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BANK LENDING TO SMALL FIRMS: METAMORPHOSIS OF A FINANCING MODEL

by Paolo Finaldi Russo*, Valentina Nigro** and Sabrina Pastorelli**

Abstract

This paper identifies idiosyncratic credit supply shocks across firm size before and after the 2008-2013 double-dip recession in Italy. Based on a fixed effects model, the empirical framework includes both single- and multiple-lender firms and relaxes the standard assumption of homogeneous credit supply across borrowers from the same bank. Results highlight that following the crisis banks notably tightened their corporate lending policies except towards large companies. A significant difference in credit supply arose between micro-firms and the others. The divide is wider for larger banks and for those with weaker balance sheets. This may reflect the greater difficulties on the part of these financial intermediaries in disbursing loans to firms with a significant degree of informational opacity and with high fixed costs compared with the low unit volume of operations. According to these findings, the shocks that hit the banking system during the crisis translated into a persistent change in credit standards, with an important shift in the supply of new loans from smaller to larger firms.

JEL Classification: G21, G32, G3.
Keywords: bank lending channel, credit constraints, SME financing, bank risk-taking.
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Contents

* Bank of Italy, Financial Education Directorate; ** Bank of Italy, Financial Stability Directorate.

1. Introduction[1]

Since the burst of the global financial crisis in 2008, close linkages between recessions and vulnerabilities in the financial sector led to severe credit market disruption. Banking systems in many countries faced a sequence of shocks, not least liquidity strains and government bond devaluations, coupled with significant developments in regulation and supervision. These events triggered relevant changes in their activity; notably on the lending side, a sharp increase in risk aversion resulted in a stiffening of credit standards and a drop in business loans (Ivashina and Scharfstein, 2010; Bassett et al., 2014; Acharya et al., 2018; Cole, 2018).

Small and medium enterprises (SMEs) bore the brunt of credit constraints (OECD, 2019), and evidence pointing at a major impact on their activity is widespread (Chodorow-Reich, 2014; Siemer, 2019; Chen et al., 2017; Bord et al., 2021), adversely affecting the pace of recovery. Indeed, credit supply shocks typically impact more the economic performance and the creditworthiness of small businesses as they are financially weaker (Rajan and Zingales, 1995; Demirgüç-Kunt et al., 2020), operate more frequently in cyclical sectors and are less able to pledge tangible assets as collateral (Ongena et al., 2015). Moreover, the need to preserve profitability and capital in a low interest rate environment may induce banks to shift credit away from smaller and younger firms, which are more opaque and require higher screening and monitoring costs (Petersen and Rajan, 1994; Berger and Udell, 1998). In addition, small borrowers retain limited ability to switch to less constrained banks or to tap alternative sources of external finance (Gertler and Gilchrist, 1994; Khwaja and Mian, 2008).

This paper investigates the changes in credit supply to SMEs and large firms occurred in Italy between pre- and post-crisis periods (2004-07 and 2014-17), with a particular focus on the impact within SMEs. Based on a large matched bank-firm dataset, we analyse: (i) whether and to what extent idiosyncratic bank supply shocks differ before and after the the double-dip of the global financial crisis and the European sovereign debt crisis (hereinafter referred to as the great financial crisis or the great recession), (ii) whether they have a different impact across

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firm size, and (iii) whether these effects can be linked to banks' characteristics and balance sheet conditions.

The identification of supply shocks implies a number of methodological challenges, not least the need to disentangle demand and supply effects on credit developments and, given the broad time span analysed, not to rely on a one-off exogenous event. In addition, since the analysis focuses on firm size, it is deemed necessary to take into account single-lender companies (typically very small business) which are mechanically excluded from studies that use multiple bank relationships to identify credit supply shocks (see, for example, Amiti and Weinstein, 2018). This is a crucial point to address as our sample includes about half of micro-firms with just one bank relationship (compared to less than 15 per cent for larger companies), which makes them more exposed to credit supply shocks (Ongena and Smith, 2000). Since micro-firms have other unique characteristics, such as lower profitability and higher risk, we need to deepen the analysis of SMEs, taking into due account the differences between micro, small and medium-sized enterprises.

To address these challenges, we modify the model proposed by Degryse et al. (2019), which use bank-time dummies to estimate the credit supply shocks and firm cluster-time dummies to control for credit demand. Firm cluster-time dummies, in fact, allow to include single-lender companies in the estimates, in contrast to the alternative approach based on firm-time dummies. Our model adds a twist to the bank-time dummies in a way that the latter can also vary across firm size; this change relaxes the standard assumption of homogeneous supply shocks among borrowers from the same bank and allows us to feature different types of companies among SMEs. Moreover, differently from Degryse et al. (2019), we add a number of firms' observables to better control for credit demand and creditworthiness. To the best of our knowledge, we are the first to identify heterogeneous credit supply shocks by firm size without relying on one-off exogenous events.

Our main results show that bank propensity to lend to firms has considerably deteriorated after the great recession for all size classes with the exception of large companies. After the crisis loan supply to micro-firms has been significantly lower compared to small, medium-sized and large companies, whereas before the crisis it did not differ significantly across firm size. We estimate that during the 2014-2017 recovery supply factors explain more than two thirds of the difference in credit change to micro-enterprises compared to large

companies and more than half with respect to small and medium-sized ones. Importantly, this 'supply gap' against the micro-firms is persistently negative and significant over all four years of the recovery period. These findings are robust to other measures for loan demand. In particular, results also hold when using time-varying individual-firm dummies, which allows to include unobservable firm-specific demand controls but needs at least two bank-relationships for the same firm in the same year to identify the supply effects. Moreover, our results seem not to be driven by firms' riskiness: even if supply shocks are stronger for riskier firms, identified by ex-ante balance sheet credit score, within all risk classes lending was curtailed more for micro-firms than for larger ones.

We round out the analysis by highlighting the correlation between credit supply shocks estimated for the different size classes and specific bank features. Our findings show that negative credit supply shocks to micro-firms are especially large for banks that experienced higher recapitalisation needs during the crisis and for those with lower profitability and lower reliance on ECB funding. Our model also suggests which type of banks may have diversified more their credit policies according to firm size. We find that the gap in credit supply shocks between micro-enterprises and other firms is positively correlated with bank size, increases in the ratio of non-performing loans to outstanding loans (NPL ratio) and in the Tier 1 ratio and lower access to interbank funding. These explanations do not imply causal inference.

All in all, our results highlight structural changes in bank lending policies after the great recession, with a significant supply shift towards larger firms. These results match literature findings on the effects of regulatory reforms and supervisory policies. In the US, a surge in fixed compliance costs for banks turned out in shrinking lending to small businesses while reducing the viability of small banks, less able than larger ones to soak up the increased operating costs imposed by the new regulation (Bordo and Duca, 2018). Other studies find that stress test exercises lowered bank risk as intended, but most likely curtailed credit availability for small firms (Covas, 2018; Cortés et al., 2020). Our analysis contributes to this strand of literature exploring the heterogeneous impact of supply shocks *within* SMEs. This group of firms is usually treated as a single category, whereas we identify very different patterns for micro, small and medium-sized firms.

Moreover, our results are consistent with the evolution of credit policies in a persistent low interest rate environment which may have induced banks (expecially capital constrained

ones) to rebalance their activities from traditional lending to fee-related and trading activities (Brei et al., 2020). We confirm that bank size is not the only relevant factor in explaining the lower credit supply to small businesses, as other important banks' features – not least their balance sheets' soundness – matter: small banks with solid conditions have kept lending to small firms while fragile intermediaries, presumably affected to a greater extent by the regulation and the low interest rate environment, have curtailed this type of loans.[2]

At last, our study also contributes to the literature about creditless recoveries, i.e. those episodes in which output recovers without credit growth (Calvo et al., 2006; Abiad et al., 2011). Focusing on the creditless recovery observed in Italy after the sovereign debt crisis in 2011-2012 (Eramo et al., 2018), our evidence suggests that after a deep recession financial frictions may play a major role in explaining the weak dynamics of business lending over a long time span. Moreover, we point out that more severe lending standards to smaller firms could represent a relevant channel through which the credit shock is transmitted to the economy. This interpretation is consistent with previous research highlighting that during creditless recoveries industries more dependent on external finance tend to grow disproportionately less than those that are more self-financed.

The rest of the paper is structured as follows. Section 2 describes the data sources and defines the variables used in the analysis. Section 3 discusses the methodology and the empirical strategy to identify bank-specific credit shocks. Section 4 illustrates the results and presents some robustness checks. Section 5 concludes.

2. Data and descriptive statistics

2.1. Data

The analysis is based on around 730,000 matched bank-firm data per year referred to 255,000 non-financial Italian limited companies and over 800 financial intermediaries (of which near 500 banks accounting for nearly 90 per cent of total credit).[3] Data come from three

[2] Several empirical studies have highlighted significant effects of banks' characteristics on credit supply: bank capital (e.g. Jiménez et al., 2017; De Jonghe et al., 2020; Conti et al., 2018), funding (e.g. Iyer et al., 2014; Carpinelli and Crosignani, 2017), and asset composition (Bottero et al., 2020). In this respect, our results also suggest that while some bank characteristics (e.g. profitability) are associated to similar supply shocks across firm size classes, other bank features (e.g. increase in the NPL ratio) lead to diversified shocks, implying a more difficult access to credit for smaller firms.

[3] We include financial intermediaries (factoring, leasing, vehicles) to take into account all non-market financing. Overall, in our sample credit granted from these intermediaries accounts for 11 per cent of the total outstanding

sources. Outstanding loan amounts are drawn from the Italian Central Credit Register (CCR), which is kept by the Bank of Italy and contains monthly evidence on all types of credit from financial intermediaries with a reporting threshold (for single intermediary) of 75,000 euros before 2009 and 30,000 thereafter.[4]

Annual non-financial firms' balance sheet and income statement data are taken from the Cerved database, which encompasses information referred to the universe of Italian limited companies. Bank of Italy supervisory reports are also used to include information on banks' annual balance sheets and income statements at the individual level.

The sample period includes two sub-periods of positive business cycle, pre- (2004-2007) and post-crisis (2014-2017). We select non-financial firms that appear in the CCR in any two consecutive years and that have data on total assets in the first one. We discard from our analysis firms with bad loans because we suppose that banks do not extend credit to such businesses. Finally, our dataset includes only non-financial companies active in each year (i.e. those with positive assets and revenues) and excludes holding companies. On average our sample accounts for 43 per cent of total loans to non-financial firms from banks and other financial intermediaries.

The analysis focuses on credit dynamics by firm size. Our variable of interest is *Credit change*: the annual change in loans granted by each bank to a firm, normalised by the firm's assets. It captures, by definition, the intensive margin of the credit change. We aggregate all types of lending at the bank-firm-year level (loans backed by account receivables, term loans, and revolving credit lines). The choice of credit granted instead of disbursed gives us a measure less dependent from loan demand.[5] Furthermore, compared with a standard growth rate in bank loans, the normalisation by firms' assets gets rid from having abnormally high values of *Credit change* due to very small amount of loans in t-1; our variable may also be better interpreted as the contribution of net credit flow to the financing of the *whole* business activity, that is always taken into account in the bank assessment of firm creditworthiness, independently from the levels of credit in t-1[6]. The variable is winsorised at the 1st and 99th percentiles to address issues

amount (13 per cent if we consider only micro-firms). We checked the robustness of this choice by replicating the main regression including only bank loans; results are similar. For the sake of simplicity in the following we use the term 'bank' to indicate a financial intermediary, either bank or other financial companies.

[4] The threshold refers to either drawn or granted debt or guarantees.

[5] We also perform the analysis using disbursed loans for robustness check.

[6] Anyway, the correlation between the variable used in our estimations, i.e. the annual change in loans normalised by the firm's assets, and a 'standard' variable as a delta log of credit is quite high, close to 90 per cent.

caused by small denominators and to control for the effect of potential outliers. Changes in credit are adjusted for banks' mergers and acquisitions.

Firm size definition (micro, small, medium, large) is based on the Commission Recommendation 2003/361/EC.[7] In our sample micro-enterprises account for 70 per cent of all firms and for 17 per cent of debt granted.

2.2. Descriptive statistics

The Italian case raises interest for a number of reasons. SMEs largely dominate the business landscape in the country, accounting for 67 per cent of value added and 79 per cent of employment, against an European average of 56 and 67 per cent, respectively. They are usually more leveraged and more dependent on bank debt compared to large firms and to their European peers.[8] In addition, the Italian economy has been hard hit by a double-dip recession that has severely curtailed bank financing for small businesses. The first crisis traced back to the wholesale interbank market collapse, which dried up funding opportunities for large banks.[9] The second turmoil stemmed from downward spirals between sovereign strains and bank vulnerability, and involved also small credit institutions.[10]

Following the sovereign debt crisis in 2011-12, the dynamics of bank loans to non-financial corporations remained very weak for a long time: annual growth rates were negative until the end of 2015 and hovered around zero in the following two years. For smaller companies the evolution of credit flows was even worse. Figure A1 shows that loans to firms with less than 20 employees have been steadily decreasing since 2012; at the end of 2018 the outstanding amounts, in real terms, were 25 per cent lower than 10 years before, whereas for larger companies the drop was equal to about 15 per cent. Annual GDP growth averaged 1.5 per cent in 2004-2007; after the recession the economy recovered at a weak pace (0.9 per cent during 2014-2017).

[7] In accordance with Commission Recommendation 2003/361/EC, SMEs employ fewer than 250 persons and have either an annual turnover or annual balance sheet total not exceeding EUR 50 million and EUR 43 million respectively. In particular, micro-firms and small businesses employ, respectively, fewer than 10 and 50 persons and have either an annual turnover or annual balance sheet total not exceeding EUR 2 and EUR 10 million. In case the number of employees is missing we use only the thresholds on turnover and annual balance sheet total.
[8] See De Socio and Finaldi Russo, 2016.
[9] See Cingano et al., 2016.
[10] See Angelini et al., 2014; Bottero et al., 2020.

Matched bank-firm data allow us to disentangle credit supply from loan demand by comparing credit change across banks lending to 'similar' firms. Table A1 provides summary statistics on our main variable *Credit change* by firm size and sub-periods. The contraction of loans in recent years is particularly sharp for micro-enterprises (by 0.8 per cent) while for larger firms credit remained virtually unchanged.

In our main regression we control for credit demand using suitable firm-time cluster dummies and time-varying firm variables which are summarized by firm size in Table A2. The share of equity to total assets (*Capitalisation*) and the ratio of financial expense to EBITDA (*Debt sustainability*) are measures of firms' vulnerability. More profitable firms (*Profitability*) and those with higher liquidity (*Liquidity*) are on average financially sounder companies that may need less credit to cover investments and current expenses (Myers, 1977). Firms with higher sales growth (*Turnover growth*) and investment rate (*Investment rate*) could, instead, demand more credit. Compared to pre-crisis period, capitalisation and liquidity have improved on average in the years 2014-17, while profitability is still slightly lower, expecially for micro-firms. Debt sustainability has strengthened in all size classes, mainly driven by the steep decline in interest rates and by the exit from the market of the smaller and highly levered firms. Sales growth and the investment rate have decreased considerably.

The general picture confirms that micro-enterprises are, on average, less capitalised, less profitable and with a higher debt burden. Therefore, they are more financially vulnerable; during the period 2014-17, according to the Z-score, only 26 per cent of micro-firms can be classified as financially sound or solvent compared to 43 per cent of small companies and to more than 50 of larger ones. As a consequence, access to external capital is usually burdensome, resulting in different financing patterns between micro-enterprises and larger firms (Masiak et al., 2017). Moreover, about half of micro-firms has just one bank relationship (compared to less than 15 per cent for other companies), which makes them more exposed to credit supply shocks. Overall, evidence highlights the need to deepen the analysis of SMEs, relating especially to their financial choices, taking into due account the differences between micro, small and medium-sized enterprises.

3. Empirical strategy

The key objective of our analysis is to investigate changes in bank credit policies over time and across firm size. The main challenges are: i) to identify bank-specific supply shocks by removing the effects of demand factors; ii) to explore the impact of supply shocks across micro, small and medium-sized enterprises (given the specific features of micro-firms as described in the previous paragraph). Issues arise from the positive correlations that both credit demand and supply may have with the business cycle. For instance, the sovereign debt crisis could have limited growth prospects and investment of Italian firms, negatively affecting credit demand; or alternatively, banks could have adopted more selective lending standards, in particular for smaller companies, to reduce the riskiness of their assets.[11]

In the following, we first describe the general methodology used in recent empirical literature to identify the bank lending channel without relying on a one-off exogenous event. Then we illustrate our proposal to analyse the differences in credit supply shocks across firm size classes.

3.1. Identifying credit supply shocks without an exogenous event

A model which allows to identify the bank lending channel without relying on a one-off exogenous event and to include most of single-lender firms is proposed by Degryse et al. (2019). Its specification is as follows:

$$\Delta C_{fbt} = \alpha_{bt} + \eta_{ct} + \delta_{fbt}, \qquad (1)$$

where ΔC_{fbt} measures the growth in lending to firm f by bank b at time t, α_{bt} are bank-time fixed effects which capture the idiosyncratic bank channel, η_{ct} are the firm cluster-time fixed effects which control for unobserved time-varying firm cluster characteristics and δ_{fbt} is the error term. The approach has the main advantage not to rely on a specific event; moreover, it enables time-varying estimates of the bank lending channel. The identification of the supply channel exploits the variation across bank lending to 'similar' firms in a given year. Degryse et al. (2019) define as 'firm cluster' the interaction industry-location-size-time to control for credit

[11] A supply shift may also occur in terms of higher costs or tighter loan terms for the borrower, which we do not consider in this analysis.

demand, enhancing the estimates of credit supply shocks compared to the alternative specifications based on firm-time fixed effects (see, for example, Amiti and Weinstein, 2018).[12] This improvement would stem from the reduction in the selection bias due to the inclusion of observations with only one bank relationship, which instead are not included in a specification with firm-time fixed effects. Indeed, the larger the share of single-bank companies, the greater the advantage of using the approach adopted by Degryse et al. (2019).

In Italy, as shown in the descriptive statistics, there is a large share of single-bank firms among micro-enterprises, from which our concerns on how to better control for credit demand. In our sample the share of single-bank firms is around 50 per cent for micro-firms, 12 for small ones, and less than 6 per cent for medium and large companies. So, the issue to include or not single-bank companies is not negligible. This is the main reason why we rely on the approach described in equation (1). The main caveat of this approach is the underlying assumption of homogeneous credit demand for firms within the same cluster (Paravisini et al., 2015); in what follows we also explain how to mitigate this shortcoming.

3.2. The proposed model

This section describes our approach to identifying the supply shocks by firm size. Our empirical strategy is based on the following model:

$$\Delta Y_{fbt} = \mu_{bt}^{s} + \eta_{ipst} + \boldsymbol{\gamma}\boldsymbol{X}_{f,t-1} + \varepsilon_{fbt}, \qquad (2)$$

where ΔY_{fbt} is *Credit change* (i.e. the annual change in credit granted by bank b to firm f at time t, normalised by one-year-lagged firm assets). Unlike the model (1), where bank shocks are supposed to be homogenous across firms, we introduce bank-time fixed effects varying across firm size s (μ_{bt}^{s}) in order to capture bank-specific supply shocks for micro, small, medium and large companies; they represent our main variables of interest. Furthermore, we control for credit demand in two ways: i) by including η_{ipst} as firm industry-province-size-time fixed effects (in line with Degryse et al, 2019), and ii) by adding suitable time-varying firm's observables $\boldsymbol{X}_{f,t-1}$. These variables can mitigate the assumption of homogeneity of credit

[12] Using firm-time fixed effects, supply shocks are identified through the variation across lending of different banks to the same firm in a given year; therefore, this strategy requires that firms have at least two bank relationships. A similar approach is used in other empirical works (see Alfaro et al., 2021; Manaresi and Pierri, 2018; Linarello et al., 2019).

demand within the cluster. Specifically, we include capitalisation, profitability, liquidity and debt sustainability as measures of financial fragility; we add sales growth and investment rate as proxies for credit demand (see paragraph 2.2). All firm variables are one-year-lagged to limit potential endogeneity issues. Moreover, leaving firm size in the cluster fixed effects to control for demand would give a cleaner measure of the supply shocks.[13] Finally, the firm cluster effects can capture also local market credit supply conditions (e.g. the competiveness of the local banking industry). We estimate the model by a weighted regression, where weights are the one-year-lagged firm's assets.[14]

The model compares the changes in credit from different banks lending to the same firm cluster in any year.[15] Under the assumption that we fully control for firm credit demand and creditworthiness we can interpret the bank-time fixed effects by firm size as bank-idiosyncratic credit supply shocks. As in Degryse et al. (2019), all bank-invariant confounders are eliminated, as well as the supply factors common to all banks. Note that all the fixed effects are identified up to a constant scale factor, but the differences across bank shocks are preserved.[16] Moreover, we can estimate how the gap in bank shocks across firm size have changed over time, even though we cannot estimate the "level" of the shocks in any particular period, i.e. we can identify a decrease/increase in banks' propensity to grant credit to a specific firm size class, but we cannot affirm that lending conditions are tight or loose at all.

4. Results

In this section we first present the time dynamics of the estimated supply effects, comparing pre- and post-crisis periods. Next, we analyse their differences across firm size and run some robustness checks. Finally, we investigate the heterogeneity of the supply effects across intermediaries linking them to bank characteristics.

[13] We use in both fixed effects the same definition of firm size, i.e. the four classes micro, small, medium and large. For a further check we also estimate a model with a firm cluster given by the industry-location-time interaction while including the logarithm of firm's assets among the individual regressors: results are similar.

[14] Weighted OLS allow us to match macro moments in the data. We also run the estimates without using weights finding qualitatively similar results (available upon request).

[15] The industry bins are based on six-digit ATECO 2007 classification codes; location bins are based on Italian provinces. In the main regression we have 445,764 clusters (around 78 per cent of the total clusters). For robustness, we run the regression also with industry bins based on two-digit NACE Rev. 2 classification codes getting 115,020 clusters (around 90 per cent of the total). Results are qualitatively similar.

[16] The model assumes the identifying restriction $\sum \beta_{ft} = \sum \mu^{s}_{bt} = 0$. This may be achieved by just using 4BT-1 bank-firm size-time dummies and NT-1 individual-time dummies, and a common intercept. In the estimation procedure we use the STATA routine *reghdfe* developed by Correia (2016).

4.1. Estimation of the credit supply shocks

Table B1 presents summary statistics of the idiosyncratic bank effects estimated by equation (2) across time and firm size, with lower values indicating tighter credit conditions. In recent years, average supply shocks seem to have worsened compared to pre-crisis values for all size classes except for large firms; overall, these results are confirmed also for the first quartile, the median and the third quartile, suggesting that after the great recession a large share of Italian firms have faced relatively tighter supply conditions. For each size class we test the statistical significance of the time trend through linear regressions of the estimated supply effects on year-dummies; the constant term stands for the pre-crisis period 2004-2007. The results shown in table B2 highlight that the tightening in credit supply after the crisis is statistically significant in each year for micro, small and medium firms, whereas for large companies the lending standards seem relatively unchanged.

As regards the differences in bank shocks across firm size, our findings show that after the crisis lending policies towards micro-firms have been much tighter relative to the other companies. Table B3 tests the differences between means of the estimated shocks across firm size. In the post-crisis period, the differences between micro-firms and the other size classes are all negative, significant and increasing in the size class (cols. 1-3); they are much lower or not significant between small and medium or large firms (cols. 4-5) and between medium and large companies (col. 6).[17] Importantly, these results also suggest that the 'supply gap' against the micro-firms remains persistently negative and significant over all four years of the recovery period.

The estimated credit supply shocks are especially sizeable among micro-enterprises. The average annual change in credit granted to micro-firms due to supply effects is 0.6 percentage points lower compared to large firms (0.5 and 0.4 with respect to medium and small-sized firms; table B4), against an average 0.5 per cent decrease in loans over the whole sample. Our estimates indicate that during the 2014-2017 Italian recovery supply factors explain more than

[17] Means are winsorised at the 1st and 99th levels. As a robustness check, we also test the differences of the medians without parametric assumptions on the distributions (Snedecor and Cochran, 1989). Overall, the results are confirmed.

two thirds of the gap in credit change to micro-enterprises compared to large companies and more than half with respect to small and medium-sized ones (figure B1).[18]

To better assess the role of supply factors across firm size classes we compare the previous results with a similar model without controlling for credit demand (by leaving out the variables η_{ipst} and $\boldsymbol{X}_{f,t-1}$ from equation (2)). In figure B2 each graph links the average estimated bank-time fixed effect for micro-firms with that of the other size classes. Panel a) presents the results of a model with only bank-time fixed effects by firm size without any control for credit demand, while panel b) gives the outcomes of the proposed model (2). After controlling for credit demand, the differences in credit flows across size classes slightly decrease though remaining quite large. This evidence suggests that after the sovereign debt crisis supply-side factors largely accounted for the gap in credit dynamics between micro-firms and larger companies.

4.2. Robustness checks

We perform different robustness checks of our estimation of supply shocks by firm size. One important concern is the control for credit demand. We test the robustness of our results in two different ways: first, we add firm-bank specific variables in model (2) to relax the assumption of homogeneous demand towards all the banks which have relationships with the firms in the same cluster; second, we substitute the demand control (η_{ipst} and $\boldsymbol{X}_{f,t-1}$) with firm-time fixed effects to capture all firm-specific observables and unobservables. Results are the following. The inclusion of the firm's share of credit granted by the bank *b* and the firm's ratio of credit drawn to credit granted by bank *b* as firm-bank specific variables (both computed in the year of first appearance in the sample for each sub-period) turns out in limited changes to our results.[19]

Instead, when using firm-time fixed effects the differences in the estimated supply shocks between micro-firms and the other companies greatly shrink. Nevertheless, these results may be driven by the different estimating sample used in the latter model which includes, by

[18] The confidence intervals in table B4 indicate that supply factors explain the gap in loan variations between 62 per cent and 73 per cent for micro vs. large firms, between 50 per cent and 62 per cent for micro vs. medium firms and between 47 per cent and 63 per cent for micro vs. small firms.
[19] Results not reported.

definition, only multiple-bank firms. To disentangle this possible selection effect we compare these figures with those of our model (2) by using the same observations with multiple relationships. Figure B3 returns only slight differences between the two estimates in each year, indicating that our demand control is effective as in the case of models with firm-time fixed effects. Moreover, it is worth noticing that lower values of estimated supply shocks in the full sample suggest that the exclusion of single-bank companies underestimates credit constraints faced by small firms. These results are also consistent with Degryse et al. (2019), obtaining very similar findings to the firm fixed effects approach.

A different issue is that the lower lending propensity towards micro-firms experienced after the crisis could be driven by an unobserved change in the composition of firms across the two sub-periods. For example, results could reflect a worsening in creditworthiness not fully captured in the regression, which may affect both credit demand and supply. To include in our estimation a measure of firm risk, in addition to that captured by some balance-sheet variables, we use the Z-score, an indicator widely used by Italian banks to assess firm default risk. [20] We substitute in the equation (2) the term μ^{s}_{bt} with bank-time fixed effects by firm size and Z-score. Figure B4 shows that differences in the estimated supply shocks between micro-firms and the other size classes persist also within the same risk group (sound, solvent, vulnerable and risky), but they are by far larger within risky firms. A possible concern is that the Z-score indicator cannot fully be in line and acknowledge the creditworthiness assessed by those banks which use the internal ratings-based (IRB) approach for credit risk evaluation.[21] To control for that, we drop from our sample the banks with IRB models. Results do not change, suggesting that there is a 'pure' size effect beyond firm riskiness.[22]

Figure B5 shows the average estimated differences in supply shocks between micro-firms and the others (small, medium and large) for each robustness check described in the following. For the sake of brevity, we focus on the year 2017. The red column of the bar chart

[20] Z-score used in the analysis is computed by Cerved Group on the base of a logistic model of firms' probability of default that includes a large number of balance-sheet indicators. It varies between 0 and 10 along with the increasing level of financial risk. The risk classes are: "sound"= scores 1 and 2; "solvent"= scores 3 and 4; "vulnerable"=scores 5 and 6; "risky"= scores 7, 8, 9 and 10.

[21] After the introduction of the Basel II framework in 2007, banks are allowed to choose between two main regulatory approaches to calculate capital charges for credit risk. Under the standardised approach, risk weights associated with each exposure are fixed and constant over time. Under the internal ratings-based approach, risk weights depend on banks' internal risk models validated by the supervisors.

[22] These results are available upon request. Also previous research highlighted that the gap in credit flows vis-à-vis larger firms can be explained only in part by their greater financial fragility, with the lower propensity of banks to finance smaller borrowers possibly accounting for the remainder (Bonaccorsi di Patti and Finaldi Russo, 2017).

represents the results of our baseline model (2). The other four columns in the chart represent respectively: i) the change in the definition of the dependent variable using credit drawn, instead of credit granted, normalised by firms' assets; ii) the exclusion of the first 5 largest Italian groups from the estimating sample;[23] iii) the removal of firms operating in construction and real estate sectors in order to verify if weaker banks are lending to firms more exposed to the business cycle; iv) the exclusion of younger companies (with less than six years), typically small and opaque. Taken together, all evidence shows that our results do not strictly rely on the definition of the main variable, do not depend on the selection of particular banks or on some matching between banks and firm sectors, and seem not to be driven by firm age.

4.3. Credit supply shocks and bank characteristics

The distribution of supply shocks across banks may vary according to firm size class. To figure it out, we plot the kernel density of the estimated bank shocks by firm size in figure B6 for the recovery period 2014-2017. The distribution related to micro-firms actually seems quite different from those of the other companies. The flatter density of the former points to a substantial bank heterogeneity in credit supply shocks compared to those of larger businesses. Moreover, the fat-tail on the left side for micro-firms indicates that the relative propensity to lend to these firms is notably low for a wide number of intermediaries.

We exploit this heterogeneity in estimated supply shocks between 2014 and 2017 to examine their correlations with some bank characteristics that are likely to affect lending (see Table A3 for definitions and summary statistics).[24] This part of the analysis does not aim to identify causal relationships between bank characteristics and credit shocks, but is more descriptive and may nevertheless be useful in highlighting avenues for future research. All bank variables refer to December 2013 and their changes are computed between December 2007 and December 2013. We run pooled regressions of the estimated supply shocks $\hat{\mu}_{bt}^{s}$ separately for the four firm size classes *s*, according to the following models:

$$\mu_{bt}^{s} = size_b + \rho_{bt}^{s}$$

$$\mu_{bt}^{s} = size_b + X_b + \sigma_{bt}^{s},$$

[23] We perform a further check excluding Italian banks that failed in 2015.
[24] This part of the analysis is based on bank data only, due to lack of information for other financial intermediaries.

with ρ and σ the error terms. In the first model we consider only size as bank characteristic (computed as the logarithm of total assets). The second model adds several bank variables to investigate if the bank size hinders other features that may be more significantly correlated with credit shocks. Indeed we consider features related with the soundness of their balance sheets (capitalisation, asset quality, profitability and liquidity levels).

Since less capitalised banks may need to reduce the riskiness of their assets (Peek and Rosengren, 1997) and may be more adverse to lend to opaque firms, we include among regressors a dummy for banks with Tier 1 ratio below 10 per cent (*T1 ratio*) as a proxy for capital constraints.[25] Moreover, we add the change in Tier 1 ratio (V*T1 ratio*) to account for recapitalisation needs arisen during the crisis. The interpretation of this variable is not straightforward since the ability to increase capital could also associate with a sound bank financial position. However, high levels of the cost of equity reached in the banking sector during the crisis (Altavilla et al, 2021) suggest that the largest increases in capital probably involved banks forced to do so.[26] In the light of the sharp deterioration in credit quality of Italian banks and its effects in terms of risk-taking attitude, we also include the change in the ratio of non-performing loans to outstanding loans (*Vnpl ratio*).[27]

Bank profitability may especially affect the capacity to grant credit to small businesses, since their higher opacity tend to increase screening and monitoring costs; thus, we include the ratio of interest margins to total assets (*Intmarg*) to take into account this factor. Similarly, low cost of funding may positively influence bank propensity to provide credit to small firms; for this reason, we also consider bank reliance on relatively cheaper funding instruments, as non-resident interbank funds (*Intbank*) and ECB funds (*Fund ECB*).[28] As for *Intbank*, however, the

[25] A dummy may be more efficient than a continuous variable to capture the effects of possible capital constraints since bank vulnerability is likely not to be linearly correlated with the Tier 1 ratio (the marginal effect of an increase in the ratio should be far stronger when it is computed near to the minimum regulatory level or when the bank is already highly capitalised). In the choice of this variable as well as in the threshold of 10 per cent we follow Peek and Rosengren (2005).

[26] Note that after the crisis different regulatory/supervisory initiatives have raised pressure on banks to increase capitalisation. Among the regulatory and supervisory initiatives: Basel III reform (approved in 2010), the stress test conducted in 2011; ECB's Comprehensive Assessment announced in 2013. Conti et al. (2018) find evidence that large shocks to bank capital, associated to those initiatives, had significant negative short-run impact on loan supply and GDP.

[27] Accornero et al. (2017) find that banks' lending behaviour can be affected by the emergence of new non-performing loans, but not by their level.

[28] Since the onset of the financial crisis in 2008 the ECB provided funding to the banks through the implementation of several unconventional monetary measures. Benetton and Fantino (2018) give evidence on the effect of the ECB Targeted Longer-Term Refinancing Operations on the cost of loans for small firms and those with a better credit scoring.

expected sign of the estimated coefficient is quite uncertain since dependence on interbank market may also capture the bank exposure to liquidity shocks, in the light of what happened in the burst of the 2008-09 financial crisis.[29]

Finally, we include among regressors the ratio of loans to total assets (*Loan ratio*), typically higher for banks adopting more traditional business models.

Results in Table B5 indicate that between 2014 and 2017 large banks adopted tighter lending standards towards micro and small firms with respect to smaller banks (cols. 1 and 3). The opposite holds for large companies (col. 7). When we add the other bank variables, *Size* loose its statistical significance. Most of the other coefficients have the expected signs. In particular, banks with lower Tier 1 ratios (near to the regulatory limit) seem to be more prone to lend to large firms. Similarly, higher capital increases during the crisis correlate with lower supply shocks to micro-enterprises, suggesting that recapitalisation needs might have induced banks to adopt tighter credit standards for small business lending. As for the funding structure, results are less clear-cut: while banks with higher recourse to ECB funding tend to increase credit supply to micro-firms, intermediaries more able to tap the interbank market seem more prone to extend loans only to large companies. Finally, profitability has a large and positive impact on credit supply to firms of all sizes and the estimated coefficient of *Loan ratio* is statistically significant (with a negative sign) only for large companies.

Besides the correlations between estimated credit shocks for each size class and bank characteristics, we are able to investigate to what extent bank conditions correlate with the gap in credit supply shocks between micro-enterprises and other firms, thus unveiling possible factors behind preferences of single banks to lend to customers of different size. The micro-credit gaps are defined at the bank level as the differences in the estimated supply shocks between small (or, alternatively, medium or large) and micro-firms for each year.

Table B6 illustrates the coefficients for regressions of the estimated supply gap between small and micro-firms (cols. 1-2), medium and micro (cols. 3-4), large and micro (cols. 5-6) on the previous set of bank variables. The significantly positive coefficients of *Size* in cols. 3-6 suggest that larger banks are more likely to lend to medium and large firms than to micro-enterprises. The gap in credit shocks between micro and medium/large companies seems also wider for banks with presumably stronger strains in their balance sheets, i.e. those with higher

[29] Ivashina and Scharfstein, 2010; Schnabl, 2012.

increases in the NPL ratio and higher capitalisation needs during the crises. Moreover, the large recourse to ECB and interbank funding seems to reduce the gap in credit supply shocks between micro-firms and the others (excluding large companies). Finally, banks with more traditional business models show a significantly higher gap in credit supply between medium and micro-firms.

All in all, the results of this section point out that the supply shocks estimated for micro-firms after the crisis are negatively correlated with: *i)* increases in banks' regulatory capital between 2007 and 2013, *ii)* lower bank profitability and *iii)* limited use of ECB funding. Interestingly, the gaps in credit supply between micro-firms and larger companies are associated to partially different bank characteristics. They are especially wide for: *i)* larger banks and those with *ii)* higher increases in the NPL and Tier 1 ratios, *iii)* lower access to interbank funding, and *iv)* more traditional business models.

5. Conclusions and policy implications

We modify the methodology adopted by Degryse et al. (2019) to identify idiosyncratic bank-time credit supply shocks across firm size. Our analysis, based on a matched sample of bank-firm relationships, focuses on the recovery following the great recession in Italy (2014-17) and compare the results with those relative to the pre-crisis period (2004-07). Our main findings highlight that, differently from the pre-crisis years, all companies faced a relevant tightening in credit supply after the sovereign debt crisis, except large ones. Moreover, between 2014 and 2017 credit supply to micro-firms has significantly dropped compared to small, medium and large companies, whereas before the great financial crisis bank shocks did not differ significantly across firm size. Importantly, this 'supply gap' against the micro-firms remains significantly large for each of the four years of the recovery period, indicating a persistently negative credit supply shock for smaller businesses. Finally, descriptive evidence shows that, at the bank level, the 'supply gap' against micro-firms correlates positively with bank size and increases in the NPL ratio during the crisis and negatively with access to cheap interbank funding.

The results are consistent with the hypothesis that during the great financial crisis banks faced relevant shocks that may have dampened their capacity to finance the productive system, especially small businesses. Indirect confirmation of our findings comes from some macro-level

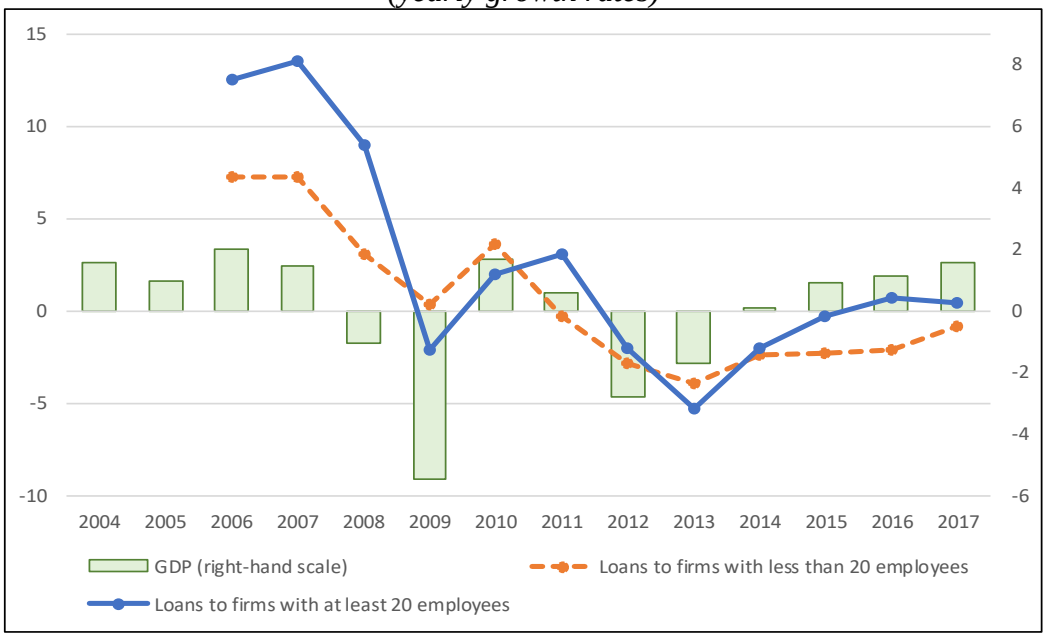
evidence (e.g. in terms of value added and number of employees) pointing to a possible tougher impact of a persistent credit tightening for smaller firms. We leave it to future research to analyse the links between credit supply shocks and these real outcomes.

Anyway, the interpretation of these developments and their possible underlying reasons is far from being univocal, thus calling for further investigation also on this important issue. On the one side, lending to these firms may imply higher costs, due to the opaqueness to external investors and the fixed costs of banks' screening processes; in a persistent low interest rate environment, some banks may not have been able to adjust their cost structure and activity – also by resorting to new technologies – to offset the adverse effects of low rates on profitability and capital, ending up cutting more costly small business loans. Specifically, changes in technology implying a larger use of hard vs. soft information and the evolution in bank organisation (decreasing number of local branches and lower levels of decentralisation in banks' credit decisions) could also have played a role in curtailing credit supply to micro-firms. Amidst increasing profitability concerns, intermediaries with less solid balance sheets conditions may have become less prone to finance small companies. On the other side, micro-firm opaqueness and the uncertainty surrounding the estimated levels of their default probability may have induced more risk averse banks to be cautious, *ceteris paribus*, to extend credit to these companies.

Our results bear relevant policy implications. As smaller firms are more exposed to the effects of exogenous shocks affecting the banking system, which occur both during crises and "normal" times, it would be advisable that policy measures typically aimed at easing SME financial constraints could become more effective if focused on - or strengthened for - micro-firms. At the same time, credit allocation could benefit from the reduction of information asymmetries. In this direction, public intervention could aim at stimulating smaller firms' transparency, standardising information delivered to market participants and promoting financial education for less alphabetised enterprises. The effects of such policies would potentially be well-suited for countries like Italy, characterised by the high fragmentation of the business landscape in small production units.

Appendix A – Summary statistics

Figure A1. Bank loans to non-financial corporations and GDP in Italy
(yearly growth rates)



Source: Bank of Italy, Supervisory reports, and ISTAT. Loans to firms with less than 20 employees include producer households.

Table A1. Summary statistics. Loan level data by firm size (per cent unless otherwise indicated). Statistics are computed on the same sample of firms used in the estimation of model (2). *Credit change* is the annual change in credit granted between two consecutive years, normalised by one-year-lagged firms' assets.

	Total			**Micro**			**Small**		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
				Sample period 2004-2007					
Credit change	0.4	0.0	7.8	0.4	0.0	10.2	0.6	0.0	6.0
Granted loans (EUR thousand)	938	300	6,300	338	176	857	623	368	1,300
Share of observations		100.0			43.6			33.1	
# of observations		2,559,736			1,117,215			846,513	
				Sample period 2014-2017					
Credit change	-0.5	0.0	5.5	-0.8	0.0	6.5	-0.1	0.0	4.4
Granted loans (EUR thousand)	791	182	7,100	269	109	982	560	300	1,800
Share of observations		100.0			53.4			28.4	
# of observations		3,260,757			1,741,004			924,758	

	Medium			**Large**		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
	Sample period 2004-2007					
Credit change	0.4	0.0	4.1	0.2	0.0	2.9
Granted loans (EUR thousand)	1,400	812	2,800	6,200	2,200	26,000
Share of observations		17.9			5.4	
# of observations		457,221			138,787	
	Sample period 2014-2017					
Credit change	0.0	0.0	3.1	0.0	0.0	2.2
Granted loans (EUR thousand)	1,400	750	3,300	6,100	1,700	30,000
Share of observations		13.2			5.0	
# of observations		430,727			164,268	

Table A2. Descriptive statistics at the firm level (per cent unless otherwise indicated). Statistics are computed on the same sample of firms used in the estimation of model (2). The balance sheet indicators, the rating and the firm size are one-year-lagged; the average values are winsorised at the 1st and the 99th percentiles. *Capitalisation* is the ratio of the equity to assets; *Liquidity* is the ratio of the liquid assets to assets; *Profitability* is the ratio of the gross operating margin to assets; *Debt sustainability* is the ratio of the financial expense to EBITDA; *Turnover growth* is the 3-year-average growth of turnover; *Investment rate* is the ratio of the 3-year investment (tangible and intangible) to fixed assets (3-year lagged). *Rating*: *Sound* includes firms with Z-score between 1 and 2, *Solvent* includes firms with Z-score between 3 and 4, *Vulnerable* includes firms with Z-score between 5 and 6, *Risky* includes firms with Z-score between 7 and 10.

	Mean	Median	Std. Dev.	Mean by firm size			
				Micro	Small	Medium	Large
	Sample period 2004-2007						
Capitalisation	20.0	14.1	20.7	19.1	21.0	24.1	25.3
Liquidity	7.3	2.5	11.4	7.4	7.4	6.9	6.0
Profitability	8.9	8.0	11.8	9.0	8.8	8.8	8.6
Debt sustainability	74.9	24.7	118.7	79.8	64.9	64.1	65.0
Turnover growth	34.8	6.4	125.4	38.1	30.3	21.1	25.9
Investment rate	166.4	66.9	251.8	170.0	167.0	141.3	132.6
Rating: Sound	8.3	0.0	27.6	4.1	15.2	20.7	25.5
Solvent	30.2	0.0	45.9	29.8	30.1	32.7	34.6
Vulnerable	39.5	0.0	48.9	41.7	36.1	33.2	31.4
Risky	22.0	0.0	41.4	24.5	18.6	13.4	8.6
Bank-relationships: 1	35.7	0.0	47.9	48.8	10.1	4.9	4.1
2-5	50.8	100.0	50.0	48.9	62.4	37.9	28.9
>5	13.4	0.0	34.1	2.3	27.5	57.1	67.0
# of firms		842,704				568,975	193,266
	Sample period 2014-2017						
Capitalisation	25.5	19.8	24.6	24.6	26.8	31.3	31.6
Liquidity	8.7	3.0	13.1	8.5	9.8	9.2	7.8
Profitability	7.8	6.7	11.4	7.7	8.2	8.6	8.0
Debt sustainability	71.1	17.8	121.7	76.2	57.5	53.2	59.5
Turnover growth	16.5	2.1	71.7	17.7	14.2	10.6	9.5
Investment rate	102.3	34.3	160.7	100.6	110.9	98.8	87.7
Rating: Sound	5.3	0.0	22.3	2.0	12.5	19.7	20.7
Solvent	26.0	0.0	43.8	24.3	30.0	32.1	33.5
Vulnerable	39.3	0.0	48.8	40.8	35.6	32.8	33.5
Risky	29.5	0.0	45.6	32.9	21.9	15.3	12.3
Bank-relationships: 1	39.4	0.0	48.9	49.0	14.4	6.7	4.1
2-5	50.6	100.0	50.0	48.6	62.3	41.4	30.9
>5	10.0	0.0	30.1	2.4	23.4	52.0	65.0
# of firms		1,201,150				886,706	230,993

Table A3. Descriptive statistics at the bank level (per cent unless otherwise indicated). Statistics are computed on the same sample of banks present in the year 2014 and used in the estimation of model (2). The indicators in levels are at December 2013, the changes are between December 2007 and December 2013. The changes take into account mergers and acquisitions across banks. Level variables are cleaned from outliers values, and the changes are then winsorised at the 1st and the 99th percentiles. *Vnpl ratio* is the change in the ratio of non-performing loans to outstanding loans in the previous year, *T1 ratio* is a dummy indicating if the Tier 1 ratio (the ratio of Tier 1 capital to risk-weighted assets) is below 10 per cent, *VT1 ratio* is the change in the Tier 1 ratio, *Fund ECB* is the funding from the Eurosystem to total funding, *Interbank* is the ratio of interbank funding from non-residents to assets, *Intmarg* is the interest margin to assets, *Loan ratio* is the ratio of total loans to assets, *Size* is the natural logarithm of total assets.

	Mean	Median	Std. Dev.
Vnpl ratio (pp)	10.5	9.9	8.2
T1 ratio	9.3	0.0	29.1
VT1 ratio (pp)	-1.5	0.4	15.9
Fund ECB	3.8	0.0	9.5
Interbank	0.7	0.0	4.0
Intmarg	1.8	1.9	0.5
Loan ratio	58.5	59.9	15.1
Size (units)	6.7	6.5	1.6
# of banks at December 2014		495	

Appendix B – Econometric analysis

Table B1. Statistics of the estimated bank-time shocks; the effects are estimated by the model (2) weighting each observation by the lagged firms' assets.

	Micro-firms					Small firms					Medium firms					Large firms				
	Mean	S.D.	1st q.	2nd q.	3rd q.	Mean	S.D.	1st q.	2nd q.	3rd q.	Mean	S.D.	1st q.	2nd q.	3rd q.	Mean	S.D.	1st q.	2nd q.	3rd q.
2004	0.0023	0.0294	-0.0113	0.0026	0.0159	0.0016	0.0190	-0.0066	0.0023	0.0087	0.0003	0.0116	-0.0048	0.0005	0.0047	-0.0015	0.0067	-0.0037	-0.0017	0.0007
2005	-0.0025	0.0275	-0.0179	-0.0008	0.0113	-0.0004	0.0161	-0.0079	0.0007	0.0078	-0.0005	0.0114	-0.0056	-0.0007	0.0046	-0.0027	0.0062	-0.0052	-0.0027	-0.0003
2006	0.0026	0.0244	-0.0103	0.0027	0.0132	0.0031	0.0159	-0.0049	0.0029	0.0099	0.0007	0.0097	-0.0044	0.0008	0.0049	-0.0016	0.0059	-0.0040	-0.0016	-0.0001
2007	0.0036	0.0235	-0.0096	0.0033	0.0151	0.0037	0.0170	-0.0039	0.0038	0.0100	0.0015	0.0105	-0.0037	0.0015	0.0059	-0.0013	0.0054	-0.0032	-0.0009	0.0004
2014	-0.0070	0.0103	-0.0124	-0.0065	-0.001	-0.0040	0.0085	-0.0082	-0.0032	0.0006	-0.0024	0.0059	-0.0057	-0.0025	0.0007	-0.0014	0.0038	-0.0030	-0.0014	-0.0001
2015	-0.0066	0.0118	-0.0125	-0.0058	-0.0003	-0.0029	0.0109	-0.0066	-0.0023	0.0016	-0.0022	0.0076	-0.0053	-0.0022	0.0009	-0.0012	0.0037	-0.0027	-0.0010	0.0003
2016	-0.0060	0.0120	-0.0121	-0.0056	0.0001	-0.0022	0.0110	-0.0072	-0.0025	0.0019	-0.0020	0.0065	-0.0049	-0.0019	0.0005	-0.0008	0.0054	-0.0023	-0.0010	0.0001
2017	-0.0069	0.0130	-0.0114	-0.0056	-0.0007	-0.0022	0.0100	-0.0066	-0.0018	0.0017	-0.0018	0.0073	-0.0048	-0.0016	0.0009	-0.0005	0.0064	-0.0024	-0.0011	0.0003

Table B2. Linear regression of the estimated bank-time shocks on year dummies for each firm size; baseline period: pre-crisis years (2004-2007). Standard errors are clustered at the bank level. Significance levels: * <0.1, ** <0.05, *** <0.01.

	(1)	(2)	(3)	(4)
	Micro-firms	Small firms	Medium firms	Large firms
2014	-0.0086***	-0.0060***	-0.0029***	0.0004*
2015	-0.0082***	-0.0049***	-0.0027***	0.0006**
2016	-0.0075***	-0.0043***	-0.0025***	0.0010***
2017	-0.0084***	-0.0042***	-0.0024***	0.0012***
Constant	0.0015***	0.0020***	0.0005**	-0.0018***
adj. R-sq	0.0379	0.0298	0.0204	0.0060
Obs.	6331	6028	5364	3944

Table B3. Tests for the differences in the means of the estimated bank-time shocks across firm size. Supply effects are estimated by the equation (2) in the text, weighting each observation by the lagged firms' assets. The effects are winsorised at the 1st and the 99th percentiles. Significance levels: * <0.1, ** <0.05, *** <0.01.

	Mean differences test					
	Micro versus:			*Small versus:*		*Medium versus:*
	Small (1)	*Medium* (2)	*Large* (3)	*Medium* (4)	*Large* (5)	*Large* (6)
2004	0.0006	0.0020*	0.0038***	0.0013	0.0031***	0.0018***
2005	-0.0021*	-0.0020*	0.0001	0.0001	0.0022***	0.0021***
2006	-0.0005	0.0019**	0.0042***	0.0024***	0.0048***	0.0023***
2007	0.0000	0.0022**	0.0049***	0.0022***	0.0050***	0.0028***
2014	-0.0031***	-0.0046***	-0.0056***	-0.0016***	-0.0026***	-0.0010***
2015	-0.0038***	-0.0044***	-0.0054***	-0.0006	-0.0017***	-0.0010***
2016	-0.0037***	-0.0040***	-0.0052***	-0.0002	-0.0015***	-0.0013***
2017	-0.0047***	-0.0050***	-0.0064***	-0.0003	-0.0017***	-0.0013***

Table B4. Statistics of the differences in the estimated bank-time shocks between micro-firms and the other size classes. Supply effects are estimated by the equation (2) in the text, weighting each observation by the lagged firms' assets. The effects are winsorised at the 1st and the 99th percentiles. Simple averages for the 'mean' rows in the last two columns.

	2004	2005	2006	2007	2014	2015	2016	2017	2004-07	2014-17
					Micro versus Small					
Mean	0.0006	-0.0021	-0.0005	0.0000	-0.0031	-0.0038	-0.0037	-0.0047	-0.0005	-0.0038
Stand. Error	0.0013	0.0011	0.0010	0.0010	0.0005	0.0006	0.0006	0.0006	0.0006	0.0003
95% Conf. Interval	-0.0018	-0.0043	-0.0025	-0.0020	-0.0040	-0.0049	-0.0049	-0.0059	-0.0016	-0.0043
	0.0031	0.0001	0.0015	0.0019	-0.0021	-0.0026	-0.0026	-0.0035	0.0006	-0.0032
					Micro versus Medium					
Mean	0.0020	-0.0020	0.0019	0.0022	-0.0046	-0.0044	-0.0040	-0.0050	0.0010	-0.0045
Stand. Error	0.0012	0.0011	0.0009	0.0009	0.0004	0.0005	0.0005	0.0006	0.0005	0.0002
95% Conf. Interval	-0.0003	-0.0041	0.0001	0.0004	-0.0054	-0.0054	-0.0050	-0.0062	0.0000	-0.0050
	0.0042	0.0001	0.0037	0.0039	-0.0038	-0.0034	-0.0030	-0.0039	0.0020	-0.0040
					Micro versus Large					
Mean	0.0038	0.0001	0.0042	0.0049	-0.0056	-0.0054	-0.0052	-0.0064	0.0033	-0.0057
Stand. Error	0.0011	0.0010	0.0009	0.0008	0.0004	0.0004	0.0005	0.0006	0.0005	0.0002
95% Conf. Interval	0.0016	-0.0019	0.0025	0.0033	-0.0064	-0.0063	-0.0062	-0.0075	0.0023	-0.0061
	0.0059	0.0021	0.0060	0.0066	-0.0049	-0.0046	-0.0043	-0.0052	0.0042	-0.0052

Table B5. Coefficient estimates for pooled regressions of the estimated supply shocks, as given by model (2); sample period 2014-2017. The indicators in levels are calculated in December 2013, the variations are between December 2007 and December 2013. The variations take into account mergers and acquisitions across banks. Level variables are cleaned from outliers values, and the variations are then winsorised at the 1st and the 99th percentiles. Variables: *Vnpl ratio*:= the change in the ratio of non-performing loans to outstanding loans in the previous year, *T1 ratio*:= dummy indicating if the Tier 1 ratio (the ratio of Tier 1 capital to risk-weighted assets) is below 10 per cent, *VT1 ratio*:= the change in the Tier 1 ratio, *Fund ECB*:= the funding from the Eurosystem over total funding, *Interbank*:= the ratio of interbank funding from non-residents to assets, *Intmarg*:= the interest margin to assets, *Loan ratio*:= the ratio of total loans to assets, *Size*:= the natural logarithm of total assets. Time dummies are included in the regressors. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

	Micro		Small		Medium		Large	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Size	-0.0004*	0.0001	-0.0003**	0.0003	0.0001	0.0004***	0.0002**	0.0001
Vnpl ratio		-0.0033		-0.0044		-0.0004		-0.0009
T1 ratio		-0.0002		-0.0005		0.0008		0.0007**
VT1 ratio		-0.0060*		-0.0010		-0.0022		-0.0023
Fund ECB		0.0099**		-0.0016		-0.0008		-0.0006
Interbank		0.0069		-0.0070		-0.0020		0.0250**
Intmarg		0.2368***		0.1553**		0.1228***		0.0528*
Loan ratio		-0.0040		-0.0008		-0.0007		-0.0037**
Constant	-0.0040***	-0.0092***	-0.0013	-0.0068***	-0.0025***	-0.0061***	-0.0025***	-0.0010
R-sq	0.0040	0.0253	0.0109	0.0150	0.0015	0.0084	0.0119	0.0764
# of obs.	2,016	1,843	1,985	1,809	1,805	1,633	1,360	1,190

Table B6. Coefficient estimates for pooled regressions of the estimated 'supply gap' for micro-firms with respect to the other companies, as given by model (2); sample period 2014-2017. The indicators in levels are calculated in December 2013, the variations are between December 2007 and December 2013. The variations take into account mergers and acquisitions across banks. Level variables are cleaned from outliers values, and the variations are then winsorised at the 1st and the 99th percentiles; year dummies are included. Significance levels: * p<0.10 ** p<0.05 *** p<0.01.

	Supply gap: small vs micro		Supply gap: medium vs micro		Supply gap: large vs micro	
	(1)	(2)	(3)	(4)	(5)	(6)
Size	-0.0000	0.0002	0.0005***	0.0005**	0.0007***	0.0004*
Vnpl ratio		-0.0006		0.0043		0.0127***
T1 ratio		-0.0002		0.0012		0.0002
VT1 ratio		0.0041		0.0062*		0.0030
Fund ECB		-0.0112**		-0.0084**		-0.0067
Interbank		-0.0148**		-0.0129***		0.0167*
Intmarg		-0.0447		-0.0411		-0.1039
Loan ratio		0.0039		0.0053**		-0.0004
Constant	0.0032**	0.0012	0.0014	-0.0008	0.0011	0.0041
R-sq	0.0014	0.0151	0.0065	0.0269	0.0137	0.0352
# of observations	1,967	1,804	1,773	1,619	1,304	1,175

Figure B1. The graph represents the composition of the average differences in the *Credit change* between micro-firms and the other companies (small, medium, large) over the period 2014-2017. The supply factors are the bank-idiosyncratic shocks estimated by the equation (2) in the text. The other factors include the demand for credit and a residual component of the supply shocks common to all intermediaries.

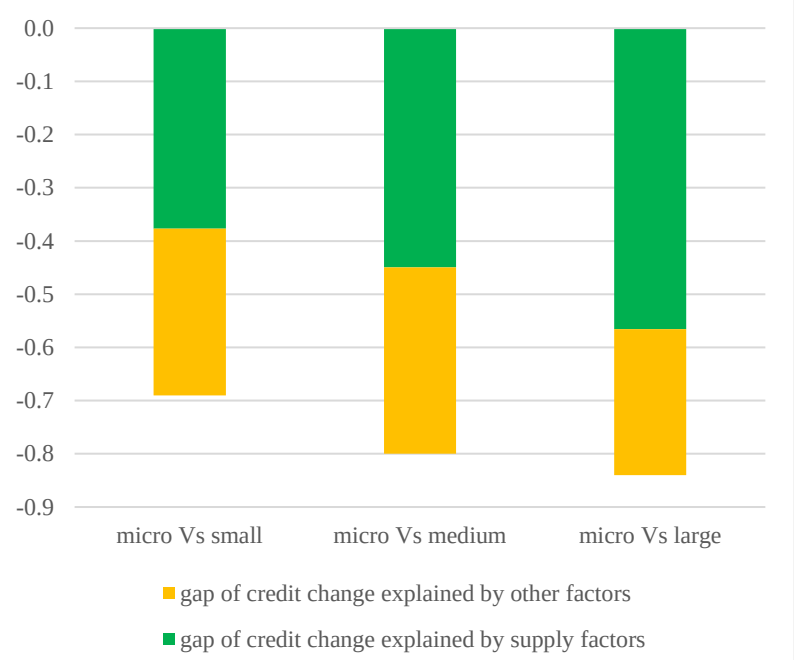


Figure B2. Average differences in the estimated bank-time shocks between micro-firms and the other companies (small, medium, large). Lower values represent tighter supply conditions. In Panel A the effects are estimated using a similar model to equation (2) but without control for credit demand; in Panel B the effects are estimated by the equation (2) in the text. The effects are winsorised at the 1st and the 99th percentiles.

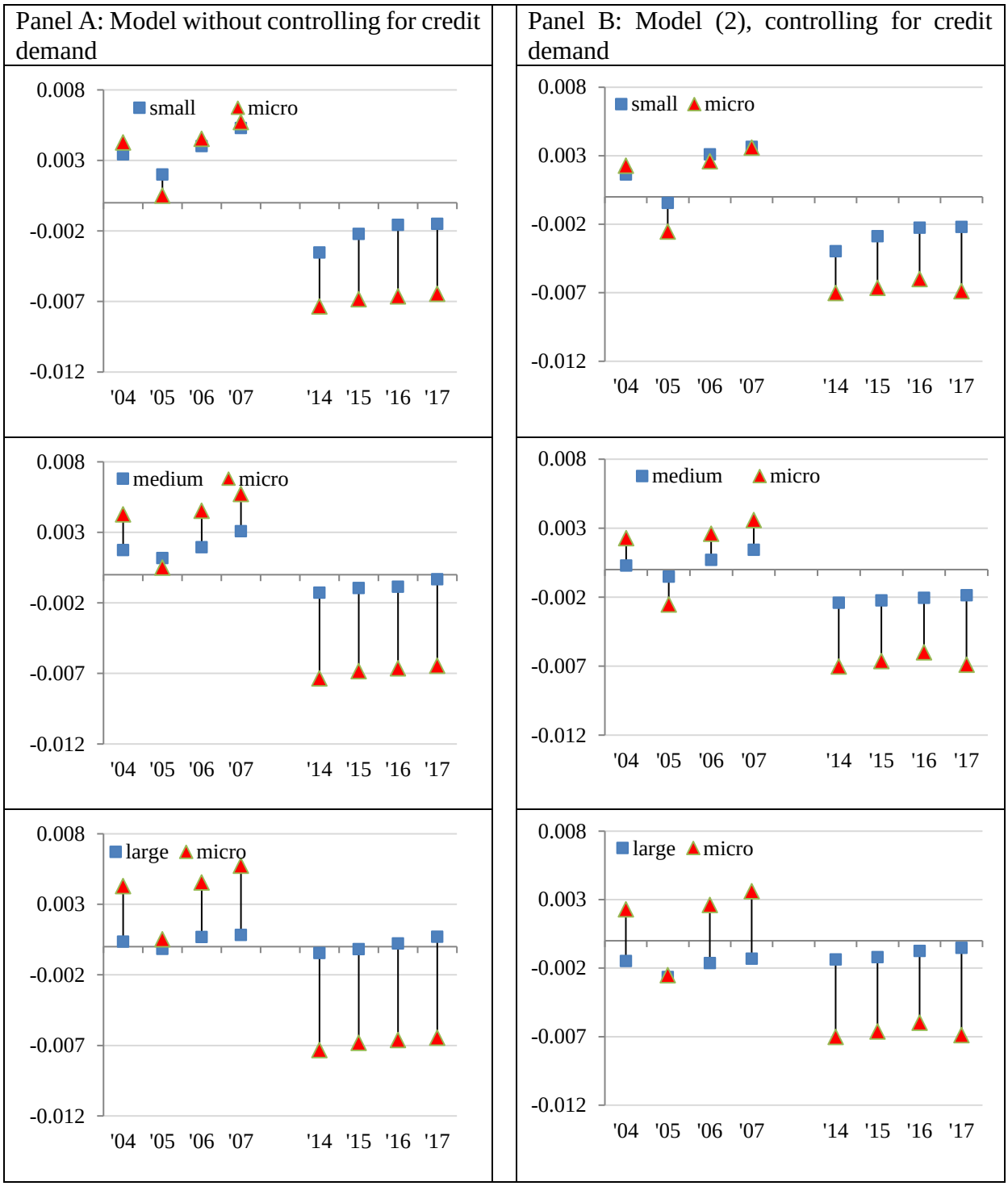


Figure B3. Differences in the average estimated supply shocks between micro-firms and the other sizes. Plots show results for the specification with firm-time fixed effects and for our main model (eq. 2) in the text), given the same estimating sample (multiple-lender firms).

Figure B4. Distribution of the estimated bank-time fixed effects by firms' size s and riskiness r. The specification used is: $\Delta Y_{fbt} = \mu^{s*r}_{bt} + \eta_{ipst} + \boldsymbol{\gamma}_1 \mathbf{X}_{ft-1} + \varepsilon_{fbt}$.

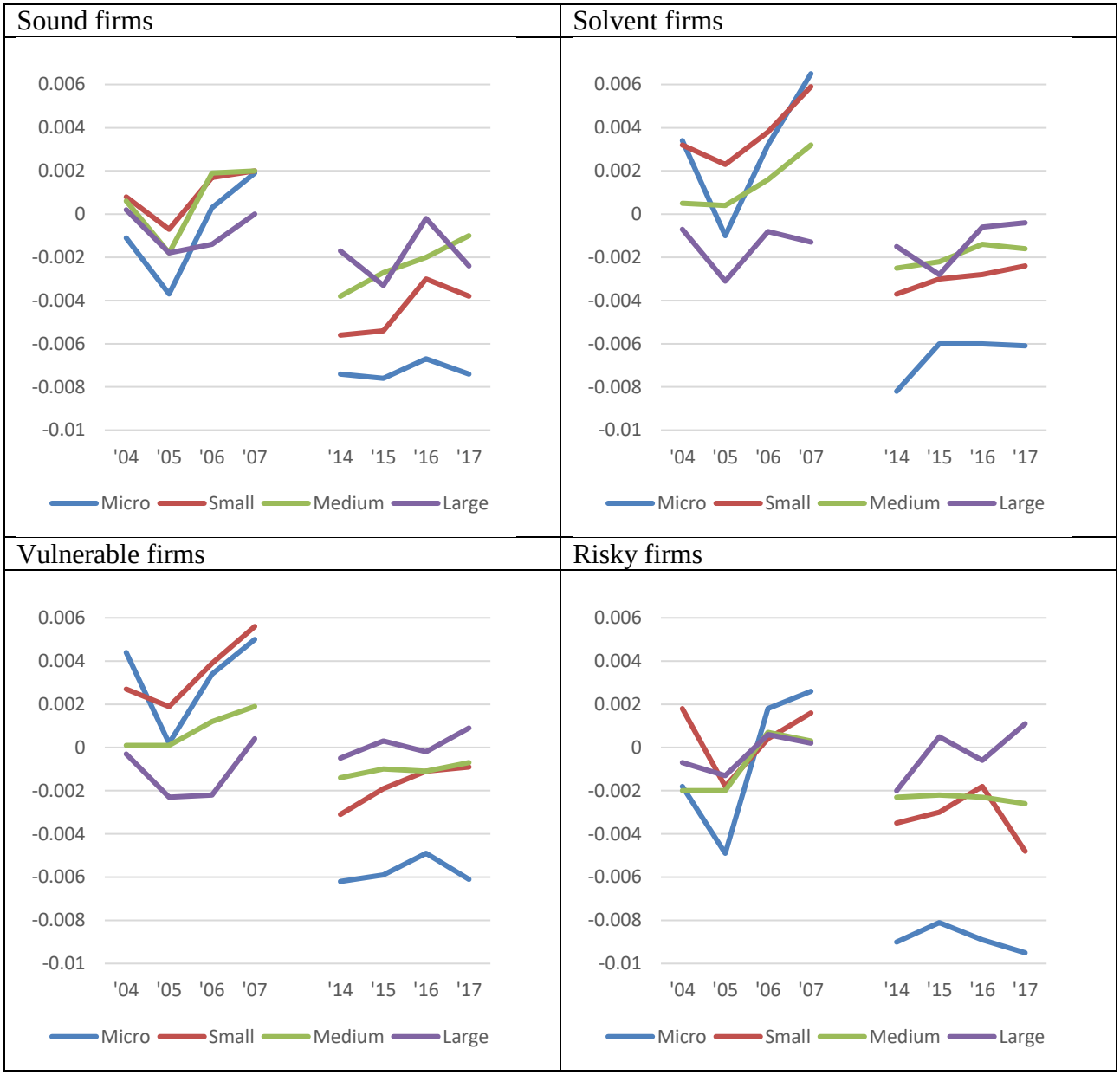


Figure B5. Differences in the average estimated supply shocks in the year 2017 between small/medium/large and micro-firms. All the estimates are based on the equation (2). The first column represents our baseline results (par. 4.1). The second uses the change in credit drawn instead of credit granted. The third excludes the largest banking groups. The fourth excludes the firms in construction and real estate sectors. The last column includes only firms with more than 5 years.

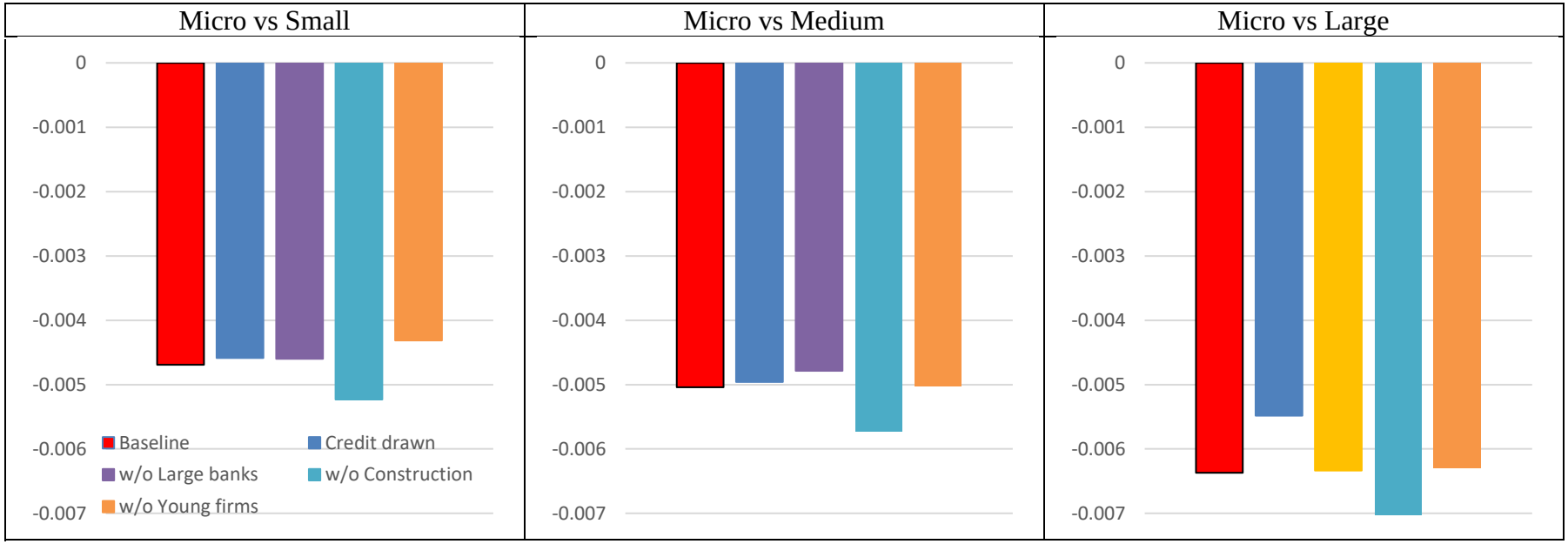
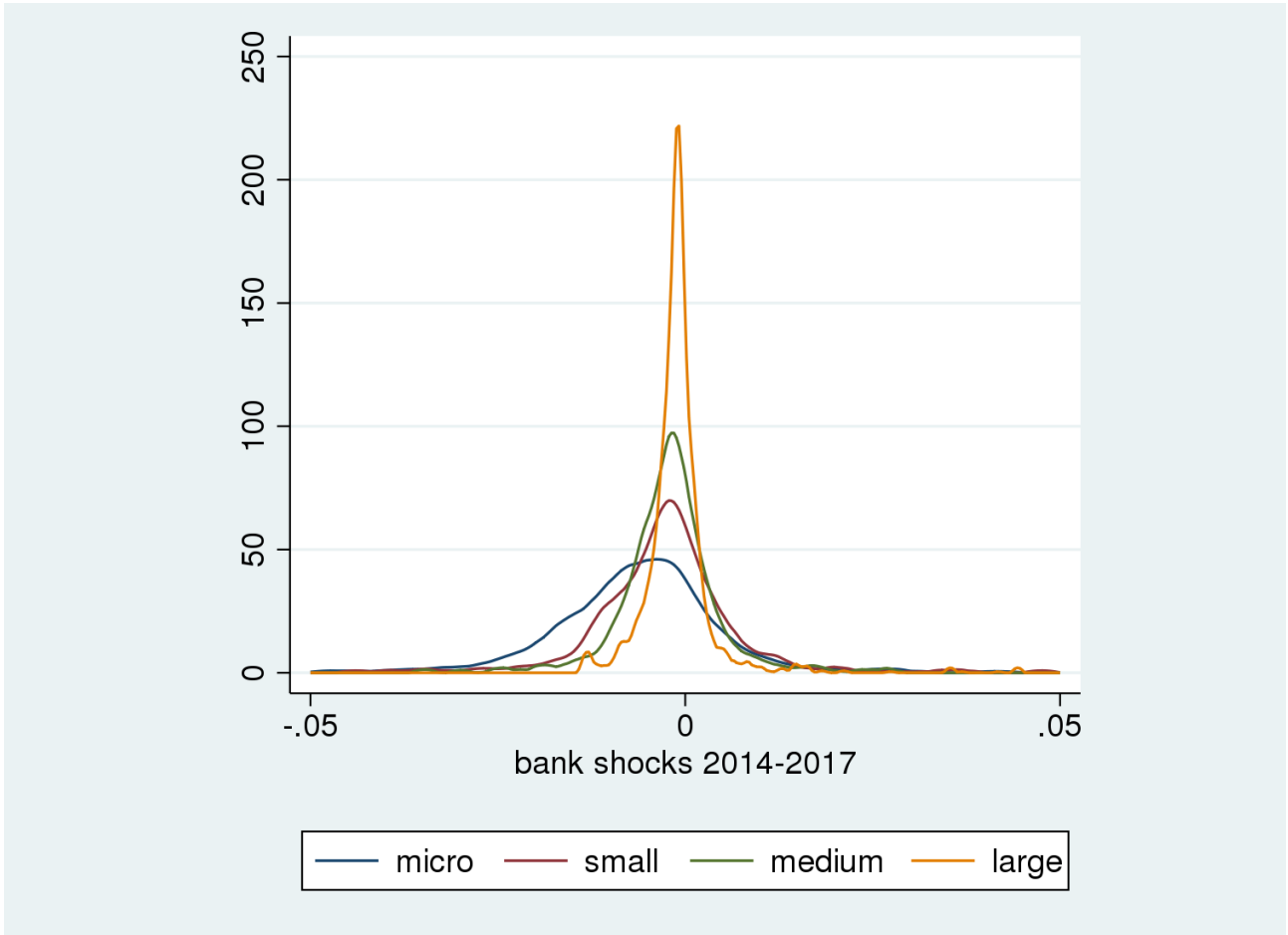


Figure B6. Kernel distribution of the estimated bank-time fixed effects by firm size; the effects are estimated by the model (2) weighting each observation by the lagged firms' assets.



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