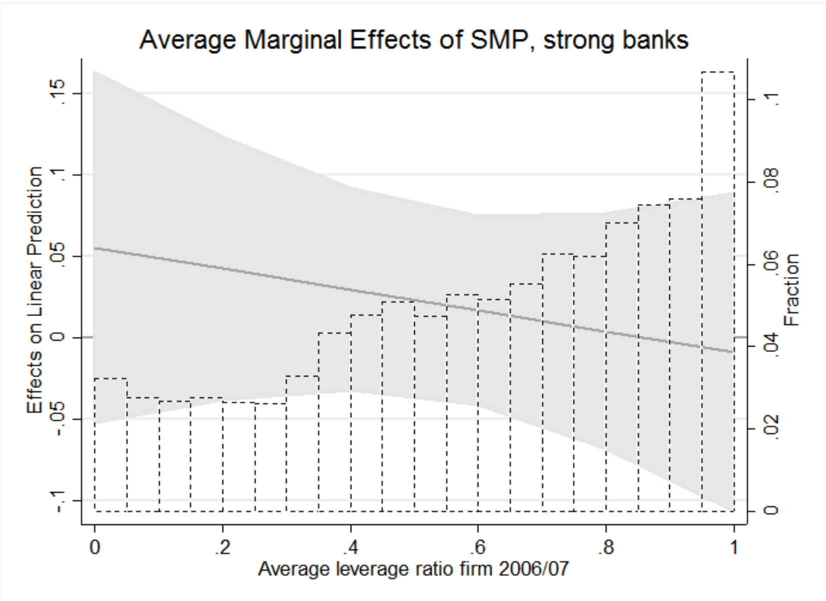


Figure A.3: Marginal effects for firms connected to weak banks

This figure shows marginal effects of the treatment (SMP) conditional on the post period on the log differences of loans (in EUR) for firms connected to weak banks. Time series are collapsed on the firm level into one observation in the pre (2007-2009) and post (2010-2013) period, respectively. A bank is defined as weak if it was among the lowest decile of the distribution of the equity ratios of all banks in the sample in the year 2007, and strong otherwise. The sample covers 57,723 small and medium German firms according to the definition of SMEs by the European Commission, or 115,446 firm-year observations (two observations per firm). The underlying regression analysis is a quadruple differences-in-differences model, including firm fixed effects, industry-period and region-period fixed effects. Standard errors are clustered on the bank level. The gray area indicates confidence intervals at the 10% level. The histogram shows the distribution of leverage ratios during the years 2006/2007 for the underlying sample.

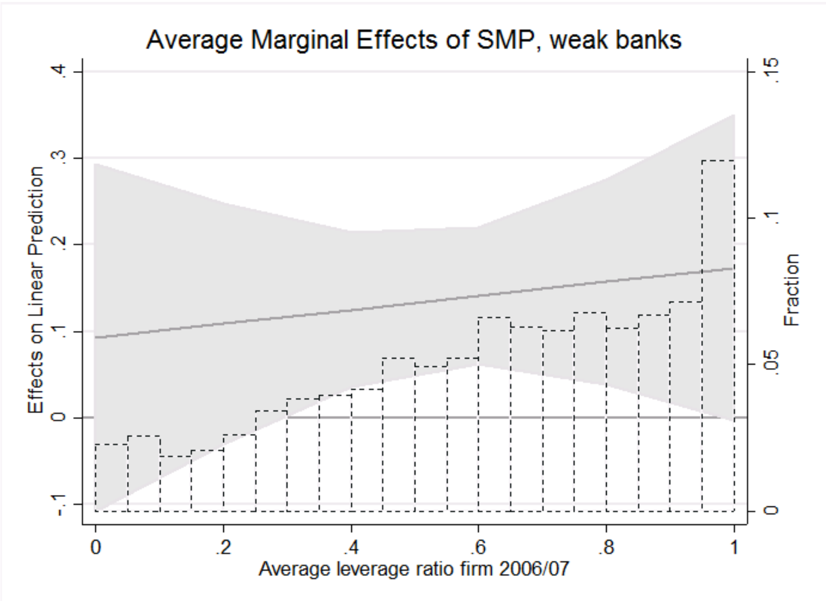


Figure A.4: Marginal effects for firms connected to strong banks, not collapsed

This figure shows marginal effects of the treatment (SMP) conditional on the post period on the log differences of loans (in EUR) for firms connected to strong banks. A bank is defined as weak if it was among the lowest decile of the distribution of the equity ratios of all banks in the sample in the year 2007, and strong otherwise. The sample covers 281,206 firm-year observations. The underlying regression analysis is a quadruple differences-in-differences model, including firm fixed effects, industry-time and region-time fixed effects. The pre period covers the years 2007-2009, the post period covers the years 2010-2013. Standard errors are clustered on the bank level. The gray area indicates confidence intervals at the 10% level. The histogram shows the distribution of leverage ratios during the years 2006/2007 for the underlying sample.

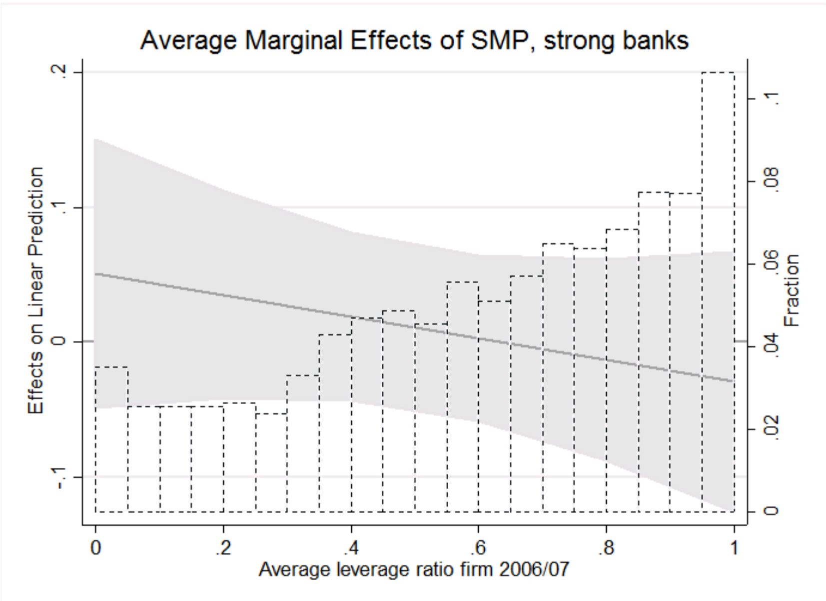
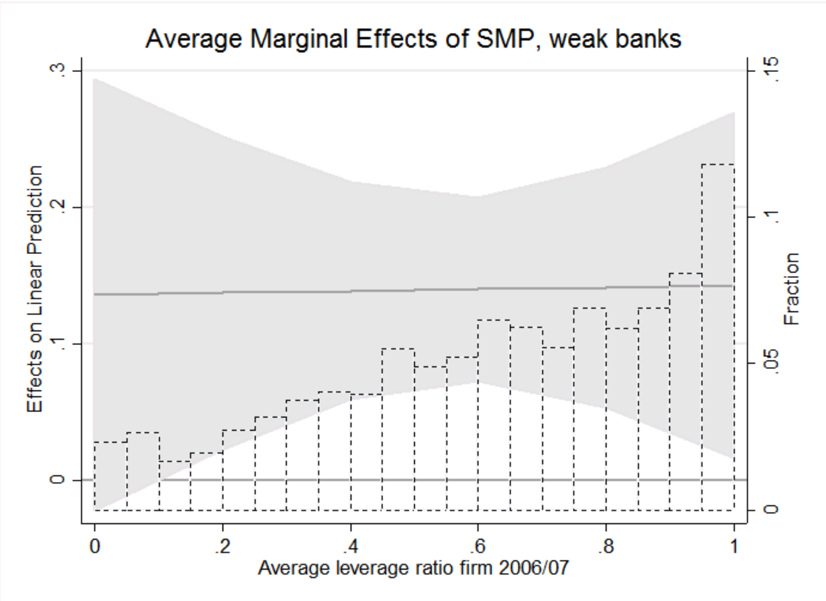


Figure A.5: Marginal effects for firms connected to weak banks, not collapsed
This figure shows marginal effects of the treatment (SMP) conditional on the post period on the log differences of loans (in EUR) for firms connected to weak banks. A bank is defined as weak if it was among the lowest decile of the distribution of the equity ratios of all banks in the sample in the year 2007, and strong otherwise. The sample covers 50,666 firm-year observations. The underlying regression analysis is a quadruple differences-in-differences model, including firm fixed effects, industry-time and region-time fixed effects. The pre period covers the years 2007-2009, the post period covers the years 2010-2013. Standard errors are clustered on the bank level. The gray area indicates confidence intervals at the 10% level. The histogram shows the distribution of leverage ratios during the years 2006/2007 for the underlying sample.



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ISSN 2194-2188