Quantitative easing in the euro area and SMEs' access to finance: Who benefits the most?

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Quantitative easing in the euro area and SMEs' access to finance: Who benefits the most?[*]

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Abstract

After the global financial crisis and during the European sovereign debt crisis, bank lending to companies in the euro area slowed down dramatically bringing the economy close to a credit crunch. It was only after the start of the ECB's quantitative easing programme in early 2015 that bank lending improved sustainably. The study analyses the impact of the ECB's Public Sector Purchase Programme (PSPP) on the access to finance of small and medium sized enterprises (SME) using firm-level data of the Survey on the Access to Finance of Enterprises (SAFE) and a fixed effects model. The analysis comprises several measures of financial access such as credit availability, financial constraints and interest rates. The micro level nature of the data allows to distinguish between aggregate and heterogeneous effects across firm size, age, sector and country. The ECB's government bond purchases improved financial access on the aggregate euro area level and particularly in the periphery of the euro area. Hence, countries which need the most stimulus benefit the most from the Public Sector Purchase Programme.

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1   Introduction and motivation

After the global financial crisis, bank lending to companies in the euro area slowed down significantly. With the intensification of the European sovereign debt crisis and the slow deleveraging process of European banks, the European economy got close to a credit crunch. From 2011 until 2015, the stock of corporate credit decreased heavily, despite an easing of interest rates and consequently lending rates for corporates (figure 1). The European Central Bank undertook unprecedented action to repair the bank lending channel of monetary policy, including conventional and unconventional measures such as the Targeted Long Term Repurchase Operations (TLTRO). However, bank lending only started to recover sustainably with the start of quantitative easing in form of the ECB's Public Sector Purchase Programme (PSPP) in March 2015 (announcement January 2015).[1] The ECB's bank lending survey and the Survey on the Access to Finance of Enterprises (SAFE) also show that credit conditions improved only after 2015.

[Figure 1: Corporate credit in the euro area]

Companies in the euro area are - especially compared to the US - particularly dependent on bank lending (see i.e. Praet (2016) or Kraemer-Eis *et al.* (2017b)). From 2002-2008, on average close to 70% of non-financial corporations' financing took place with banks. The share decreased to about 50% in the period of 2002 to early 2016, which implies that the structure of non-financial corporations' external financing started to change recently (European Central Bank, 2016). Nevertheless, the share remains much higher than in the US (25%). US corporates rely more on capital markets and non-bank lending to fund themselves. Generally, small and medium sized enterprises (SMEs) rely heavily on bank loans as source of funding. Most of the euro area's firms are SMEs, they employ more than two third of the labour force and generate about 60% of the value added (Kraemer-Eis *et al.*, 2017b). Therefore, the SMEs' funding conditions are crucial for the euro area's business cycle and monetary policy transmission. However, they face more difficulties accessing finance and have higher funding costs than large companies.

The heterogeneous structure of the euro area as monetary union with a supranational monetary policy institution, yet 19 countries with different economic structures, business cycles, economic policies, cultural differences and language barriers, pose additional challenges to monetary policy. Therefore, the transmission and effects of monetary policy may differ heavily across countries and sectors.

The paper at hand analyses the impact of the PSPP on SMEs' access to finance by

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[1]The stock of corporate credit increased slightly from the end of 2010 onwards until end of 2011, although the European sovereign debt crisis was already under way (end of 2009 - mid 2012). In May 2010, the Securities Markets Programme SMP was introduced to remove tensions in certain credit market segments, which hampered the proper transmission of monetary policy. The ECB purchased government and corporate bonds in the secondary markets (Ireland, Greece, Spain, Italy, Portugal). In contrast to the PSPP, the purchases were fully sterilized. Hence, the SMP may have also had a positive effect on credit access. However, the SMP is not part of the analysis, because there is not data on the amount of government bonds purchased by country and month.

using firm-level data of the SAFE. The effect of the PSPP on SMEs financial access measured by credit availability, financial constraints and interest rates charged on credit lines or bank overdrafts is estimated using a fixed effect (linear probability) model controlling for credit demand, economic conditions and inflation. The heterogeneous nature of the data allows to distinguish the effect of the PSPP by firms' country, size, age and sector. According to the credit channel of monetary policy, the PSPP should have a positive impact on financial access. However, the effect may be very heterogeneous across firms.

The analysis shows that the ECB's quantitative easing programme indeed improved financial access for SMEs by increasing credit availability, easing financial constraints and lowering interest rates charged on credit lines and bank overdrafts. The PSPP is on average correlated with an increase of the probability that a firm reported an improvement of availability by roughly 1.3-1.8%. Furthermore, it correlates with a reduction of probability of being financial constraints by 0.46% on average and with a reduction of interest rates by 0.46% on average.

Firms in the periphery of the euro area especially in Italy, Spain and Ireland benefit more from the ECB's QE programme than firms in the core of the euro area. An explanation for this could be the level of government bond yields before the introduction of the QE programme. Countries with high government bond yields had more room to lower yields and hence the PSPP can be more effective. Another evidence is banks' solvency, measured by the banks' capital ratio. Countries with poorly capitalized banks benefit more from the QE programme by improving banks' health and consequently stimulated bank lending (see i.e Acharya *et al.* (2017) or Gambacorta and Marques-Ibanez (2011)). The differences of the effect of the PSPP across firm size age and sector are insignificant or small in magnitude.

The analysis that follows adds to the existing literature on the credit channel of unconventional monetary policy, by adding a focus on SMEs and on recent years. The effect of the ECB's quantitative easing on micro, small and medium sized firms has not been studied so far. Furthermore, a distinction between companies' size, age, sector as well as country allows a discussion on heterogeneous versus aggregate effects of the PSPP. The literature that already uses the SAFE dataset has not done an analysis of the PSPP yet, but focuses mostly on firm characteristics and macroeconomic variables and their effects on SMEs' access to finance.[2] The use of the SMEs' interest rate level allows to not only draw conclusions about the availability of external financing using qualitative questions, but to quantify the effect on the interest rate faced by firms.

There is recently a vastly developing literature on bank lending (see section 2). Most of the studies use bank-firm matched data on bank loans from i.e. DealScan or national sources (i.e. Acharya *et al.* (2017), Peydró *et al.* (2017), Banerjee *et al.* (2017) or Alves *et al.* (2016)). While this data allows to control for supply and demand effects as well as to track down channels of which policies influence bank

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[2]Ferrando *et al.* (forthcoming) analyse the impact of the OMT announcement of SMEs using the SAFE dataset.

lending, this data is only available in certain countries (i.e. Italy, Spain, Germany, France, Portugal). Data which is comparable across the euro area is scarce. The dataset Anacredit (Analytical Credit Dataset) tries to harmonize data on individual bank loans across the euro area. However, this dataset is not available to the public yet and has some weaknesses in covering small loans (which are mostly used by small firms). Therefore, relying on the SAFE dataset has some advantages. First, it allows to focus on SMEs, without proxying them with small loans or small banks. Second, a consistent comparison across euro area countries is possible.

At first, an overview of the existing literature on the determinants of the access to finance of SMEs and the credit channel of (unconventional) monetary policy will be given. The literature review is followed by a description of the dataset and the econometric strategy. The presentation of the results and their discussion concludes.

2 Literature

The related literature covers on the one hand bank lending to SMEs and its influencing factors in general and on the other hand the analysis of the impact of unconventional monetary policies on bank lending:

Wehinger (2014) provides an excellent literature review on bank lending to SMEs. The study concludes that supply constraints hampered bank lending during the euro area sovereign debt crisis and there is some evidence for a credit crunch. Particularly SMEs were affected, but policy reactions have mitigated the risk of a severe crunch. A range of studies using the SAFE data comes to a similar conclusion and determines the factors, that influence SMEs' access to finance: Ferrando and Griesshaber (2011) investigate the impact of firm's characteristics such as age, size or the ownership structure on perceived financial obstacles during the financial crisis. They find that particularly age and ownership matter for financial access. Also Artola and Genre (2011) support that SMEs' size and age influence financial access. Younger and smaller firms tend to be more financially constrained. Öztürk and Mrkaic (2014) determine banks' funding costs and other borrowers' balance sheet characteristics such as debt-to-asset ratio and the firms' size as important drivers of SMEs' access to finance. Holton *et al.* (2013) find that banks tighten credit conditions for SMEs if the economy weakens or private sector debt increases by controlling for borrowers' balance sheet characteristics and the risk free interest rate. Holton *et al.* (2014) analyse the effect of the euro area crisis on the supply and demand of SMEs' bank finance from 2009 until 2011. They find that weak economic conditions both reduced supply and demand for credit. Weak financial conditions reduced credit supply which is evidence for the bank balance sheet channel. Finally, borrowers' balance sheets matter for credit access. Casey and O'Toole (2014) conclude that SMEs which are financially constrained are more likely to apply for trade credit. Ferrando *et al.* (2015) focus on the role of firm balance sheet characteristics such as leverage, profit or liquidity on perceived and actual financial constraints. They match a large dataset on firm balance sheet data from Amadeus with the nearest neighbour from

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the SAFE dataset. They find that young firms as well as firms with low profit, lower return on equity or high coverage ratios face higher actual financial constraints.

There are few studies which do a policy analysis using the SAFE dataset yet. One example, to which the analysis is closely related to, is the work done by Ferrando *et al.* (forthcoming) on the impact of the OMT announcement on bank lending to SMEs. They also use the data from SAFE, but match it with data from banks' exposure to sovereign debt and thus build a confidential firm-bank dataset. They find that SMEs' credit access improved after the OMT's announcement more for firms with high exposure to sovereign debt from stressed countries. Furthermore, firms got more confident with regards to future availability of debt finance.

Furthermore, the credit channel of monetary policy, introduced by Bernanke and Gertler (1995), and the impact of unconventional monetary policy is part of various papers focusing on the euro area.[3] However, they do not explicitly analyse the credit channel for SMEs. Ciccarelli *et al.* (2013) show that the bank lending channel was quite important during the financial crisis by using time-varying vectorautoregression. However, the ECB's monetary policy was not successful in easing funding conditions for small firms in countries under stress.[4] De Santis and Surico (2013) analyse bank lending and monetary transmission in Germany, Italy, Spain and France. They find a significant and heterogeneous impact of monetary policy on bank lending in Germany and Italy. The effect on bank lending in Spain and France is homogeneous, but weak. The authors study the effect of monetary policy using data from Bankscope, but do not specifically focus on non-standard measures. Gambacorta and Marques-Ibanez (2011) show that bank-specific characteristics, such as the capital position have a high impact on bank lending, and even more pronounced during the financial crisis. Therefore, it is likely that these characteristics also influence the transmission mechanisms of monetary policy especially in crisis time. Hempell and Kok Sørensen (2010) use confidential microdata from the ECB's bank lending survey to show that bank's balance sheet characteristics have an impact on loan growth. During the financial crisis, banks' difficult liquidity position contributed to a slowdown in bank lending to firms by impairing the supply side of the credit market. Behrendt (2017) shows, using structural VAR model with sign restrictions, that the ECB's unconventional monetary policy has a positive effect on bank lending. However, the effect is smaller if newly issued credit instead of outstanding stock of credit is used as measure for bank lending.

Acharya *et al.* (2017) analyse the effects of the OMT announcement not only on bank lending, but also its real effects. Using a bank-firm matched dataset, they find that the OMT program led to an improvement in bank health. This translated to increased bank lending at the aggregate level. However, particularly under-capitalized banks lend to low-quality borrowers to prevent bailouts. These firms used the credit supply to build up cash reserves rather than for real activity such as employment

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[3]The literature review restricts to studies focusing on the credit channel in the euro area. There is also a vast literature using loan applications data on the national level.

[4]The authors proxy lending conditions of small firms with lending from small banks by using the fact that small firms tend to have a relationship with a small bank.

or investment. This led to a credit misallocation, from which creditworthy firms in sectors with a high share of low-quality borrowers suffered from a slowdown of the economic recovery.

Horvath *et al.* (2018) analyse the interest rate pass-through of the ECB policies by distinguishing between conventional and unconventional measures and small and large sized loans. They apply panel cointegration methods and find that the interest rate pass-through was only complete for small loans. Furthermore, the ECB's unconventional policies (both quantitative easing and other balance sheet policies) have reduced bank interest rates.

Hence, the analysis that follows adds to the existing literature on the credit channel of unconventional monetary policy, by adding a focus on SMEs and on recent years. Furthermore, it allows to distinguish between aggregate and heterogeneous effects across firms' size, age, sector and country. The advantage of the SAFE data is that it is comparable across euro area countries and focuses on small and medium sized enterprises only.

3   Data

The analysis uses firm-level data of the Survey of Access to Finance (SAFE) by the ECB and the European Commission (EC). The survey is conducted biannually since 2009 relying on telephone interviews and an online questionnaire (since 2014). 60% of the participants are part of a panel, such that they were interviewed in more than one wave. The questionnaire contains information on the firms' characteristics, on the current situation of the enterprise, and on the current as well as expected availability of finance and market conditions.

The panel covers the survey results from waves 1-17, which runs from 2009 until 2017. In each survey round, about 11 000 interviews are conducted. Companies from ten countries which are Austria, Belgium, Germany, Spain, Finland, France, Ireland, Italy, the Netherlands and Portugal are used.[5] Therefore, the analysis uses about 4 000 observations per round on average. About 40% of the dataset comprise micro firms with 1-9 employees, 30% are small companies employing 10-49 workers and medium sized companies with 50-249 employees constitute another 30%.

The access to finance is measured with three different sets of variables. Firstly, the *availability* of 5 different financial instruments is measured with a dummy variable equal to one if a company reported an improved availability of that financial instrument for the enterprise over the past six months. The financial instruments comprise: 1. credit lines, bank overdrafts or credit cards summarised as "credit", 2.

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[5]These countries are part of each wave and the ECB's PSPP. The small euro area countries (Estonia, Cyprus, Latvia, Lithuania, Luxemburg, Malta and Slovenia) are only interviewed in every second round by the European Commission. Slovakia is only part of each round since 2014. The ECB does not buy government bonds in Greece, since the eligible criteria are not met.

bank loans, 3. trade credit, 4. equity capital and 5. debt securities. All availability data is available since wave 1 (2009), despite credit availability only since wave 3 (2010).

The second set of variables is called *financial constraints.* It is a dummy variable which captures whether a company was financially constrained over the past six months. The variable is equal to one if a firm applied for a financial instrument, but was rejected, received less than 75% of the requested amount or refused the received offer because of too high costs. The firm is also financially constrained if it did not apply for external financing because of the possibility of a rejection.[6] The financial instruments cover 1. credit lines, bank overdrafts or credit cards summarised as "credit", 2. bank loans and 3. trade credit. Data on financial constraints is available since wave 3 (2010).

Finally, the terms and conditions of bank loans is captured by the third measure of access to finance. Participants are asked which interest rate (fixed or variable) was charged on a credit line or bank overdraft which the firm applied for over the past six months.[7] This variable is not a dummy variable, but reflects the actual interest rates charged in the market. Data on interest rates is available since wave 11 (2014). If firms needed credit, but did not apply because of too high costs, the interest rate is not measured. Therefore, the variable can be seen as a lower bound. It is both measured for fix and variable rates.

[Figure 2: Aggregated dependent variables: Development over time]

According to the SAFE data, financial conditions and credit access for SMEs in the euro area improved since 2014. Figure 2 illustrates the aggregated time series of the nine dependent variables for the whole euro area. The graphs use the weighted share, respectively the weighted average of the firm-level data.

The share of firms reporting and improvement in credit availability declined after 2010 and it took until the second half of 2013 to start rising again. After the introduction of the QE programme, the share increased, but not as much as from 2013-2015. Among the five credit instruments, bank loan availability is highest. Trade credit is evaluated as the least available. The share of financially constrained SMEs declined heavily from 2014 onwards.[8] At the beginning of 2014, 16% of euro area's SMEs were financially constrained with regards to bank loans or credit lines, and 14% with respect to trade credit. This share declined to 8% for all three categories in 2017. Since 2014, the weighted average of interest rates on credit lines,

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[6]This definition of financial constraints using SAFE data is standard in the literature (see i.e. Ferrando and Mulier (2015)). The share of firms who are constrained because of too high costs (they refused the approved loan because of too high costs) is low (4.7% bank loans, 4.1% credit line, bank overdraft or credit cards overdraft and 2.7% trade credit).

[7]The data includes interest rates charged on a credit line or bank overdraft, which the firm applied for. However, the firm does not necessarily need to have accepted it. It also includes firms who are financially constrained, because they refused an offered credit line, but refused it because of too high costs. However, the share of firms, reporting an interest rate, but refusing the offer because of too high costs, is with 1.8% low.

[8]Data on financial constraints is only available since wave 3 (2010).

bank overdrafts or credit card overdrafts decreased from 6% (2014) to 3.2%.

To control for firms' characteristics or balance sheet conditions as well as proxies for credit demand, a variety of control variables are used. Table 1 provides an overview of their definitions. The economic reasoning for the inclusion of these control variables is given in the description of the econometric strategy. Summary statistics of all variables can be found in table 4.

[Table 4: Summary statistics]

The firm-level data of the SAFE survey is complemented by country-level data. The definition of those macroeconomic control variables is given in table 2. To measure the ECB's government purchases, the amount of actual government bonds purchased by the ECB as share of government bond market size in each country of the panel is used. The government bonds purchased by the ECB are attributed to the euro area countries according to the ECB's capital key (which is a mix of a country's GDP and population). The actual purchases are summed up from the beginning of the purchases until the end of the respective reference period.[9] It is then divided by each countries' government bond market size.[10] The reference period for most SAFE question used in the analysis are the last six months and is given by the ECB (see table 3).

[Figure 3: ECB's cumulative PSPP purchases]

Figure 3 illustrates the cumulative government bond purchases of the ECB under the PSPP from March 2015 until September 2017 according to the countries included in the quantitative easing programme. Due to the capital key allocation, five countries of the euro area - Germany, France, Italy, Spain and the Netherlands - account for 87% of all bond purchases.

[Figure 4: ECB's cumulative PSPP purchases as share of government bond market]

However, the allocation of the government bond purchases according to the capital key (gdp and population) does not necessarily mean that the effect on the government bond market and most importantly the government bond yield is the same in each country. The share of the cumulative government bond purchases of each countries' government bond market size may be a relevant measure to evaluate the size of the QE programme in each country. I assume that the higher the share of the ECB's purchases of the country's government bond market, the bigger the effect on the government bond yield. This takes into account, that the ECB's government

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[9]It may be better to use the actual holdings of government bonds, since this data takes into account whether government bonds mature and are or are not re-purchased. However, this data is not available at the country level. However, since the maturity of the government bonds purchased are usually longer than the time frame considered, these differences in measurement may be small. On the euro area level, the cumulative purchases from March 2015 until September 2017 amounts to 1'784'134 million euro, while the holdings in September 2017 are 1'748'063 million euro - a difference of roughly 2%.

[10]The government bond market size is measured by the amount of outstanding debt securities issued by the general government.

bond purchases may be high in a cross-country comparison in terms of the capital key, but it may be low with regards to the country's government bond market.[11]

The shares at the end of September 2017 are illustrated in figure 4. Looking at this measure of the QE programme, Germany is not the biggest QE country any more, but the Netherlands with 28%, followed by Germany (26%) and Finland (25%). The lowest shares have Belgium and Italy (both 15%).

4   Econometric strategy

The analysis will try to disentangle whether the improvement in access to finance for SMEs in the euro area can be attributed to the ECB's PSPP by controlling for firm characteristics, the economic condition and credit demand.

The effect of the PSPP on SMEs' financial access is estimated using a linear (probability) model with firm fixed effects:

$$y_{ijt} = \alpha + \beta pspp_{jt} + \tau gdp_{jt} + \eta hicp_{jt} + \delta demand_{ijt} + \mu_i + \epsilon_{ijt} \tag{1}$$

Dependent variable y_{ijt}

The dependent variable y_{ijt} comprises the several measures of financial access described earlier. First, the *availability* of five different financial instruments, namely 1. credit lines, bank overdrafts and credit card overdrafts (credit), 2. bank loans, 3. trade credit, 4. equity capital as well as 5. debt securities.

Second, a measure whether a firm is *financial constraint* with regards to three financial instruments: 1. Credit lines, bank overdrafts and credit card overdrafts (credit), 2. bank loans as well as 3. trade credit.

Third, the interest rate for credit line or bank overdraft is the last dependent variable. It is the interest rate charged on a credit line or bank overdraft, which a firm applied for in the past six months. Since the variable is continuous and measures the actual interest rates charged, it allows a quantification of the effect, compared to the qualitative variables *availability* and *financial constraint*.

Treatment variable $pspp_{jt}$

The treatment variables $pspp_{jt}$ measures the ECB's government bond purchases as cumulative purchases per country since the beginning of the programme as share of the country's government bond market size. The variable is equal to zero before the announcement and introduction of the programme (equal to 0 for wave 1-11). The reference period for the survey wave 12 is October 2014-March 2015. The QE

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[11]All variables in the analysis are either in growth rates or in shares.

programme was announced on 22 January 2015 and the purchases started in March 2015. Hence, both the announcement and the start of the programme took place in SAFE wave 12. Therefore, the variable $pspp_{jt}$ can be seen as a treatment variable equal to zero before the treatment (QE programme). During the treatment period, the variable is not only equal to 1, but has a time and country dimension which measures the intensity of the programme.

The rumours about a euro area QE programme and hints by ECB staff with regards to such a programme before the introduction before wave 12 (before October 2014) are not captured by the treatment variable. For example, Mario Draghi's speech in Jackson Hole on 22 August 2014 was seen as a sign that the ECB will introduce a QE programme. However, compared to the announcement effect and the actual purchases, these effects may be small.

Control variables

First of all, two control variables control for macroeconomic conditions: GDP growth (gdp_{jt}) and the inflation rate ($hicp_{jt}$). Economic conditions have an influence on credit access. If the economic situation is solid, banks are in a better position to lend. The choice of GDP and inflation as controls is linked to the ECB's mandate to maintain price stability. The decision to introduce a QE programme was primarily driven by the low inflation environment. Furthermore, the ECB also monitors the business cycle closely. These variables vary at the country and time level. The SAFE survey also includes a question on whether the economic outlook improved, remained unchanged or deteriorated. However, I prefer to use a quantitative variable measuring the business cycle.

The third control variable is credit demand ($demand_{ijt}$). It measures whether demand for the respective financial instruments increased over the last six months (=1) and is equal to zero otherwise. If credit demand increases, it is more likely that firms are credit constrained. Furthermore, if a firm has higher demand for credit, it may evaluate credit availability to be poorer.

Firm-level fixed effects

The estimation includes firm-level fixed effects μ_i to control for time-invariant firm characteristics. The literature using SAFE microdata mainly applies random effects probit model and use a variety of variables controlling for firm-characteristics such as age, ownership or sector. The use of firm fixed effects is even more restrictive than using variables for age, ownership or sector. Furthermore, I prefer to apply fixed effects rather than random effects to control for firm specific effects and because of the policy aspect of the analysis.[12]

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[12]Age is measured as a categorical variable with categories from below 2 years, 2 to 5 years, 5 to 10 years and more than 10 years. Consequently, this variable is also almost time-invariant and cannot be added next to the firm fixed effects. I do not add time fixed effects, since the treatment variable uses the time aspect. If the analyses controlled for survey waves, the treatment variable could not distinguish between the pre-QE period and the QE-period.

Functional form

The variables regarding *availability* and *financial constraints* are either equal to 0 or 1, which require a probability model. Choosing between non-linear and linear probability models have several advantages and disadvantages. Non-linear models such as logit or probit model make sure that the probabilities lie between zero and one. However, with the inclusion of fixed effects, estimates can be biased (Fernández-Val, 2009). A linear probability model has more estimation flexibility, especially with regards to panel data (with fixed effects) and interaction effects. Therefore, the estimation is performed using a linear probability model.[13]

Heterogeneous effects

To analyse the heterogeneous effects of the ECB's quantitative easing programme, the estimation is done including interaction effects of $pspp_{jt}$ with dummies for the firms' sector (industry, construction, services, trade), size (micro, small, medium and large), age (less than 2 years, 2-4 years, 5-9 years, more than 9 years) as well as country:

$$y_{ijt} = \alpha + \beta pspp_{jt} + \omega X + \tau gdp_{jt} + \eta hicp_{jt} + \delta demand_{ijt} + \mu_i + \epsilon_{ijt} \qquad (2)$$

where X is a matrix of interaction terms with the $pspp_{jt}$ with either dummies for firms' sector, firms' size, firms' age, firms' country or firms' country group.

The set-up of the euro area with a single supra-national monetary institution, but heterogeneous economic structures and (fiscal) policies make heterogeneous dynamics likely. Interaction effects not only include the interaction of the PSPP with firms' country, but also an interaction with a country group. Countries are divided into two groups, the core and the periphery of the euro area. The division is done according to the height of the government bond yield before the introduction of the QE programme.[14] Countries with higher government bond yield may have more room to lower the yield via quantitative easing which then transmits to bank lending to SMEs. However, the credit channel of monetary policy may be particularly impaired in countries under stress, such as in the periphery.

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[13]The robustness analysis shows that almost all fitted probabilities lie between zero and one (see table 16).

[14]The "core" comprises Germany, Austria, Belgium, Finland, France and the Netherlands. These are countries having low government bond yields before the introduction of the PSPP. The second country group "periphery" contains Italy, Spain, Ireland, Portugal and Slovakia. All countries with higher government bond yields. The classification is done according to government bond yields, because quantitative easing transmits to the interest rates of SMEs by lowering government bond yields. If government bond yields are high, there is more room to lower yields and hence lending rates by using quantitative easing. If yields are already close to zero, there is not much room to lower yields even further. If the distinction was made by the height of interest rates charged on credit line or bank overdrafts by SMEs, Germany would be in the group "periphery". Although the German government bond yield is very low, SMEs' interest rates are high in European comparison.

An excursion adds further macroeconomic variables to the regression and interacts it with the PSPP programme:

$$y_{ijt} = \alpha + \beta pspp_{jt} + \gamma macro_{jt} + \omega pspp_{jt} * macro_{jt} + \qquad (3)$$
$$\tau gdp_{jt} + \eta hicp_{jt} + \delta demand_{ijt} + \mu_i + \epsilon_{ijt}$$

First, the macroeconomic variable comprise the amount of sovereign debt on the countries' banks' balance sheet. If banks in a country have a high exposure to sovereign debt, they benefit more from a QE programme via higher asset prices for government bonds. Second, the banks' capital ratio measure the capital position of the banks in a country. If banks are poorly capitalized, the ECB's stimulus may be more helpful. A third macroeconomic variable is banks' credit default swap spreads (CDS). With higher banks' CDS, the bank balance sheet channel may be more effective. Finally, sovereign credit default swap spreads (sovereign CDS) are used. This proxies the riskiness of government bonds. If government bonds are more risky, a central bank's purchase of government bonds may be more effective in lowering bond yields.

5 Results

5.1 PSPP's aggregate effect

The analysis shows that the ECB's PSPP has improved the SMEs' access to finance on an euro area aggregate level. Table 5 summarizes the results of estimating equation 1.

First, it has helped to increase credit availability. The PSPP is positively and significantly correlated with higher availability of credit lines, bank loans and trade credit. The magnitude of the effect on credit lines, bank loans and trade credit is similar. An increase of government bond purchases share of the outstanding amount of government bonds by 1 ppt, increases the probability of improved availability of credit lines, bank loans or trade credit by 0.29-0.39 ppt. The average amount of government bond holdings as share of the bond market size is 4.6% (table 4). Hence, to put this into context with a back-on-the-envelope calculation, the aggregate average effect of the PSPP on the probability of improved availability is about 1.3%-1.8%. The estimated coefficient for equity capital and debt securities availability is not significant. This could be linked to the limited sample size. Especially SMEs' financing via debt securities is scarce in the euro area (particularly in comparison to the US). GDP is as expected positively correlated with credit availability, while inflation is negatively correlated. Interestingly, credit demand is positively associated with credit availability.

Second, the QE programme is associated with less financial constraints. A 1 ppt

increase of $pspp_{jt}$ is correlated with a reduction of the probability of being financial constraint with regards to credit lines, bank loans or trade credit by roughly 0.1 ppt. The aggregate average effect of the PSPP on the probability of being financial constraint is 0.46%. Higher credit demand is as expected positively correlated with financial constraints. Hence, it has the expected sign, in contrast to the regressions using *availability* as dependent variable.

Third, the PSPP correlates negatively with interest rates charged on credit lines or bank overdrafts. A 1 ppt increase of $pspp_{jt}$ is associated with an interest rate reduction of -0.1 ppt. The aggregate average effect amounts to -0.46%. This is in line with Horvath *et al.* (2018) who also find that the ECB's QE have decreased bank interest rates for both small and large loans (below and above 1 million euro).

[Table 5: Aggregate effect of the PSPP on access to finance]

5.2   PSPP's heterogeneous effects

The firm level dimension of the datasets allows to not only analyse the aggregate effect of the ECB's quantitative easing programme, but to disentangle the effect depending on firms' country, sector, size and age by adding interaction effects (equation 2).

Country group

The PSPP had a very heterogeneous effect on SMEs' access to finance according to the country of origin. Especially Italy, Spain and Ireland benefited from the programme with regards to credit availability, financial constraints and interest rates, as summarised in table 6. For example, interest rates charged on credit lines or bank overdrafts were lowered by 0.07 ppt more in Spain than in Germany. Bank loan availability increased by 0.8 ppt in Italy compared to Germany.

In general, it seems that countries in the periphery of euro area have higher financial access after the introduction of the programme. These countries had higher government bond yields before the introduction of the QE programme and higher tension in the financial markets. Furthermore, the share of small loans (<0.25 millions) of total loans as a share of total lending to non-financial corporations is higher in vulnerable economies such as Italy (Kraemer-Eis *et al.*, 2017a). Consequently, the QE programme could be more effective because it had more room to lower government bond yields.

To support this assumption, I divide the countries into two groups according to the level of government bond yields before the introduction of the QE programme. The dummy for the periphery is interacted with the variable $pspp_{jt}$. The results of the regression is shown in table 7. Indeed, countries in the periphery benefited more from the QE programme by increasing credit availability by 0.2-0.3 ppt more compared to countries in the core. Financial constraints were lowered by 0.3 ppt, while interest rates are lowered by 0.07 ppt more compared to the core.

Ciccarelli *et al.* (2013) have shown that the ECB's LTRO has helped to repair the credit channel in countries under stress. However, they have argued that the ECB's policy may have been insufficient to improve credit availability to small firms.[15] The analysis at hand shows, however, that the ECB's QE programme has particularly improved lending conditions for SMEs in countries under stress. Hence, the programme provided more stimulus in countries that needed the most support.

Firm sector

The results of the sector analysis are shown in table 8. It shows that there are only few significant sectoral differences of the effect of the PSPP on SMEs' financial access.

The manufacturing and the construction sector have a significantly higher impact of the PSPP on the interest rate compared to the service sector. However with 0.002 ppt, the difference is very small in economic terms. All other effects are insignificant because the estimated coefficient of either the interaction term or the aggregate effect of PSPP is insignificant.

[Table 8: Effect of the PSPP on access to finance according to firms' sector]

Firm size

The results according to firms' size classes do not allow a general conclusion on which size class experienced a stronger improvement of financial access (table 9). Small firms have a smaller effect of the PSPP on financial constraints of bank loans than medium sized firms by 0.07 ppt. However, all other coefficients of the interaction terms are insignificant.

[Table 9: Effect of the PSPP on access to finance according to firms' size]

Firm age

Young firms (less than 2 years old) benefit more from the ECB's QE programme compared to old firms (more than 9 years) with regards to financial constraints. Financial constraints of credit and bank loans are lowered by 0.4-0.5 ppt more for firms younger than 2 years compared to firms older than 9 years (table 10). However, interest rates for young firms' were lowered less than for old firms. Therefore, there is no clear picture on the effect of the PSPP according to age group.

[Table 10: Effect of the PSPP on access to finance according to firms' age]

5.3 Excursion: Determinants of country heterogeneity

The PSPP's effect on SMEs' financial access is quite different for countries in the core and periphery of the euro area. The reasons for this may be manifold. The

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[15]They proxy small firms by small banks, by assuming that small firms mainly lend from small banks.

difference could for instance be linked to the countries' banks' exposure to sovereign debt, the banks' capitalization or sovereign respectively bank distress. The following analysis tries to find an explanation for the heterogeneous effect of the PSPP among countries by interacting $pspp_{jt}$ with various other macroeconomic variables. The results are shown in tables 11 - 14.

[Table 11: Effects of the PSPP according to banks' sovereign debt]

The amount of sovereign debt held by banks may be a reason why bank lending increases after the introduction of QE. If a bank has a high exposure to sovereign debt, it benefits from QE by lower interest rates and higher prices of its bond holdings. Thereby it has more room to provide credit to the real economy. Hence, the bank lending channel may be stronger. Therefore, the estimation is complemented by the amount of euro area sovereign debt on banks' balance sheet as a fraction of their total assets.[16] However, the interaction with the amount of sovereign debt does not yield a clear result (table 11). In contrast, Ferrando *et al.* (forthcoming) find that firms lending from banks with high exposure to sovereign debt to impaired countries, benefited more from the OMT announcement than firms with a relationship to a bank with low exposure. However, they were able to match the firms to the bank they have a relationship to with a confidential dataset. Thereby, a higher variation among firms and bank rather than on the country level improve identification. Furthermore, the OMT focused on stressed countries only, while the PSPP covered all euro area countries (with some exceptions). Hence, the banks' exposure to sovereign debt may be even more important for the OMT than for the PSPP.

[Table 12: Effects of the PSPP according to banks' capital ratio]

The banks' solvency, measured for instance with the capital ratio, may be another reason for the different effects in the core and periphery. The ECB's PSPP should lead to an improvement of the banks' balance sheet (bank lending channel). Acharya *et al.* (2017) have shown that the OMT announcement had a positive effect on banks' health and thereby bank lending improved on the aggregate level. If the banks' capital position in a country is worse than in others, their marginal benefit from the PSPP may be even bigger and hence the positive effect on credit access may be bigger. Also Gambacorta and Marques-Ibanez (2011) show that an improvement in the banks' capital position lead to higher bank lending. Table 12 shows the estimation results by including an interaction term of the PSPP with the banks' capital position. The higher the capital ratio, the smaller the impact of the PSPP on availability of credit lines, bank loans and trade credit as well as on the interest rate. Countries with less capitalized banks have a bigger impact of the PSPP on credit availability (credit lines, bank loans as well as trade credit) and on the interest rate. The recent literature on bank lending has shown that undercapitalized banks tend to lend to low-quality borrowers to prevent bailouts. These firms use these funds to build up cash-reserves rather than to boost their real activity and create unemployment - a credit misallocation (see i.e. Acharya *et al.* (2017)). If the

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[16]Observations from the Netherlands is not included in the regression, since banks' exposure to sovereign debt is not available for the Netherlands.

different effect across the core and the periphery of the euro area is indeed related to banks' capitalization, it would be interesting to investigate whether creditworthy or low-quality SMEs benefit from the higher financial access - which is left for future research.

[Table 13: Effects of the PSPP according to banks' cds]

Banks' CDS spreads are another measure for the banks' balance sheet conditions. It could also be a measure for the supply of credit or the bank lending channel. Table 13 shows the results from interaction PSPP purchases with banks' CDS spreads. The coefficients of the interaction effects are insignificant.

[Table 14: Effects of the PSPP according to sovereign cds]

Another reason for country heterogeneity could be linked to the sovereign debts' characteristics rather than the banks themselves. If the country faces sovereign distress, the ECB's quantitative easing programme may be a positive signal to investors which supports bank lending even more than in countries with low distress. However, the interaction term of sovereign CDS spreads and the PSPP is only significant for the interest rate regression, but small in economic terms. Therefore, in the analysis the country heterogeneity cannot be explained by sovereign debt holdings or sovereign distress, but the banks' balance sheet conditions such as the capital ratio plays a role.

6 Robustness analysis

Other studies analysing SMEs' access to finance with SAFE data use firms' balance sheet characteristics as further control variables in the analysis (i.e. Ferrando and Mulier (2015)). In this policy analysis, I do not include these control variables to avoid over-fitting.

To make sure that this does not induce an omitted variable bias, table 15 shows the regressions from 1 with further controls for the firms' balance sheet, such as profit, leverage, capital position or credit history. Better balance sheet conditions are expected to be positively correlated with credit availability and to be negatively correlated with financial constraints and the interest rate charged on credit lines or bank overdrafts. The sign of the coefficients are mostly as expected. Most importantly, the effect of the PSPP on financial access are in magnitude very similar to the baseline. Therefore, I am confident to use the specification in equation 1.

[Table 15: Robustness: Firms' balance sheet]

In contrast to non-linear probability models, a disadvantage of the linear probability model is that predicted probabilities can lie outside of the zero one interval. Horrace and Oaxaca (2006) show that if the predicted probabilities are inside the unit circle, the linear probability model using OLS is (to a large extent) unbiased and consis-

tent. Table 16 shows the summary statistics of the predicted probabilities from the estimation results summarised in table 5. Despite for debt securities availability, all fitted values lie between zero and one.

[Table 16: Summary statistics fitted values]

The definition of the variables on credit availability rely on parts of the answer choices only, namely whether availability improved. The firms have also the choice of a deterioration of credit availability as well as that availability remained the same. Therefore, a robustness analysis uses an alternative definition of availability, where the independent variable y_{ijt} is equal to 0 for a deterioration, equal to 0.5 for remained the same and equal to 1 for an improvement. The results are shown in table 17 and are quite similar to the baseline estimation.

[Table 17: Robustness analysis: Alternative definition availability]

7   Conclusion

European companies are very dependent on bank lending as source of financing. During the height of the euro area crisis, credit availability diminished, bringing the economy close to a credit crunch. The ECB acted to repair the smooth transmission of monetary policy with unconventional monetary policy measures. However, it is not clear whether these unconventional monetary policy measures such as the PSPP helped to ease funding conditions also for SMEs. Furthermore, the effects may operate only on an aggregate level or are heterogeneous across firms.

The analysis using firm-level data from the SAFE has shown that the PSPP has improved access to finance for SMEs on the aggregate level in terms of credit availability and financial constraints. Furthermore, it lowered interest rate charged on credit lines and bank overdrafts. The PSPP's impact was heterogeneous across countries. Especially SMEs in the periphery such as in Italy, Spain or Ireland benefited from the PSPP. These differences may be explained by bank capitalization. The PSPP has a higher positive impact on credit access if banks have a low capital ratio. There are also differences in the impact of the PSPP across firm size, sector and age - but they are mostly not significant or economically small.

These findings have important policy implications. First, not only large companies, but also SMEs benefit from the ECB's PSPP. While the ECB's mandate is to achieve price stability at the euro area level, its policies can have very different effects across countries and economic actors. SMEs in countries which needed the most policy support benefit also the most from the PSPP.

However, other unconventional measures conducted by the ECB, particularly the targeted longer-term refinancing operations, have not been analysed since the data on this programme is not available on a country level. However, these measures may have had a big impact on credit supply, since they focused on easing private sector

credit conditions. Furthermore, the use of firm-level survey data has the advantage to allow an analysis across different dimensions. Nevertheless, the firms' responses are subjective and the results depend on their assessment of financial access.

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Figure 1: Corporate credit in the euro area
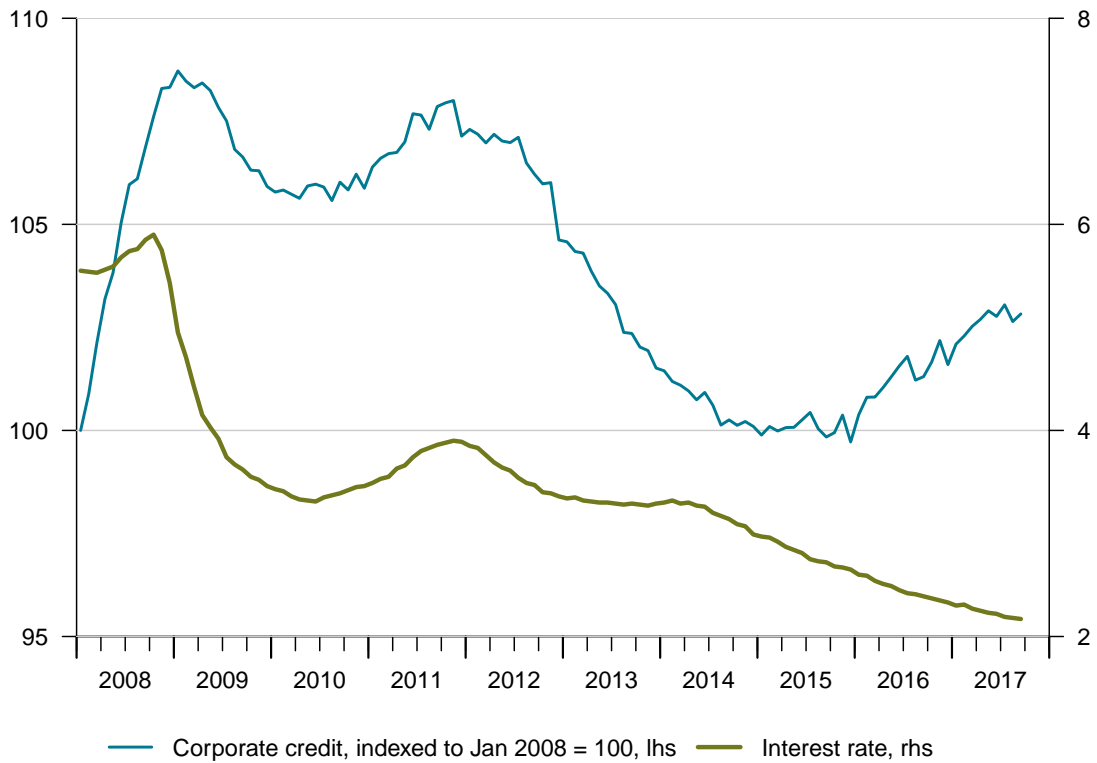
The figure displays the stock of corporate credit in the euro area as loans vis-a-vis euro area non-financial corporations reported by monetary financial institutions excluding European System of Central Banks (ESCB) indexed to January 2008 to deduct the effects of factors that do not relate to transactions (i.e. reclassifications, changes in exchange rates, price fluctuations and write-offs/write-downs) from the MFI Balance Sheet Items Statistics (ECB). The interest rate represents the interest rate charged by credit and other institutions (monetary financial institutions except money market funds and central banks) on loans to corporations (outstanding amounts) as the annual agreed rate with the original maturity (MFI interest rate statistic, ECB).

Figure 2: Aggregated dependent variables: Development over time
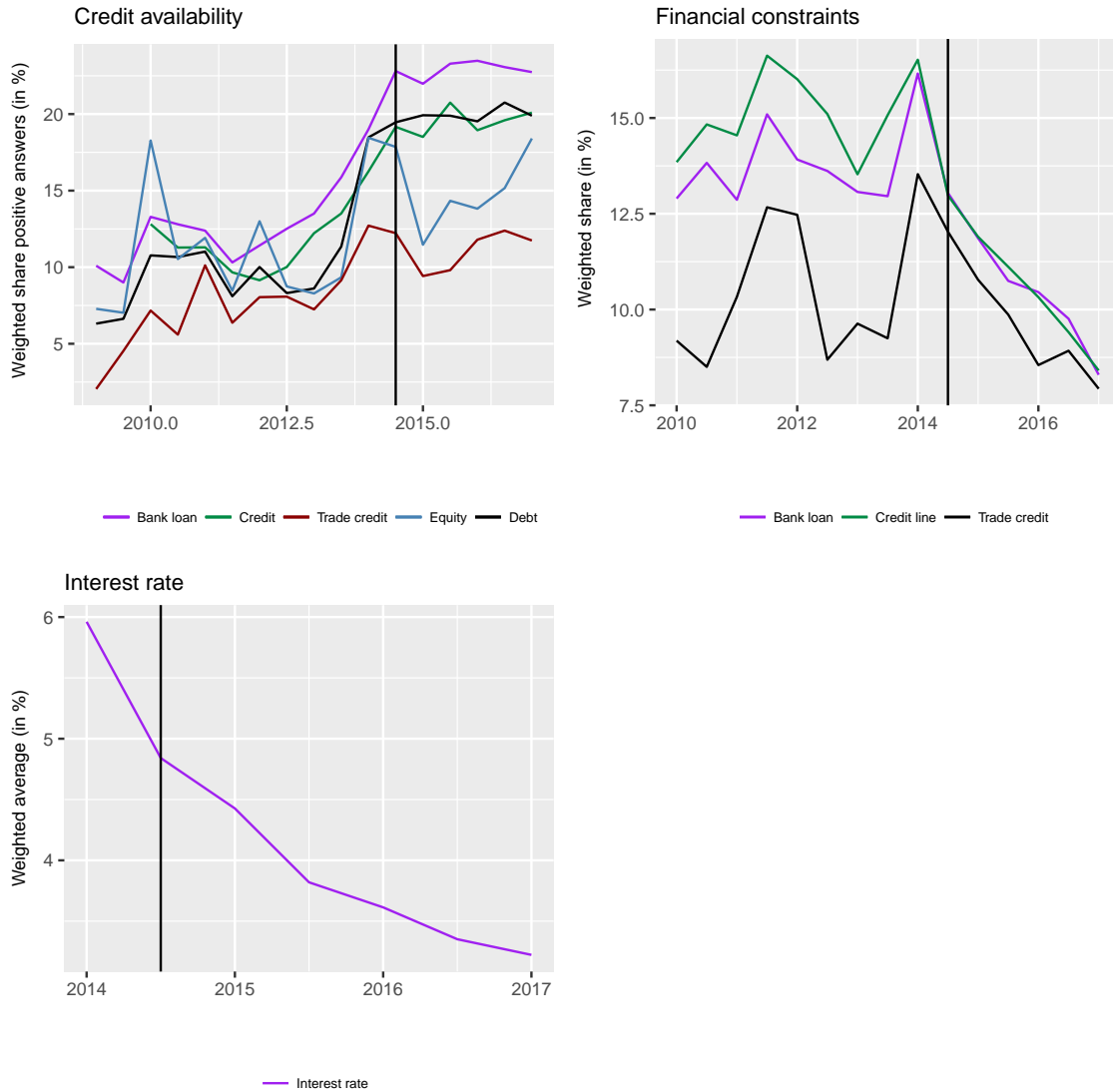
The figure displays the weighted share of the positive (improvement) answers of availability of credit lines, bank loans, trade credit, equity capital as well as debt securities. A positive value indicates a higher share of firms responding an increase (improvement) over the past six months. The variable financial constraints is the weighted net share of firms facing financial obstacles with regards to credit lines, bank loans and trade credit respectively. A higher value indicates more firms being constrained. The interest rate level is the weighted average of the interest rate charged on a credit line or bank overdraft (fixed or variable) for which the firm applied over the past six months. The vertical line indicates the introduction of the ECB's QE programme (wave 12). The data comprises the whole euro area (changing composition).

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Figure 3: ECB's cumulative PSPP purchases
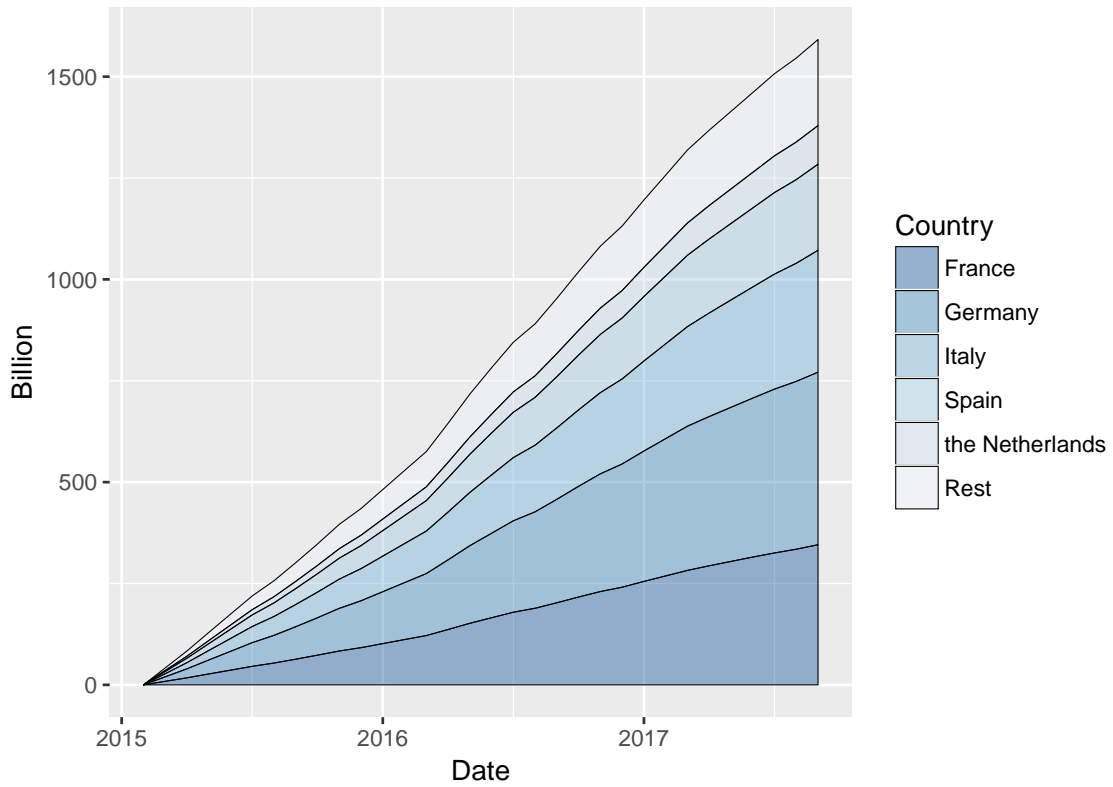
The figure displays the ECB's cumulative monthly government bond purchases under the PSPP in billion euro according to country. The Rest includes Austria, Belgium, Cyprus, Estonia, Finland, Ireland, Lithuania, Luxemburg, Latvia, Malta, Portugal, Slovenia and Slovakia.

Figure 4: ECB's cumulative PSPP purchases as share of government bond market
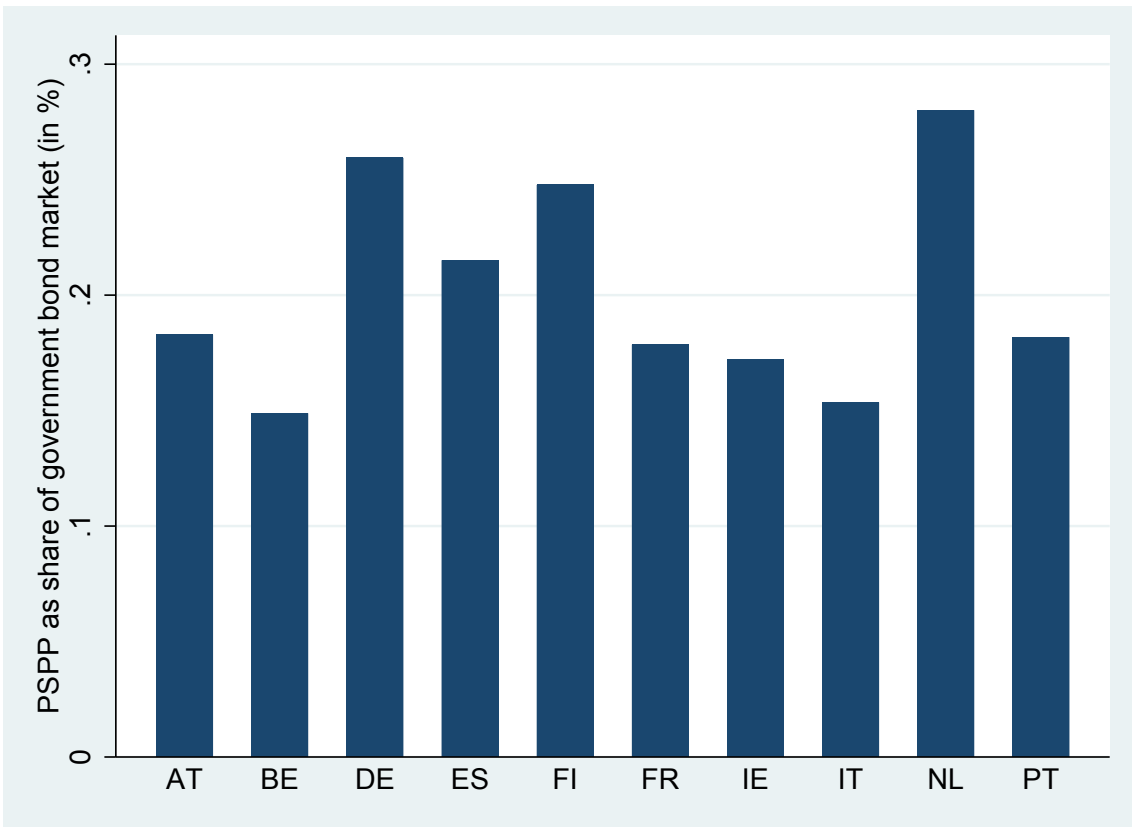
The figure displays the ECB's cumulative government bond purchases under the PSPP as share of the outstanding amount of government bonds on a country level as of September 2017 (wave 17).

Table 1: Variable definition

Variable	Definition
Dependent variables	
Availability	Dummy variable = 1 if firm reported an improved availability of...
Credit line	... credit line, bank overdraft or credit cards overdraft over the past six months. = 0 otherwise.
Bank loans	... bank loans (excluding bank overdrafts and credit lines) over the past six months. = 0 otherwise.
Trade credit	... trade credit over the past six months. = 0 otherwise.
Equity capital	... equity capital (including venture capital or business angels) over the past six months. = 0 otherwise.
Debt securities	... debt securities issued over the past six months. = 0 otherwise.
Financial constraints	Dummy variable = 1 if firm applied for/negotiated [credit type] and was rejected, received less than 75%, rejected because cost was too high or did not apply because of possible rejection in the past six months. = 0 otherwise.
Credit line	Credit line, bank overdraft or credit cards overdraft
Bank loan	Bank loans (excluding bank overdrafts and credit lines)
Trade credit	Trade credit
Interest rates	Interest rate (fix or variable) charged for credit line or bank overdraft which the firm applied for in the past six months.
Control variables	
Need increased	Dummy variable = 1 if firm reported an increased need for ...
Credit line	... credit line, bank overdraft or credit cards overdraft over the past six months. = 0 otherwise.
Bank loans	... bank loans (excluding bank overdrafts and credit lines) over the past six months. = 0 otherwise.
Trade credit	... trade credit over the past six months. = 0 otherwise.
Equity capital	... equity capital (including venture capital or business angels) over the past six months. = 0 otherwise.
Debt securities	... debt securities issued over the past six months. = 0 otherwise.
Profit increased	Dummy variable = 1 if firm reported an increase of the company's profit over the past six months. = 0 otherwise.
Leverage increased	Dummy variable = 1 if firm reported an increase of the company's debt compared to assets over the past six months. = 0 otherwise.
Capital deteriorated	Dummy variable = 1 if firm reported a deterioration of the company's own capital over the past six months. = 0 otherwise.
Credit history deteriorated	Dummy variable = 1 if firm reported a deterioration of the company's credit history over the past six months. = 0 otherwise.
Size	
Micro	1-9 employees.
Small	10-49 employees.
Medium	50-249 employees.

All data stem from SAFE (ECB), unless mentioned. The reference period is the SAFE
questions' reference period (last six months, refer to table 3).

Table 2: Definition additional macroeconomic control variables

Variable	Definition
PSPP	Cumulated ECB's government bond purchase per country from March 2015 until the end of the reference period as share of government bond market size. Source: ECB.
Government bond market size	Amount outstanding of debt securities issued by the general government in EUR at the end of the reference period. Source: Bank for International Settlement.
GDP growth	Average quarterly real GDP growth. Average over the question's reference period. Seasonally adjusted. Source: Eurostat.
Inflation	Monthly HICP. Aggregated to bi-annual growth rate as average over the question's reference period. Source: Eurostat.
Sovereign debt	Debt securities from general government (euro area) on MFI balance sheet, adjusted for the effects of factors that do not relate to transactions, as % of total assets. Reference period average. Source: ECB MFI statistic
Sovereign CDS	10 year sovereign CDS spread, USD. Reference period average. Source: Thomson Reuters
Banks' CDS	5 year bank CDS, EUR, divided by 1000. Country and reference period average. Source: Thomson Reuters
Capital ratio	Tier 1 capital ratio (Regulatory Tier 1 Capital to Risk-Weighted Assets). Reference period average. Source: IMF Financial Soundness Indicators

The reference period is the SAFE questions' reference period (last six months, refer to table 3).

Table 3: SAFE survey's reference period and publication dates

Wave	Round	Publication date	Reference period - last 6 months
1	2009H1	21.09.2009	January-June 2009
2	2009H2	16.02.2010	July-December 2009
3	2010H1	22.10.2010	March-September 2010
4	2010H2	27.04.2011	September 2010-February 2011
5	2011H1	01.12.2011	April-September 2011
6	2011H2	27.04.2012	October 2011-March 2012
7	2012H1	02.11.2012	April-September 2012
8	2012H2	26.04.2013	October 2012-March 2013
9	2013H1	14.11.2013	April-September 2013
10	2013H2	30.04.2014	October 2013-March 2014
11	2014H1	12.11.2014	April-September 2014
12	2014H2	02.06.2015	October 2014-March 2015
13	2015H1	02.12.2015	April-September 2015
14	2015H2	01.06.2016	October 2015-March 2016
15	2016H1	30.11.2016	April-September 2016
16	2016H2	24.05.2017	October 2016-March 2017
17	2017H1	29.11.2017	April-September 2017

Table 4: Summary statistics

	count	mean	sd	min	max
Availability credit line	69589	0.150	0.358	0.000	1.000
Availability bank loans	75099	0.186	0.389	0.000	1.000
Availability trade credit	55741	0.134	0.340	0.000	1.000
Availability equity capital	11563	0.076	0.265	0.000	1.000
Availability debt securities	2372	0.095	0.293	0.000	1.000
Financial constraints: credit lines	67117	0.127	0.333	0.000	1.000
Financial constraints: bank loans	86533	0.119	0.323	0.000	1.000
Financial constraints: trade credit	56412	0.089	0.285	0.000	1.000
Interest rates	6593	0.038	0.034	-0.003	0.340
PSPP	124789	0.048	0.074	0.000	0.280
GDP growth	124789	0.003	0.010	-0.038	0.114
Inflation	124789	0.011	0.011	-0.027	0.041
Need credit line increased	69589	0.247	0.431	0.000	1.000
Need bank loan increased	80620	0.227	0.419	0.000	1.000
Need trade credit increased	58802	0.182	0.386	0.000	1.000
Need equity capital increased	26247	0.079	0.269	0.000	1.000
Need debt securities increased	5902	0.079	0.269	0.000	1.000
Profit increased	121977	0.286	0.452	0.000	1.000
Leverage increased	111151	0.197	0.398	0.000	1.000
Capital improved	122767	0.274	0.446	0.000	1.000
Credit history improved	116947	0.251	0.433	0.000	1.000
Sovereign debt	115089	6.033	2.944	0.711	20.136
Capital ratio	47288	0.168	0.028	0.115	0.243
Sovereign CDS	124789	141.270	133.039	26.491	992.196
CDS	114193	0.210	0.203	0.041	1.438

The variables' definition is given in tables 1 and 2.

Table 5: Aggregate effect of the PSPP on access to finance

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.286***	0.307**	0.390***	0.165	0.225	-0.134**	-0.132*	-0.108**	-0.102***
GDP growth	0.898**	0.988	1.761***	0.688**	0.909**	-0.659***	-0.308*	-0.309***	0.036
Inflation	-2.730**	-2.907***	-2.217*	-0.926	-4.356*	-0.253	-0.018	0.156	0.059
Need credit line increased	0.032**					0.070***			-0.001
Need bank loan increased		0.079***					0.051***		
Need trade credit increased			0.134***					0.050***	
Need equity capital increased				0.240***					
Need debt securities increased					0.259**				
N	67348.000	69997.000	54580.000	11369.000	1912.000	64976.000	75778.000	55212.000	6257.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. PSPP is measured as share of government bond market size.

GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 6: Effect of the PSPP on access to finance according to country

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.087***	0.024	0.133***	0.516***	-0.311	-0.006	-0.018**	0.023***	-0.077***
GDP growth	0.851**	0.952	1.803***	0.634**	0.829**	-0.710***	-0.310*	-0.322***	0.016
Inflation	-2.828**	-2.899***	-2.138*	-0.898*	-4.067*	-0.313	-0.007	0.180	0.252*
Need bank loan increased		0.079***					0.051***		
Need trade credit increased			0.134***					0.050***	
Need credit line increased	0.033**					0.070***			-0.001
Need equity capital increased				0.236***					
Need debt securities increased					0.272***				
AT PSPP	0.218***	0.327***	0.230***	-0.593***	-13.857***	-0.045***	0.003	0.261***	0.006*
BE PSPP	0.358***	0.348***	0.640***	-0.114*	-1.388*	0.044*	0.102***	0.102***	-0.116***
ES PSPP	0.517***	0.325***	0.181***	-0.954***	1.269**	-0.284***	-0.340***	-0.250***	-0.072***
FI PSPP	0.042	0.013	0.162**	-0.279**	0.879**	0.044***	0.018	0.005	0.042***
FR PSPP	0.023	0.318***	0.007	-0.075	1.068***	0.021***	0.096***	-0.024***	0.011***
IE PSPP	0.199***	0.365***	0.636***	-1.042***	0.170	-0.534***	-0.398***	-0.276***	-0.031**
IT PSPP	0.400***	0.826***	0.600***	0.753***	0.595**	-0.356***	-0.299***	-0.070***	-0.061***
NL PSPP	0.264***	0.254***	0.088***	-0.701***	-0.134	-0.143***	-0.186***	-0.219***	-0.017***
PT PSPP	0.087***	0.247***	0.238***	-0.473***	0.509**	-0.041***	0.076***	-0.106***	-0.077***
N	67348.000	69997.000	54580.000	11369.000	1912.000	64976.000	75778.000	55212.000	6257.000

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

LPM regression with firm fixed effects. Standard errors are clustered at the country level. The reference group is Germany.

PSPP is measured as share of government bond market size. GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 7: Effect of the PSPP on access to finance depending on country group

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.195***	0.185**	0.253***	0.250*	0.307	-0.032	-0.022	-0.026	-0.072***
GDP growth	0.894**	0.964	1.750***	0.653**	0.907**	-0.652***	-0.281*	-0.302***	0.007
Inflation	-2.749**	-2.949***	-2.254*	-0.921*	-4.391*	-0.231	0.022	0.180	0.175
Need bank loan increased		0.080***					0.051***		
Need trade credit increased			0.134***					0.050***	
Need credit line increased	0.033**					0.070***			-0.001
Need equity capital increased				0.237***					
Need debt securities increased					0.259**				
PSPP periphery	0.248**	0.300*	0.243*	-0.516	-0.156	-0.277***	-0.272***	-0.144	-0.066***
N	67348.000	69997.000	54580.000	11369.000	1912.000	64976.000	75778.000	55212.000	6257.000

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

LPM regression with firm fixed effects. Standard errors are clustered at the country level. The reference group is the core euro area.

The core comprises Germany, Austria, Belgium, Finland, France and the Netherlands. The periphery consists of Italy, Spain, Ireland, Portugal and Slovakia.

Countries are allocated according to the level of government bond yield before the introduction of the PSPP. PSPP is measured as share of government bond market size.

GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 8: Effect of the PSPP on access to finance according to firms' sector

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.128	0.156	-0.011	-0.243	1.569	-0.133*	-0.058	-0.093	-0.054**
GDP growth	0.003	-0.533**	0.434**	0.791*	0.746	0.027	0.117	-0.022	0.055
Inflation	-1.065	-1.956*	-1.465	2.203	-15.869	-0.087	-0.759	-0.275	-0.106
Need bank loan increased		0.106***					0.036***		
Need trade credit increased			0.159***					0.038***	
Need credit line increased	0.072***					0.053***			-0.001
Need equity capital increased				0.249***					
Need debt securities increased					0.221**				
PSPP Construction	-0.003	-0.009**	-0.003	-0.010	0.275***	-0.000	0.003	-0.005	-0.000
PSPP Industry	-0.009*	-0.013**	0.001	-0.014	-0.074***	0.002	0.002	0.003	-0.002**
PSPP Trade	-0.009*	-0.004	0.006	-0.011	-0.047	0.002	-0.000	0.004	-0.002*
N	30481.000	30567.000	19878.000	3059.000	735.000	28954.000	30568.000	18778.000	5409.000

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

LPM regression with firm fixed effects. Standard errors are clustered at the country level. PSPP is measured as share of government bond market size.

Reference group is the service sector. GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 9: Effect of the PSPP on access to finance according to firms' size

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.246**	0.261*	0.350***	0.120	-0.005	-0.149**	-0.157**	-0.041	-0.095***
GDP growth	0.898**	0.984	1.758***	0.683**	0.890**	-0.659***	-0.310*	-0.308***	0.034
Inflation	-2.720**	-2.902***	-2.204*	-0.944	-4.434*	-0.249	-0.015	0.156	0.062
Need bank loan increased		0.079***					0.051***		
Need trade credit increased			0.134***					0.050***	
Need credit line increased	0.032**					0.070***			-0.001
Need equity capital increased				0.239***					
Need debt securities increased					0.260***				
PSPP Micro	-0.009	0.005	-0.088	-0.017	0.516	-0.004	-0.002	-0.075	-0.015
PSPP Small	0.117	0.120	0.177	0.116	0.274	0.045	0.070**	-0.124	-0.010
N	67348.000	69997.000	54580.000	11369.000	1912.000	64976.000	75778.000	55212.000	6257.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. The reference group are medium sized companies.

PSPP is measured as share of government bond market size. GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the
past six months. Micro: 1-9 employees, Small: 10-29 employees, Medium: 50-249 employees, Large: More than 249 employees.

Table 10: Effect of the PSPP on access to finance according to firms' age

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.294***	0.306***	0.398***	0.151	0.254	-0.129**	-0.129*	-0.098	-0.105***
GDP growth	0.895**	0.976	1.772***	0.832***	0.815*	-0.658***	-0.292*	-0.348***	0.035
Inflation	-2.723***	-2.907***	-2.167*	-0.771	-4.532*	-0.274	-0.006	0.149	0.069
Need bank loan increased		0.081***					0.051***		
Need trade credit increased			0.133***					0.050***	
Need credit line increased	0.034**					0.071***			-0.001
Need equity capital increased				0.233***					
Need debt securities increased					0.243**				
PSPP Less than 2 years	0.284	0.243	0.136	2.545***	10.803***	-0.452*	-0.408**	-0.153	0.106***
PSPP 2 to 4 years	-0.477***	-0.037	-0.168	-0.338	-0.759**	0.053	-0.357**	-0.292	0.075
PSPP 5 to 9 years	-0.049	-0.047	-0.137	-0.251	-1.308	-0.037	0.016	-0.039	0.015
N	66155.000	68873.000	53627.000	11132.000	1878.000	63805.000	74415.000	54152.000	6253.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. PSPP is measured as share of government bond market size.

Reference group is the age group with more than 9 years. GDP and inflation in growth rates.

Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 11: Effects of the PSPP according to banks' sovereign debt

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	-0.063	-0.082	0.303	0.172	0.171	0.154	0.274*	0.037	-0.028
GDP growth	0.868**	0.891	1.693***	0.639**	0.849**	-0.651***	-0.349**	-0.335***	0.044*
Inflation	-2.987**	-2.829**	-1.758	-0.709	-3.529	0.208	0.754**	0.444	0.109
Sovereign debt	-0.001	0.011*	0.016	0.010	0.018	0.010*	0.018**	0.008	-0.001
Sovereign debt PSPP	0.061**	0.068**	0.015	0.023	0.020	-0.052**	-0.070***	-0.022	-0.012**
Need credit line increased	0.034**					0.067***			-0.001
Need bank loan increased		0.080***					0.048***		
Need trade credit increased			0.137***					0.046***	
Need equity capital increased				0.235***					
Need debt securities increased					0.265**				
N	61906.000	65695.000	50768.000	10699.000	1859.000	59859.000	71282.000	51493.000	6050.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. Sovereign debt measures the amount of government debt held on banks' balance sheet
as percent of total assets. PSPP is measured as share of government bond market size. GDP and inflation in growth rates.

Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 12: Effects of the PSPP according to banks' capital ratio

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.828**	1.276**	0.879***	1.458*	0.665	-0.133	-0.286	-0.090	-0.261***
GDP growth	0.672	0.526	1.122**	0.524	0.832**	-0.662**	-0.327	-0.308***	0.080***
Inflation	-2.260**	-2.505**	-1.433	-0.988	-4.981*	-0.242	-0.073	0.033	0.094
Capital ratio	0.985	1.520*	2.376***	0.380	-0.583	0.020	0.005	-0.152	-0.167
Capital ratio PSPP	-4.168*	-7.364**	-5.212***	-7.786	-2.085	-0.021	0.985	0.032	1.168**
Need credit line increased	0.033**					0.070***			-0.001
Need bank loan increased		0.080***					0.051***		
Need trade credit increased			0.134***					0.050***	
Need equity capital increased				0.236***					
Need debt securities increased					0.260***				
N	67348.000	68830.000	53131.000	10958.000	1860.000	64976.000	73805.000	53012.000	6257.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. PSPP is measured as share of government bond market size.

GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 13: Effects of the PSPP according to banks' cds

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.261**	0.211	0.244*	0.471	0.531*	-0.103	-0.116	-0.056	-0.103**
GDP growth	0.539*	0.556	1.338***	0.566*	1.087***	-0.512**	-0.103	-0.145	0.035
Inflation	-2.061**	-2.146**	-1.233	-0.751	-3.948	-0.587*	-0.320	-0.176	0.026
CDS	-0.105***	-0.128***	-0.125***	-0.022	0.055	0.044***	0.054**	0.046***	-0.029
CDS PSPP	0.043	0.572	0.612	-3.222	-1.914**	-0.225	-0.081	-0.271*	0.053
Need credit line increased	0.035**					0.071***			-0.001
Need bank loan increased		0.083***					0.049***		
Need trade credit increased			0.138***					0.051***	
Need equity capital increased				0.256***					
Need debt securities increased					0.272**				
N	63871.000	66232.000	51328.000	10583.000	1830.000	61570.000	71499.000	51957.000	6084.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. Banks' CDS are 5 year CDS as country average, divided by 1000.

PSPP is measured as share of government bond market size. GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 14: Effects of the PSPP according to sovereign cds

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.188*	0.081	0.183	0.171	0.402	-0.045	-0.047	-0.040	-0.050***
GDP growth	0.439*	0.486	1.351***	0.505*	1.211***	-0.488**	-0.038	-0.102	0.033
Inflation	-1.639*	-1.856*	-1.153	-0.551	-5.556	-0.640*	-0.578*	-0.388	0.142
Sovereign CDS	-0.000***	-0.000***	-0.000**	-0.000*	0.000	0.000**	0.000***	0.000***	0.000**
Sovereign CDS PSPP	0.000	0.002	0.001	-0.000	-0.001	-0.001	-0.001	-0.000	-0.001***
Need credit line increased	0.034**					0.070***			-0.001
Need bank loan increased		0.080***					0.051***		
Need trade credit increased			0.134***					0.050***	
Need equity capital increased				0.240***					
Need debt securities increased					0.255**				
N	67348.000	69997.000	54580.000	11369.000	1912.000	64976.000	75778.000	55212.000	6257.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. Sovereign CDS are 10 year sovereign CDS spreads.

PSPP is measured as share of government bond market size. GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 15: Robustness: Firms' balance sheet

	Availability					Financial constraints			Interest rate
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit	Credit line
PSPP	0.254***	0.258**	0.351***	0.149	0.226	-0.125**	-0.121	-0.098*	-0.104***
GDP growth	0.591	0.569	1.346***	0.493*	0.842**	-0.684***	-0.244	-0.343***	0.068**
Inflation	-2.460**	-2.708***	-2.053*	-0.599	-4.763**	-0.312	-0.042	0.227	0.096
Need credit line increased	0.047***					0.064***			-0.000
Profit increased	0.050***	0.049***	0.051***	-0.000	0.042	-0.015*	-0.014**	-0.009	-0.003*
Leverage increased	-0.015	-0.009	-0.016*	-0.003	-0.012	0.030***	0.024***	0.024***	-0.000
Capital improved	0.057***	0.063***	0.043***	0.043	0.021	-0.006	-0.004	0.002	0.001
Credit history improved	0.124***	0.140***	0.125***	0.025	0.096*	-0.023***	-0.023***	-0.016*	-0.001
Need bank loan increased		0.084***					0.046***		
Need trade credit increased			0.131***					0.050***	
Need equity capital increased				0.240***					
Need debt securities increased					0.223***				
N	60786.000	65286.000	48968.000	10448.000	1823.000	58776.000	69744.000	49265.000	5992.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM regression with firm fixed effects. Standard errors are clustered at the country level. PSPP is measured as share of government bond market size.

GDP and inflation in growth rates. Credit need is equal to 1 if firm reported an increased need in the past six months.

Table 16: Summary statistics fitted values

	Availability					Financial constraints		
	Credit	Bank loan	Trade credit	Equity capital	Debt securities	Credit	Bank loan	Trade credit
count	67348	69997	54580	11369	1912	64976	75778	55212
mean	0.148	0.187	0.133	0.075	0.107	0.129	0.124	0.089
sd	0.046	0.056	0.073	0.080	0.113	0.033	0.024	0.021
min	0.050	0.069	0.003	0.009	-0.062	0.048	0.079	0.046
max	0.297	0.381	0.453	0.374	0.473	0.195	0.181	0.147
share below zero in %	0.000	0.000	0.000	0.000	15.010	0.000	0.000	0.000

Summary statistics of fitted values from linear probability model's estimation illustrated in table 5.

Table 17: Robustness analysis: Alternative definition availability

	Credit	Bank loan	Trade credit	Equity capital	Debt securities
			Availability		
PSPP	0.398***	0.474***	0.450***	0.161*	0.367**
GDP growth	1.170**	1.545*	1.613***	0.743*	-0.226
Inflation	-3.215***	-2.579***	-2.205**	-1.511	-2.848***
Need credit line increased	-0.042***				
Need trade credit increased		-0.019**	0.036**		
Need equity capital increased				0.090**	
Need debt securities increased					0.094
N	61696.000	40645.000	45757.000	6368.000	1912.000

* p < 0.10, ** p < 0.05, *** p < 0.01.

LPM with firm fixed effects. Standard errors are clustered at the country level.

Availability is measured as 0 = availability decreased, 0.5 = availability remaind constant, 1 = availability increased.

PSPP is measured as share of government bond market size. GDP and inflation in growth rates.

Credit need is equal to 1 if firm reported an increased need in the past six months.

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