Higher capital requirements and credit supply: Evidence from Italy*

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Abstract

We use a rich dataset on bank loans to firms matched to information on firms' and banks' characteristics, and exploit the implementation of Basel III reforms in Italy to investigate the impact of higher risk-based capital requirements on credit supply. While we do not address the steady state impact of capital requirements, we find that the introduction of higher requirements is associated with credit tightening in the early years after the reform. Banks facing more stringent requirements tighten credit supply to risky firms in favor of sounder ones. We also show that banks with lower and higher values of the capital ratio pre-reform tighten the credit to a lesser extent, i.e., the lending supply response is U-shaped in the capital strength, as predicted by the forced safety effect (Bahaj and Malherbe 2020). Finally, firms relying more on less capitalized banks were only partially able to switch their lenders, experienced a worsening in lending conditions and invested less compared to other firms after Basel III implementation.

JEL classification: G21, G28, G38.

Keywords: Financila institutions, Basel III, Capital requirements, Forced safety effect, Lending conditions

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1 Introduction

Over the last decade, the relationship between lending and capital requirements has been at the center of intensive debates. Both theoretical and empirical works have tried to shed light on the link between capital requirements, lending, and the real economy. Results are mixed. Some studies argue that an increase in capital requirements might, under some conditions, reduce average banks' funding costs and thus increase bank lending (see Hanson, Kashyap, and Stein 2011, Admati et al. 2013, Bassett and Berrospide 2018 and Begenau 2020). On the contrary, others suggest that an increase in the risk-based capital requirement increases the bank's loan-funding cost, making lending less attractive (see among others, Thakor 1996, Martinez-Miera and Suarez 2014 for a theoretical perspective, and Aiyar et al. 2014, Gropp et al. 2019 and Ragnar and Wold 2020 for empirical evidence). A recent paper by Bahaj and Malherbe 2020 connects the two conflicting views showing that one should not necessarily expect a monotonic relationship between capital requirements and lending. They develop a model in which raising the capital requirement reduces lending, through a composition effect (an increase in costly liabilities), but it also makes the bank safer. This forced safety effect (FSE) alleviates the composition effect; as the default boundary for the bank is shifted, there will be more states of the world where banks' shareholders will benefit from the potential surplus of loans. Therefore, a loan that would have been passed on by a low-capital bank, will be underwritten by the same bank once equipped with more capital in order to comply with tighter regulation. The forced safety effect makes the lending response to higher requirements less negative, and after a given level it may dominate the composition effect, thus making lending increase. Bahaj and Malherbe 2020 show that in their model the lending response is typically U-shaped in requirements and that the forced safety effect could be relevant under plausible conditions. Testing the U-shaped relationship between credit supply and the level of the requirement is possible only in a sample with sufficient variation in the level of capital requirements. The empirical analysis of Bahaj et al. 2016 and Bahaj and Malherbe 2017 relies on a data set encompassing only 18 banks: their panel does not provide enough variation in requirements to test the U-shaped relationship, which is still empirically unexplored. In this paper, we exploit data from a large number of banks and use the variance in the levels of capital ratios before Basel III as a proxy for the variation in the tightness of new capital requirements, by assuming that pre-reform different levels of the capital ratio correspond to different distances from the new requirement. To our best knowledge, this paper is the first to offer a test of the shape of the relationship between credit supply and the enforced capital requirements, by exploiting the heterogeneity in capital ratios held by a large sample of banks before the implementation of the Basel III reforms.

Beyond having enough variation in capital ratios, to test convincingly the impact of capital regulation on credit supply, including the predictions by Bahaj and Malherbe 2020, other identification challenges need to be addressed. First, the supply of credit needs to be disentangled from demand. We exploit detailed datasets virtually encompassing the universe of bank-firm relationships in Italy, from 2009 to 2018. A rich information set on lenders, borrowers, and their relationships serves to isolate supply-side effects caused by changes in the requirement from other confounding factors. The latter could be due to either demand-driven or supply-side dynamics not related to higher capital requirements. Analysis based only on macro data or bank-level data may suffer from an omitted-variables problem. Second, the trigger of the increase in capital requirements should be exogenous to economic conditions. A country's business cycle conditions affect capital requirements as lending increases in the ascending phase of a cycle when also risks are lower and vice-versa in the descending phase. We exploit as a shock to capital requirements the increase in required risk-based capital due to the implementation of the Basel III reform in Italy. The Basel III reform was agreed at a global level to strengthen the resilience of the financial system, mitigating the vulnerabilities uncovered by the global financial crisis. The decision and the content of the reform were independent of Italian economic conditions. The implementation of the Basel III regime in Italy occurred in January 2014, although the reform was originally agreed at the global level in 2010. Therefore, the introduction of the reform was largely expected, even if implemented worldwide according to different timelines and specificities.

Although the higher requirements introduced by Basel III were levied on all banks at the same time, they affected banks differentially due to their pre-reform capital ratios. To isolate the regulatory impact in the first years after the reform, we, therefore, exploit the fact that, at the time of the Basel III reform, some banks had balance sheet indices that made them more exposed to the new, stricter capital standards; by contrast, other banks were in a stronger financial position to comply with the new rules. As banks hold voluntary buffers to reduce the chance that they breach regulatory requirements, their reaction to increases in the latter also depends on their desired amount of excess capital (De Jonghe, Dewachter, and Ongena 2020), which is however unobservable. After defining the two groups of more and less exposed banks, we measure the differential changes in credit supply conditions applied post-reform by banks in the treated group (more exposed banks), with respect to the supply conditions applied by non-hit banks, or banks hit to a lesser extent. Our main identification strategy relies on the fact that the behaviour of the two groups of banks looks very similar before the reform as we show by performing parallel trends tests on treated and untreated bank-firm relationships. Using loan-level data, we also include granular sets of fixed effects to control for credit demand. We add location-by-time fixed effects to control for local factors that may affect credit demand and we also include bank-by-firm fixed effects to account for the possibility that credit supply and demand are driven by endogenous matching between lenders and borrowers and for unobservable changes in the pool of borrowers. We find evidence supporting the view that higher capital requirements are associated with lower credit growth and higher cost of credit, consistent with a tightening of credit supply. The reduction reflects a risk shifting: banks facing more stringent requirements relocate credit supply from risky to sounder firms, which is to a large extent an intended effect of the Basel III reforms. Moreover, we check whether the

lending response is U-shaped in the level of the requirement as theorized by Bahaj and Malherbe 2020 by assessing whether the reaction of banks varies across different ex-ante levels of the capital ratio. We show that for lower and higher values of the ex-ante capital ratio the credit tightening is weaker, i.e., the lending response is U-shaped in the stringency of the requirement consistently with the existence of a forced safety effect. Our results on credit quantities are confirmed also using data on interest rates.
Furthermore, we complement the main bank-firm analysis with a firm-level analysis. This different focus enables to ascertain that stricter capital requirements did not trigger a mere relocation of bank debt from constrained to unconstrained banks, but they entailed, for some firms, an effective reduction in credit volumes, an increase in credit costs, and eventually a negative impact on firm investment.

We contribute to the existing literature in different ways. This paper addresses the question of the effects of higher capital requirements through granular datasets, allowing us to deploy state-of-the-art techniques to control for confounding factors, both time-invariant and time-varying. By contrast, previous works on the topic rely either on aggregate data (without "banks or firms" details) or on bank-level data, with no firm-level details, entailing a higher risk to confuse demand- and supply-driven factors (Aiyar, Calomiris, and Wieladek 2014, Banerjee and Mio 2018). Gropp et al. 2019 use bank-firm data but from a sample of syndicated loans, a market typically skewed towards bigger and less bank-dependent firms, rather than from the universe of bank loans within a credit market. Other studies adopt an identification approach similar to ours, while not directly addressing the effects of the higher risk-based capital requirements introduced with the Basel III regulation package: this is the case, e.g., of Fraisse, Lé, and Thesmar 2020, or Behn, Haselmann, and Wachtel 2016, featuring French and German loan-level data, respectively. As for the Italian credit market, Gallo 2021 studies how the introduction of the internal ratings-based (IRB) method, which makes capital more risk-sensitive compared to the standard approach, impacts credit supply. He shows that banks adopting the IRB approach raise interest rates and reduce credit to high-risk borrowers compared to low-risk ones. Bonaccorsi di Patti, Moscatelli, and Pietrosanti 2020 study the effect of a change in capital requirements on the cost of credit by exploiting the introduction of the "Small and Medium Enterprises (SME) Supporting Factor" in a regression discontinuity design.[1] They estimate a reduction in interest rates charged to SMEs of 9.5 basis points per percentage point drop in capital requirements. As in these studies, we infer that capital requirements are a relevant factor in banks' lending decisions.

After having established that higher risk-based capital requirements are associated with reduced lending and higher interest rates, we use the richness of our data to dig deeper into how banks rebalance the riskiness of their portfolios. Ragnar and Wold 2020 already provide evidence of portfolio rebalancing due to the introduction of risk-weighted capital requirements.

[1]The "SME Supporting Factor" is a capital relief introduced in the EU to mitigate the stricter capital rules enforced by the capital requirements regulation (CRR) and the capital requirements directive IV (CRD IV) for specific exposures towards small borrower firms.

They focus on the shift from corporate to household lending, assuming that corporate loans are riskier. In this paper, we identify borrowers' risk using scores provided by Cerved Group, a private company selling information about Italian firms to banks (Albareto et al. 2011). We show that - in the early years after Basel III - low-capitalized banks granted less credit to risky companies while easing conditions to more creditworthy firms, in line with the objectives of the Basel III reform. Finally yet importantly, we provide novel empirical evidence on the forced safety effect that, as explained by Bahaj and Malherbe 2020, might lead the lending response to be U-shaped in the stringency of the requirement. Our findings show that the forced safety effect is not large enough to make the lending response to higher requirements positive.

We extend our analysis by investigating whether the credit supply shock induced by the increase in capital requirements caused a credit restriction for some Italian non-financial firms or just a credit reallocation from constrained to unconstrained banks. In this way, we contribute to the growing literature that hinges on granular data to assess the impact of credit supply shocks on the real economy (Chodorow-Reich 2014 and Paravisini et al. 2015, among others).[2] We find that firms relying more on less capitalized banks were only partially able to switch their lenders and experienced a worsening in lending conditions. Firms exposed to higher risk-based capital requirements through their lenders eventually invested less than peers after Basel III implementation. While this last analysis takes a step towards the ultimate

[2]For Italy, using as a shock to credit supply the liquidity drought in interbank markets that followed the 2007 financial crisis, Cingano, Manaresi, and Sette 2016 show that firm investment decisions are highly sensitive to bank credit availability.

real economic consequences of higher capital requirements, it remains to some extent partial as we cannot assess the quality of the unfunded investments.

All in all, higher capital requirements succeed in increasing resilience by leading banks to reduce lending to risky borrowers, that as shown by Bonaccorsi di Patti and Kashyap 2017 are responsible for most loan losses when a profitability shock occurs. In bad times, banks with higher capital buffers are more able to maintain credit to the real economy, which is relevant from a macroprudential viewpoint (see among others, Gambacorta and Mistrulli 2004 and Jiménez et al. 2017). However, consistently with Martinez-Miera and Suarez 2014, this gain comes at the cost of lowering credit and investments, and thus output, in the capital building phase.

The rest of the paper is organized as follows. The next section describes the Basel III reform. Sections 3 and 4 summarizes the related literature and the hypotheses we are testing. Section 5 describes the data and the econometric strategy. In section 6 we comment on the results of the main bank-firm level analysis and in 7 we complement it with the firm-level findings. Section 8 provides some robustness checks and 9 concludes.

2 The Basel III Reform

The global financial crisis demonstrated that a stronger capital and liquidity base (in terms of both quality and size) was needed to improve the ability of the global banking system to withstand severe economic shocks. In the aftermath of the crisis, the G20 launched a comprehensive program of financial reforms to increase the resilience of the global financial system. To improve the quality and quantity of capital, the Basel Committee on Banking Supervision agreed on detailed capital measures, commonly referred to as Basel III. Table 1 briefly summarizes the main changes to the existing definition of regulatory capital and the increase of minimum Tier 1 capital requirements from 4 percent to 6 percent of risk-weighted assets. In addition to raising the quality of the capital base, the Basel Committee considerably strengthened the rules underlying counterparty credit risk and introduced a capital conservation buffer of 2.5 percent above the minimum, and the counter-cyclical buffer, allowing national regulators to require up to an additional 2.5 percent during periods of high credit growth. Basel III foresees a gradual transition to the stricter standards, with full implementation as of 1 January 2019. The new framework was introduced almost worldwide, although according to slightly different timelines and with limited specificities in selected jurisdictions. As of 30 June 2015, all large internationally active banks have met Basel III minimum capital requirements (BCBS 2016). In the EU the Basel III framework was implemented with the entry into force of the Capital Requirements Directives IV (CRD IV) package on 17 July 2013.[3] Institutions were required to apply the new rules from 1 January 2014; the new Tier 1 requirement was fully implemented by 2015 and the capital conservation buffer was phased-in from 2016 until 2019. The European regulation enabled Member States to adopt stricter definitions or

[3]The CRD IV package included the Capital Requirement Regulation (CRR).

to anticipate the enforcement of the new capital requirements with respect to the Basel III time schedule. As of 1 January 2014, Italian banks were required to maintain a level of Tier 1 capital equal to 8.5 percent of risk-weighted assets, of which 2.5 percent as a capital conservation buffer requirement.[4] Banks that fail to comply with the CCoB may not distribute dividends, variable remuneration and must define the measures necessary to restore the required level of capital.

Therefore, the Basel III stricter requirements were defined at the global level, then translated into the European laws, and were not tailored to the specificities of the Italian economy; the new constraints were implemented in Italy without country-level departures from the common framework or further transitional periods. This makes the new framework independent of the Italian situation and enables us to isolate the effects of increased capital requirements as an exogenous shock.

3 Theory and Empirical Evidence

When confronted with increased requirements, affected banks can increase their regulatory capital ratios in two ways: they can increase their levels of regulatory capital (the numerator of the capital ratio) or they can shrink

[4]More precisely, banks were required to maintain 1.5 percent of additional Tier 1 and a level of Common Equity Tier 1 (CET1) capital equal to 7 percent of risk-weighted assets, of which 4.5 percent as a minimum requirement and 2.5 percent as a capital conservation buffer requirement. For banking groups the requirement was to be calculated on a consolidated basis. In January 2017, the Bank of Italy announced the decision to amend the fully loaded implementation of the capital conservation buffer (CCoB) in favor of the transitional arrangement provided for by the CRD IV, permitting its gradual phasing-in until 2019.

their risk-weighted assets (the denominator of the capital ratio). The latter may be achieved by reducing the assets' risk density, the assets themselves, or both. Reducing assets has potentially adverse effects on the economy if many banks simultaneously engage in lending cuts (Hanson, Kashyap, and Stein 2011). Both theoretical and empirical works have tried to shed light on the link between higher capital requirement, lending, and the real economy. Thakor 1996 shows that capital requirements linked solely to credit risk increase credit rationing in equilibrium and lower aggregate lending. An increase in the risk-based capital requirement, by raising the bank's loan-funding cost, makes lending less attractive, especially to risky borrowers and borrowers who have less bargaining power. In the same vein, Repullo and Suarez 2013 and Martinez-Miera and Suarez 2014 show that higher capital requirements reduce systemic risk but at the cost of reducing credit and output in non-crisis times. A related view is that higher capital levels may curtail risk-taking since managers and shareholders would have more skin in the game that incentivizes them to behave prudently (Furlong and Keeley 1989; Acharya, Mehran, and Thakor 2016; Barth and Seckinger 2018). A quite large strand of the empirical literature finds evidence of a tightening in lending after capital requirements are stepped up (see among others Aiyar et al. 2014; Aiyar, Calomiris, and Wieladek 2014; Gropp et al. 2019); consistently Ragnar and Wold 2020 document that banks improve capital ratios by reducing risk-weighted assets and also show that most of the reduction is obtained through reducing risk weights, suggesting that higher capital requirements have *risk-mitigating incentives.*

A stream of the theoretical literature on the consequences of the principal-agent asymmetric information problem suggests that higher requirements may foster risk-taking under some conditions. Dewatripont and Tirole 1994 conclude that banks with low leverage have an incentive to take on more risk. Admati et al. 2018 show that if a firm has superior information about its asset quality, shareholders would prefer to reduce leverage by selling safer assets and retaining the riskier ones, without issuing equity. To raise capital ratios by boosting earnings, banks may choose to lend more to riskier borrowers, applying higher fees and interest rates. Consistently with this view, the empirical findings by Wieladek and Uluc 2016 and Dautović 2020 suggest that higher capital requirements intended to make a bank more resilient may also end up increasing the riskiness of its balance sheet.

On the other side, there are theoretical studies supporting the idea that higher capital requirements lead to higher lending even in the short term (i.e., over an beyond their steady-state effect). Begenau 2020 shows that a higher capital requirement, by reducing ceteris paribus the supply of deposits, increases households' willingness to hold deposits at a lower deposit rate. As a result, an increase in capital requirements might, under some conditions, reduce average banks' funding costs, as the deposit rate decreases, and thus increase bank lending. Admati et al. 2013 argue that the return on equity contains a risk premium that goes down as capital requirements increase so that higher requirements would not necessarily reduce lending. On the contrary, better-capitalized banks suffer fewer distortions in lending decisions and would perform better. However, only a few papers find that higher capital requirements do not restrict loan growth, at least in a transition phase. Bassett and Berrospide 2018 find that higher capital requirements implied by supervisory stress tests relative to those suggested by banks' own models do not to restrict loan growth. Deli and Hasan 2017 find that capital stringency has a weak negative effect on loan growth and that this effect is completely offset if banks hold moderately high levels of capital.

Recently, Bahaj and Malherbe 2020 show that these contrasting views may coexist. Bank's lending response to an increase in the requirement need not be negative. Raising the capital needed to comply with higher requirement reduces lending, through the *composition effect* on liabilities, but it also makes the bank safer, shifting the default boundary. As a result, there are more states of the world in which revenues from lending accrue to the bank's shareholders, thus increasing the bank's willingness to lend. As this second effect reflects the fact that the requirement forces the bank toward safety, Bahaj and Malherbe 2020 name it the *forced safety effect* (FSE). They show that the FSE can be positive and can dominate the composition effect, which is why lending can increase with the capital requirement. The forced safety effect makes the lending response to requirements increase less negative, and after a given level it dominates the composition effect, making lending increase. As a result, lending is U-shaped in the requirement. The main takeaway from the paper for the policy debate is that, whether the FSE dominates the composition effect or not, in many cases it will make the lending response substantially less negative than expected from the mere

4 Testable Hypotheses

Following the theoretical literature, we formulate four non-alternative testable hypotheses about the impact of an increase in the risk-based capital requirement

- **H1 - Credit Supply**: The increase in the risk-based capital requirement causes banks to tighten credit supply in the early years after the reform (lower amounts granted or higher costs applied).
- **H2 - Risk-mitigating effect**: The increase in the risk-based capital requirement pushes banks to rebalance their portfolio away from high-risk borrowers.
- **H3 - Forced safety effect**: Lending is U-shaped in the requirement as the forced safety effect makes the lending response to requirements' increase less negative and possibly positive beyond a given requirement threshold.
- **H4 - Real effects on firms**: The negative credit supply shock due to higher capital requirements effectively worsens credit conditions for some firms, and in turn it dampens their investments in the early period post-reform.

The next section describes the data and the empirical strategy we use to test these hypotheses.

5 Data and Empirical Strategy

5.1 Data

We build a unique data-set for a period that spans from 2009 to the end of 2018 by exploiting three main sources of data: banks' balance sheets data from supervisory reporting, firms' balance sheet and income statements from the Cerved Group database, and loan level information from the Italian Central Credit Register.

Banks' balance sheet data are from the Bank of Italy Supervisory reports, which provide detailed data on banks' assets and liabilities. Particularly, we use bank-specific capital ratios to identify banks more exposed to the increase in capital requirement. Since Basel III standards have been applied to all Italian banks in our sample in a substantially uniform manner (Section 2), we lack a genuine control group of thoroughly unregulated (untreated) lenders to run a textbook difference-in-difference exercise. Consistently with the approach used by recent studies (see among others, FSB 2019; Ragnar and Wold 2020) to isolate the regulatory impact on lending, we exploit the fact that, at the time of the Basel III reforms, some banks had balance sheet indices that made them more exposed to the new, harsher capital standards, as their capital ratios were barely above or even below the new standards; by contrast, other banks were in a stronger financial position to comply with the new rules. We identify banks' exposure to the reform using the average Tier 1 capital ratio before the reform (we consider the bank level average

Tier 1 ratio over the period 2009 to 2013). Banks with capital ratios in the bottom quartile of the distribution before the reform are identified as "more exposed" to the reform.[5] Intuitively, credit supply from less capitalized banks is more likely to be constrained by an increase in capital requirement than the credit supply from better-capitalized banks. After the introduction of Basel III, banks increased their capital ratio: as shown in Figure 1, the distribution of the Tier 1 ratio shifted to the right. The shift was more pronounced for more-exposed banks (Figure 2) compared to the others. Banks more exposed to the increase in capital requirements due to Basel III were on average larger in terms of total assets compared to other banks (Table 2). More-exposed banks had lower operating costs as a percentage of total assets and a higher loan to asset ratio. After 2014, the increase in the share of non-performing loans was marked for both groups but the profitability deteriorated the most for more-exposed banks. We will control for these characteristics in all our specifications.

From the Italian Credit Register (CR) we obtain very detailed information on the end-of-year bank debt exposure of each borrower whose total debt from a bank is at least 30,000 euros.[6] We complement data on the amount granted with the individual loan rates priced on credit lines by a large sample of Italian banks from the Sample Survey of Lending Rates (a survey encompassing over 70% of all credit granted to the Italian economy). Loan

[5]Results are robust identifying "more exposed" banks as those with capital ratios below the median value of the distribution.

[6]We exclude firms whose loans were reported to the CR as bad loans; during the period we analyze banks carried out several bad loan securitizations, which therefore do not affect our calculated changes in extended credit.

rates are computed as the ratio of interest expenditures to the quantity of credit used.

We merge information from the CR on corporate borrowers from 2009 to 2018 with balance-sheet data from Cerved Group, a private company providing a database for a large sample of Italian firms, which contains detailed information about firms' activity, balance sheets, and risk, reported on a yearly basis.[7]

In our bank-firm dataset, we add banks' balance sheets indicators to firms' characteristics and information about the borrower-lender relationships to identify bank-firm relationships whose lender banks were more exposed to the increase in capital requirements. Our estimation sample includes around 6.5 million observations pertaining to half a million firms; 22 percent of the bank-firm relationships involve "more-exposed" bank. Table 3 shows that on average before 2014 affected bank-firm relationships do not differ significantly from all the others. In the following of the paper, we formally explore whether the parallel trend assumption holds, i.e. whether affected and non-affected firms displayed similar trends in relevant variables before the reform.

5.2 Empirical Strategy

We study the effect of higher capital requirements on banks' credit supply in the early period after their introduction (i.e. an adjustement effect),

[7]Cerved Group sells this information to several banks that can use it for their lending decisions (Albareto et al. 2011).

while we do not address the steady state impact of reforming bank capital requirements. To this end, we use individual, bank-firm level annual data to disentangle credit supply from credit demand. We estimate the following regression specification:

$$y_{bit} = \alpha + \beta_{RBC}(RBC_t * Affected_b) + \gamma_f FirmC_{i,t-1} + \\ + \gamma_b BankC_{b,t-1} + FirmBank_{ib} + LocationTime_{i,t} + u_{bit} \quad (1)$$

where y_{bit} is alternatively the loan granted by bank b to firm i (log change over a 1 year period) or the short term interest rates paid by firm i to bank b (level), RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform in Italy (Section 2), $Affected_b$ is a dummy variable that equals 1 if for bank b the average tier 1 ratio between 2008 and 2013 was below the first quartile of the distribution, $FirmC_{i,t}$ are time-varying controls at the firm level including risk (Cerved score), size (total assets) and a dummy for the eligibility of the credit relationship to the SME Supporting factor.[8] $BankC_{b,t}$ is a vector of time-varying controls at the bank level including total assets, loans-to-assets ratio, bad loans ratio, deposit ratio, tier 1 capital ratio, liquidity ratio, roe, and operating costs ratio. To reduce concerns that our findings are the results of demand-driven factors, we add location-by-time fixed effects ($LocationTime$) to control for local cycles at the province level. We also include bank-by-firm fixed effects

[8] A capital relief for loans to SMEs introduced by the CRR/CRD IV in Europe. Several studies show that the SME Supporting factor makes lending constraints less binding for SMEs (Mayordomo and Rodríguez-Moreno 2018; Lecarpentier et al. 2019; Bonaccorsi di Patti, Moscatelli, and Pietrosanti 2020).

($FirmBank$). In this way, we control for time-invariant observable, for instance, the sector of activity of the firm, and unobservable characteristics as it is common when firms and banks fixed effects are introduced separately. Beyond this, the inclusion of firm-by-bank effects accounts for unobservable changes in the pool of borrowers and for the possibility that changes in the credit supply reflect endogenous matching between lenders and borrowers. This set of fixed effects enables exploiting the difference in lending from the same bank towards the same borrower. Differently from Khwaja and Mian 2008 that limit the analysis only to multi-banks firms, our approach also exploits information from single lenders, while looking at the same bank-firm relationship over time. [9] Since error terms are likely to be correlated across the relationships of the same firm with the banking system over time, we run estimations by clustering standard errors at the firm level (as in Albertazzi and Bottero 2014, Banerjee, Gambacorta, and Sette 2017, Schäfer 2019).[10] Therefore, β_{RBC} measures the differential changes in credit supply conditions applied post-reform by banks in the treated group (heavily hit banks), with respect to the supply conditions applied by non-hit banks, or banks hit to a lesser extent. A negative coefficient estimated for β_{RBC} would support H1, see Section 4. To examine H2 and H3, we will decompose β_{RBC} along ex-ante firms' riskiness and banks' capital ratio, respectively.

[9]Further, we investigate the robustness of our findings including industry-location-time fixed effects to account for changes in loan demand in line with Degryse et al. 2019. Table available upon request.

[10]As a robustness check, we also assume that the standard errors are clustered at the bank-time level and multi-clustered simultaneously at the bank, firm, and time level, in line with Jiménez et al. 2012, and Jiménez et al. 2014. Tables available upon request.

6 Results

6.1 Capital Requirements and Credit Supply (H1)

First, we apply our identification strategy to the full sample of bank-firm relationships within our dataset, regardless of the size and riskiness of the firm. In Table 4 Panel (a), we address the impact on the change in committed credit by banks to Italian firms, controlling for firm-bank fixed effects. In the first specification, in place of the location-by-time fixed effects ($LocationTime$) we include macro variables (sovereign yield, GDP growth, unemployment rate, credit to GDP gap, and 3 months short term interest rate) and the standalone post-Basel III dummy, RBC_t . We find that in the years following the increase in capital requirements a reduction in committed credit to firms took place. Of course, this reduction could depend on several confounding coincident factors. In the second column we, therefore, apply our identification tools, interacting the Basel III timing with the banks being likely to be capital-constrained ($RBC_t * Affected_b$). We detect a statistically negative sign only for the interaction term while RBC_t is no longer statistically significant, suggesting that the credit squeeze was triggered by the reaction of the capital-constrained bank to the new regulatory environment. In our preferred specification (third column), we deploy a set of borrower location-by-year fixed effects to control more rigorously for confounding factors, thus dropping the RBC_t dummy variable. The coefficient of the dummy $RBC_t * Affected_b$ remains statistically negative: After the Basel III implementation, the annual growth of credit to firms is estimated 1.5 percentage points lower for affected banks compared to other banks.

Another way to measure changes to the supply of credit is by looking at loan rates. When a bank wants to tighten credit supply quickly, an effective way to do so is to increase interest rates. We investigate the rates paid on overdraft facilities (i.e. credit lines), as the bank is allowed to unilaterally change the interest rate charged on these open-ended credit lines at short notice. Furthermore, as these loans are highly standardized, a cross-firm comparison of the cost of credit is not affected by loan-contract-specific covenants that are unobservable to an econometrician. In line with the results obtained for loan amounts, we find also for the cost of credit evidence of a tightening in credit supply after the introduction of Basel III: Table 4 Panel (b) shows that banks more exposed to the reform charged higher interest rates afterwards. According to our preferred specification, column (3), the interest rate charged by affected banks was 16 basis points higher than the rate charged by banks affected to a lesser extent, against an average rate in our sample over the whole period equal to 5.68 per cent.

The impact of higher capital requirements may be particularly significant for SMEs, as these are heavily dependent on banks while they have limited access to non-bank finance. In Table 5, we focus our analysis on SME borrowers.[11] Again, the introduction of tighter risk-based capital requirements translates into a lower yearly growth of committed credit for banks belonging to the

[11] In line with the definition used for credit risk exposures under Basel III and for benefitting of the SMEs supporting factor, we identify SMEs as those firms whose annual sales are less than 50 million. These firms account for the majority of bank-firm relationship in our whole sample. We cannot apply the SME identification criterion based on employees, owing to lack of data.

lowest quartile of capitalization, all other factors being equal, including the quality and the location of the borrower firm. Even when we turn to the cost of credit, rather than amounts, poorly capitalized banks apply on average higher interest rates to borrower firms.

Our identification framework rests on a difference-in-difference (DD) analysis based on comparing the lending behavior of more-exposed banks (Tier 1 ratio below the first quartile) to other banks'. In this framework, the identification assumption hinges on parallel trends: absent the Basel reform, lending from more-exposed and other banks would have evolved along the same path. To facilitate a transparent examination of pre-trends in the data, we estimate a year-by-year DD on each bank-firm relationship, to assess the lending behavior of highly constrained banks compared to less constrained banks and present the results in Figure 3 for credit growth and 4 for interest rate. The results confirm that before the Basel reform both the amount and the cost of credit from treated and untreated banks evolved similarly: the parallel trends assumption holds.

6.2 Risk-mitigating effect (H2)

The results in the previous section show that higher capital requirements are associated with reduced lending, in line with a large strand of the existing empirical literature (Aiyar et al. 2014; Aiyar, Calomiris, and Wieladek 2014; Gropp et al. 2019; Ragnar and Wold 2020). We also add evidence on the response of the affected banks to higher requirements in terms of applied interest rates, confirming a reform-induced tightening of credit supply.

Thakor 1996 argues that enforcing an increase in the risk-based capital makes lending to risky borrowers less attractive. Consistently, Repullo and Suarez 2013 and Martinez-Miera and Suarez 2014 suggest that higher capital requirements are associated with both reduced lending and stifled risk-taking. An alternative view instead suggests that increases in capital requirements intended to make a bank more resilient may also raise the riskiness of a bank's balance sheet (Dewatripont and Tirole 1994, Admati et al. 2018, Wieladek and Uluc 2016 and Dautović 2020). In this section, we explore banks' risk-taking behavior in response to Basel III implementation. To this aim, we need to identify risky customers. First, we proxy firms' riskiness using their size. Due to the large difference in average risk weights between micro and other firms, it can be plausibly assumed that the reduction in average risk weights can be achieved through *lending away* from micro firms (firms with less than 10 employees) if there are risk-mitigating incentives. The first two columns of Table 6 report the coefficient β_{RBC} decomposed for micro firms and other firms. After the implementation of Basel III, the reduction in credit granted, column (1), as well as the increase in loan rate, column (2), was almost double towards micro firms than towards others, suggesting that the smallest firms were particularly hit by the capital constraints of their lenders. Secondly, we exploit differences in creditworthiness. We split the coefficient β_{RBC} into three components, measuring the reaction of banks towards firms of low, medium, and elevated riskiness, as quantified ex ante using credit scores that we obtain from Cerved Group, a private company selling information about Italian firms to banks. These scores range from

1 to 9, scores below 3 typically indicate sound firms (low risk) and scores above 7 identify financially fragile firms (high risk). The last two columns of Table 6 show that after Basel III implementation, low-capitalized banks, compared to other banks, granted less credit to companies having a medium or high level of ex-ante riskiness while re-directing loans to sounder firms, column (3). The same capital-constrained banks, in turn, with respect to more capitalised banks applied relatively tighter credit conditions to riskier firms and looser conditions to more creditworthy firms, column (4). In line with the objectives of Basel III, the increase of risk-based capital contributes to temper risk-taking.

6.3 Forced Safety Effect (H3)

Bahaj and Malherbe 2020 show that raising the capital requirement reduces lending, through a higher cost of funding (the composition effect), but it also makes the bank safer. They argue that a second effect is at work, reflecting the fact that the higher requirement forces banks toward safety. Because of this effect, increased requirements boost banks' willingness to lend, as for a sounder bank there are more states of the world in which revenues from lending accrue to the bank's shareholders, rather than being passed to creditors of the defaulting bank. The forced safety effect makes the lending response to requirements increase less negative, and beyond a given level of capital requirement it may dominate the composition effect, making lending increase with the requirement. Due the forced safety effect mitigating and eventually offsetting the composition effect, lending is U-shaped in the requirement. In this section we test H3 of Section 4, i.e. we check whether the lending response is U-shaped in the requirements as theorized by Bahaj and Malherbe 2020. To this aim, we assess whether the reaction of banks to higher capital requirements varies across different ex-ante levels of capital ratio. For banks having a lower capital ratio before the reform, the impact of the increase in the requirement is larger than for banks having more capital. We therefore implicitly assume that there is a continuum of actual stringency in capital requirements, owing to the enforcement of new homogeneous capital requirements against heterogeneous initial levels of compliance. We estimate coefficients β_{RBC} for different levels of Tier 1 ratios, spanning from 5 to 12 per cent (to this end, we consider the bank level average Tier 1 ratio over the period 2009 to 2013). H3 is accepted if the coefficients for low and high values of the pre-Basel III capital ratio are larger than coefficients estimated for mid-range values. Figure 5 plots the lending response showing that it is U-shaped in the requirement, with peaks in relative tightening reached for banks with pre-reform Tier 1 ratios of around 9 per cent. However, the forced safety effect is never large enough to make the lending response positive: for both low and large values of the initial capital ratio, the overall impact on credit remains negative. We explore if the existence of the forced safety effect is confirmed also using data on interest rates. To endorse H3, the relation between the loan rate and the requirement should be inverse-U-shaped, because a negative β_{RBC} would indicate an easing and a positive one a tightening of credit supply. The lower panel of Figure 5 shows that the existence of the forced safety effect is confirmed also using the cost of credit as an alternative measure of credit supply, with peaks in relative tightening reached at pre-reform Tier 1 ratios in the range 6 to 8 per cent.

7 Assessing the real effects on firms (H4)

7.1 Empirical Strategy and Predictions

The previous section establishes that, following the Basel III implementation, relatively constrained banks decreased the amount of loan granted and charged higher interest rates compared to other banks. However, we are not able to ascertain whether the credit supply shock induced by the increase in capital requirements caused a credit restriction for Italian non-financial firms or just a reallocation of debt from constrained to unconstrained banks. In the former case, the ensuing credit constraints could curtail investment ability of affected borrowers. This section explores this issue moving closer to those contributions that investigate the real effects of an exogenous shock to credit supply (Chodorow-Reich 2014 and Paravisini et al. 2015, among others). To this aim, we collapse our dataset moving from the bank-borrower level to the borrower level and follow a generalized difference-in-difference approach with continuous treatment. The treatment period corresponds, as in previous sections, to the years after the implementation of more stringent capital requirements (2014). Treated firms are identified as those that were borrowing from constrained banks before 2013; the share of credit that each firm obtained from constrained banks identifies the intensity of treatment.

This econometric approach leverages the extensive literature showing that borrowers and lenders form relationships that help to overcome informational asymmetries, and therefore borrowers of capital-constrained banks could not be able to smoothly switch to borrowing from less constrained banks (Berger and Udell 2002, Presbitero and Zazzaro 2011, Chodorow-Reich 2014, Bolton et al. 2016, among others).

As for the exercises presented in the previous sections, our empirical strategy rests on the parallel trends hypothesis: Conditional on a set of firm-level observables, the credit and investment decisions of a firm exposed to constrained banks and firms not exposed would have been similar in the absence of the credit supply shock. Figures 6 to 8 show that these identifying assumptions hold, and therefore our difference-in-difference estimates will have a valid causal interpretation. Therefore, we test two difference-in-difference (DD) predictions:

o Prediction 1: There is a negative relationship between a firm's initial exposure (i.e., before the introduction of the reform) to capital-constrained banks and the credit conditions obtained afterwards.

o Prediction 2: There is a negative relationship between initial firms' exposure to capital-constrained banks and subsequent investment decisions.

We estimate the following model:

$$y_{it} = \alpha + \beta_{RBC}(RBC_t * Exposed_i) + \gamma_f FirmC_{i,t-1} + \\ + LocationTime_{i,t} + Firm_i + \epsilon_{it} \quad (2)$$

where y_{it} is, alternatively, credit growth at the corporate level, the average interest rate, or one year ahead investment, i.e., the investment in time $t+1$. RBC_t is a dummy taking value 1 since 2014, i.e., the implementation date of risk-based capital reform in Italy (Section 2), $Exposed_i$ is the average share of loans that firm i takes from constrained banks from 2009 to 2013. We control for time-invariant observable, as the sector of activity, and unobservable firm's features by including firm fixed effects, $Firm_i$, for time-varying characteristics of the firm, $FirmC_{i,t}$, including risk (Cerved score) and size (total assets); we also introduce location-by-time fixed effects ($LocationTime$) to control for local cycles.[12] Standard errors are clustered by sector of activity to account for correlation within each sector.[13]

7.2 Results

We begin with the test of Prediction 1. Columns (1) and (2) of Table 7 show that exposed firms experienced reductions in the amount of obtained credit and an increase in the average interest rate after 2014. Because of the differential responses to the more stringent capital requirement, firms that relied more on constrained banks to access credit were negatively affected by the implementation of Basel III. The results suggest that there was less than complete substitution between constrained and unconstrained banks. A firm fully relying on affected banks before 2013 would experience an annual lending growth almost one percentage point lower compared to other firms

[12]Our findings are confirmed also by including of sector-by-location-by-time fixed effects. Table available upon request.

[13]Results are robust to multi-clustering errors at the main bank-sector of activity level and at the sector of activity and location level. Tables available upon request.

from 2014 to 2018. Finally, Column (3) adds some evidence supporting Prediction 2. Companies more exposed to the increase in capital requirement through their lenders experienced a drop in investments: investments by firms fully relying on affected banks before the Basel reform were, on average, 5 percent lower after 2014.

8 Robustness Checks

In this section, we explore the robustness of our results along many dimensions. First, we test whether our results are driven by banks using the internal ratings-based (IRB) method. The first IRB models have been validated in Italy in late 2008. Gallo 2021 shows that banks adopting IRB raise interest rates and reduce credit to high-risk borrowers compared to low-risk ones. Therefore, the implementation of the IRB approach by some large banks in the same observation period may challenge our findings. To reassure the reader that IRB banks are not driving our results, we re-estimate our main specifications excluding IRB banks.[14] Using this subsample, by excluding the largest banking groups, also enables us to establish that our findings are not driven by a few lenders, e.g. those most affected by concurring events, like the Asset Quality Review that involved large European groups in 2014 (Abbassi et al. 2020). Table 8 reports the estimations excluding IRB banks, results confirm H1, H2, and H3.

[14] We are grateful to Raffaele Gallo for sharing his dataset on IRB implementation by Italian banks.

Our sample includes the whole Italian banking system. This delivers a more comprehensive analysis but considers all together intermediaries that have very different business models. Particularly, we include cooperative banks (banche di credito cooperativo or BCCs) that have different institutional features than the other banks (Bologna, Cornacchia, Galardo, et al. 2020). BCCs tend to be more capitalized (Figure 9) as law provisions require them not to distribute a large fraction of their annual profits, at least 70 percent. Moreover, between 2007 and 2014, cooperative banks increased their presence on local markets, expanding their branch network while other banks' networks shrank, and bolstered their market share of loans to households and firms (Stefani et al. 2016). Due to their high capital ratios, BCCs were not immediately affected by the Basel III reforms; this, along with the increase in credit market shares they experienced in the period we analyze, may raise the doubt that the differential response we detect between high- and low-capitalized banks is driven by structural differences in banks' segments rather than Basel III impact. We, therefore, re-run the estimation by splitting the sample into a no-Bcc and an only-Bcc subsample. The stringency of capital requirements, in terms of quartiles of the pre-Basel III Tier 1 ratio, is re-defined according to the distribution of the relevant sub-sample. Table 9 reports estimation excluding BCCs, for this subsample our findings are confirmed. Table 10 reports estimations for a subsample focusing only on BCCs. For cooperative banks, no difference between the behavior of less-capitalized banks and other banks is clearly detected. Estimations covering only credit relationships involving BCCs should be taken with a grain of salt as observations drastically shrink to 14 percent of our initial sample. However, they seem to confirm that banks having high Tier 1 capital ratios already before the Basel reform, as it was the case for BCCs, were not materially affected in the early years after the reform implementation.

Our main analysis assumes that banks equipped with more capital before the reform were less affected by the introduction of Basel III, but this could not always be the case. There may be banks that, despite having higher capital ratios, also have higher requirements to meet because of their riskier portfolios. In these cases, the level of the capital ratio *per se* is no longer a sufficient measure of the exposure to the reform. To deal with this possibility, affected banks should be identified using their capital headroom over the requirement. However, it is difficult to collect data on bank-level requirements. We obtained information on the amount of Common Equity Tier 1 (CET1) capital that each bank was expected to hold based on the Supervisory Review and Evaluation Process in 2016 (SREP 2016), the year for which this requirement is available that is closest to Basel III implementation date. We used it to have a measure of the required Tier 1 capital ratio.[15] We then calculate the capital headroom as the difference between the average Tier 1 capital ratio before Basel III and the required Tier 1 capital ratio based on SREP 2016. While the capital headroom gives

[15] For further details on SREP exercises, we refer to https://www.bankingsupervision.europa.eu/banking/srep/2016/html/index.en.html and https://www.bankingsupervision.europa.eu/banking/srep/2017/html/index.en.html.

a better picture of the amount of capital needed due to the introduction of Basel III, it poses some endogeneity issues as the level of the requirement depends on each bank's portfolio riskiness.[16] Although there is no perfect measure of the exposure to Basel III, Table 11 shows that all our main findings are confirmed using banks' capital headrooms as a measure of the exposure.

Our analysis covers a long period, from 2009 to 2018, where different confounding factors may affect our findings. We restrict the estimation sample to two years around the introduction of Basel III. Table 12 shows that results are robust.

9 Concluding remarks

In the aftermath of the financial crisis, the G20 launched a comprehensive program of financial reforms to increase the resilience of the global financial system; a pivotal role in this regulatory overhaul was assigned to stricter capital requirements for banks. The economic implications of such higher capital requirements remain a matter of discussion. This paper, while disregarding the medium-to-long term effects of bank capital regulation, investigates the impact of higher risk-based capital requirements on credit supply in the early period post-reform (i.e. the adjustement effect). To this

[16] Moreover, the new measure does not address the possibility that some banks aim to keep unchanged their capital headroom against higher capital requirements: under this (unobservable) desired management buffer hypothesis, higher requirements would affect banks with high and low capital ratio or capital headroom to the same extent.

end it uses a rich dataset on bank loans to firms from the Italian Credit Register matched to information on firms' and banks' characteristics and exploiting the implementation of Basel III in Italy as an exogenous shock to capital requirements. Granular data along with a large set of controls at the bank and borrower level disentangle credit supply from demand. We find evidence supporting the view that, in the first years after their enforcement, higher requirements are associated with tighter credit supply. We explore how this impact varies across corporates' creditworthiness and show that banks dealing with more stringent requirements tighten credit supply towards risky firms in favor of sounder ones, confirming that higher requirements encourage de-risking behavior. Moreover, we estimate the shape of the relationship between lending supply and capital requirement, explicitly testing for the forced safety effect theorized by Bahaj and Malherbe 2020. We exploit the dispersion in the level of the Tier 1 capital ratio across Italian banks measured before the introduction of Basel III to estimate different lending responses corresponding to different implicit stringency of the new capital requirements. We show that for low and high values of the capital ratio the credit tightening is weaker, i.e., the lending response is U-shaped in the stringency of the requirement, in line with the prediction of Bahaj and Malherbe 2020. Nevertheless, differently from the conclusions of these authors, we find that the forced safety effect does not appear sufficiently large to fully offset the composition effect of costlier liabilities, thus reverting the overall impact of higher requirements on credit tightening. Finally, we explore the consequences of higher requirements at firm level, besides bank-firm analysis. We find that firms relying more on banks that were less capitalized before Basel III experienced a worsening in lending conditions and invested less compared to other firms. Our results suggest that the more stringent requirements introduced by Basel III encouraged less capitalized banks to reduce lending to risky borrowers. However, this gain came at the cost of lowering credit and investments.

References

Abbassi, Puriya, José-Luis Peydró, Rajkamal Iyer, and Paul E Soto (2020). "Stressed Banks? Evidence from the Largest-Ever Supervisory Review". In: *FDIC Center for Financial Research Paper* 2020-06.

Acharya, Viral V, Hamid Mehran, and Anjan V Thakor (2016). "Caught between Scylla and Charybdis? Regulating bank leverage when there is rent seeking and risk shifting". In: *The Review of Corporate Finance Studies* 5.1, pp. 36–75.

Admati, Anat R, Peter M DeMarzo, Martin F Hellwig, and Paul C Pfleiderer (2013). "Fallacies, irrelevant facts, and myths in the discussion of capital regulation: Why bank equity is not socially expensive". In: *Working paper, Stanford Graduate School of Business*.

Admati, Anat R, Peter M DeMarzo, Martin F Hellwig, and Paul Pfleiderer (2018). "The leverage ratchet effect". In: *The Journal of Finance* 73.1, pp. 145–198.

Aiyar, Shekhar, Charles W Calomiris, and Tomasz Wieladek (2014). "Does macro-prudential regulation leak? Evidence from a UK policy experiment". In: *Journal of Money, Credit and Banking* 46.s1, pp. 181–214.

Aiyar, Shekhar, Charles W Calomiris, John Hooley, Yevgeniya Korniyenko, and Tomasz Wieladek (2014). "The international transmission of bank capital requirements: Evidence from the UK". In: *Journal of Financial Economics* 113.3, pp. 368–382.

Albareto, Giorgio, Michele Benvenuti, Sauro Mocetti, Marcello Pagnini, Paola Rossi, et al. (2011). "The organization of lending and the use of credit scoring techniques in Italian banks". In: *Journal of Financial Transformation* 32, pp. 143–168.

Albertazzi, Ugo and Margherita Bottero (2014). "Foreign bank lending: evidence from the global financial crisis". In: *Journal of International Economics* 92, S22–S35.

Bahaj, Saleem and Frédéric Malherbe (2017). "A positive analysis of bank behaviour under capital requirements". In: *CEPR Discussion Paper No. DP11607*.

Bahaj, Saleem and Frederic Malherbe (2020). "The forced safety effect: How higher capital requirements can increase bank lending". In: *Journal of Finance*.

Bahaj, Saleem, Jonathan Bridges, Frederic Malherbe, and Cian O'Neill (2016). "What determines how banks respond to changes in capital requirements?" In: *Bank of England Working Paper*.

Banerjee, Ryan, Leonardo Gambacorta, and Enrico Sette (2017). "The real effects of relationship lending". In: *Bank of Italy Temi di Discussione (Working Paper) No* 1133.

Banerjee, Ryan N and Hitoshi Mio (2018). "The impact of liquidity regulation on banks". In: *Journal of Financial intermediation* 35, pp. 30–44.

Barth, Andreas and Christian Seckinger (2018). "Capital regulation with heterogeneous banks–unintended consequences of a too strict leverage ratio". In: *Journal of Banking & Finance* 88, pp. 455–465.

Bassett, William F and Jose M Berrospide (2018). "The impact of post stress tests capital on bank lending". In:

BCBS (2016). "Basel III Monitoring Repor". In: *https://www.bis.org/bcbs/publ/d354.pdf*.

Begenau, Juliane (2020). "Capital requirements, risk choice, and liquidity provision in a business-cycle model". In: *Journal of Financial Economics* 136.2, pp. 355–378.

Behn, Markus, Rainer Haselmann, and Paul Wachtel (2016). "Procyclical capital regulation and lending". In: *The Journal of Finance* 71.2, pp. 919–956.

Berger, Allen N and Gregory F Udell (2002). "Small business credit availability and relationship lending: The importance of bank organisational structure". In: *The economic journal* 112.477, F32–F53.

Bologna, Pierluigi, Wanda Cornacchia, Maddalena Galardo, et al. (2020). "Prudential policies, credit supply and house prices: evidence from Italy". In: *Bank of Italy Temi di Discussione (Working Paper) No* 1294.

Bolton, Patrick, Xavier Freixas, Leonardo Gambacorta, and Paolo Emilio Mistrulli (2016). "Relationship and transaction lending in a crisis". In: *The Review of Financial Studies* 29.10, pp. 2643–2676.

Bonaccorsi di Patti, Emilia and Anil Kashyap (2017). *Which Banks Recover From Large Adverse Shocks?* Tech. rep. National Bureau of Economic Research.

Bonaccorsi di Patti, Emilia, Mirko Moscatelli, and Stefano Pietrosanti (2020). *The impact of bank regulation on the cost of credit: Evidence from a discontinuity in capital requirements*. Tech. rep. Bank of Italy, mimeo.

Chodorow-Reich, Gabriel (2014). "The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis". In: *The Quarterly Journal of Economics* 129.1, pp. 1–59.

Cingano, Federico, Francesco Manaresi, and Enrico Sette (2016). "Does credit crunch investment down? New evidence on the real effects of the bank-lending channel". In: *The Review of Financial Studies* 29.10, pp. 2737–2773.

Dautović, Ernest (2020). "Has regulatory capital made banks safer? Skin in the game vs moral hazard". In: 2449.

De Jonghe, Olivier, Hans Dewachter, and Steven Ongena (2020). "Bank capital (requirements) and credit supply: Evidence from pillar 2 decisions". In: *Journal of Corporate Finance* 60, p. 101518.

Degryse, Hans, Olivier De Jonghe, Sanja Jakovljević, Klaas Mulier, and Glenn Schepens (2019). "Identifying credit supply shocks with bank-firm data: Methods and applications". In: *Journal of Financial Intermediation* 40, p. 100813.

Deli, Yota D and Iftekhar Hasan (2017). "Real effects of bank capital regulations: Global evidence". In: *Journal of Banking & Finance* 82, pp. 217–228.

Dewatripont, Mathias and Jean Tirole (1994). "A theory of debt and equity: Diversity of securities and manager-shareholder congruence". In: *The quarterly journal of economics* 109.4, pp. 1027–1054.

Fraisse, Henri, Mathias Lé, and David Thesmar (2020). "The real effects of bank capital requirements". In: *Management Science* 66.1, pp. 5–23.

FSB, Financial Stability Board (2019). "Evaluation of the effects of financial regulatory reforms on small and medium-sized enterprise (SME) financing". In: *FSB Final Document, November*.

Furlong, Frederick T and Michael C Keeley (1989). "Capital regulation and bank risk-taking: A note". In: *Journal of banking & finance* 13.6, pp. 883–891.

Gallo, Raffaele (2021). "The IRB approach and bank lending to firms". In: *Banca d'Italia Temi di Discussione (Working Paper) No* 1347.

Gambacorta, Leonardo and Paolo Emilio Mistrulli (2004). "Does bank capital affect lending behavior?" In: *Journal of Financial intermediation* 13.4, pp. 436–457.

Gropp, Reint, Thomas Mosk, Steven Ongena, and Carlo Wix (2019). "Banks response to higher capital requirements: Evidence from a quasi-natural experiment". In: *The Review of Financial Studies* 32.1, pp. 266–299.

Hanson, Samuel G, Anil K Kashyap, and Jeremy C Stein (2011). "A macroprudential approach to financial regulation". In: *Journal of economic Perspectives* 25.1, pp. 3–28.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina (2012). "Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications". In: *The American Economic Review* 102.5, pp. 2301–2326.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina (2014). "Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk-Taking?" In: *Econometrica* 82.2, pp. 463–505.

— (2017). "Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the Spanish dynamic provisioning experiments". In: *Journal of Political Economy* 125.6, pp. 2126–2177.

Khwaja, Asim Ijaz and Atif Mian (2008). "Tracing the impact of bank liquidity shocks: Evidence from an emerging market". In: *American Economic Review* 98.4, pp. 1413–42.

Lecarpentier, Sandrine, Mathias Lé, Henri Fraisse, Michel Dietsch, et al. (2019). *Lower bank capital requirements as a policy tool to support credit to SMEs: evidence from a policy experiment.* Tech. rep. University of Paris Nanterre, EconomiX.

Martinez-Miera, David and Javier Suarez (2014). "Banks' endogenous systemic risk taking". In: *manuscript, CEMFI.*

Mayordomo, Sergio and María Rodríguez-Moreno (2018). "Did the bank capital relief induced by the Supporting Factor enhance SME lending?" In: *Journal of Financial Intermediation* 36, pp. 45–57.

Paravisini, Daniel, Veronica Rappoport, Philipp Schnabl, and Daniel Wolfenzon (2015). "Dissecting the effect of credit supply on trade:

Evidence from matched credit-export data". In: *The Review of Economic Studies* 82.1, pp. 333–359.

Presbitero, Andrea F and Alberto Zazzaro (2011). "Competition and relationship lending: Friends or foes?" In: *Journal of Financial Intermediation* 20.3, pp. 387–413.

Ragnar, E. Juelsrud and Ella Getz Wold (2020). "Risk-weighted capital requirements and portfolio rebalancing". In: *Journal of Financial Intermediation* 41, p. 100806.

Repullo, Rafael and Javier Suarez (2013). "The procyclical effects of bank capital regulation". In: *The Review of financial studies* 26.2, pp. 452–490.

Schäfer, Larissa (2019). ""Forgive but not forget": the behavior of relationship banks when firms are in distress". In: *Review of Finance* 23.6, pp. 1079–1114.

Stefani, Maria Lucia, Valerio Vacca, Daniele Coin, Silvia Del Prete, Cristina Demma, Maddalena Galardo, Iconio Garri, Sauro Mocetti, and Dario Pellegrino (2016). *When local banks lend to local communities: evidence from Italy (2007-2014)*. Tech. rep. Bank of Italy, Economic Research and International Relations Area.

Thakor, Anjan V (1996). "Capital requirements, monetary policy, and aggregate bank lending: theory and empirical evidence". In: *The Journal of Finance* 51.1, pp. 279–324.

Wieladek, Tomasz and Arzu Uluc (2016). "Capital Requirements, Risk Shifting and the Mortgage Market". In:

Table 1: Main changes to the definition of regulatory capital

	Basel II requirements	8%	Basel III requirements	8%
Tier 3			Abolished	
Tier 2	E.g. undisclosed reserves, subordinated debt - Deductions	4%	No substantial alterations	2%
Additional Tier 1	Some preference shares Hybrid capital - Deductions	2%	Some preference shares Portions of minority interests Hybrids with innovative features no longer accepted	1.5%
Core Tier 1	Common equity Retained earnings Minority interests Some preference shares - Deductions	2%	Common equity Retained earnings Portions of minority interests Preference shares generally excluded Silent partnerships generally excluded Portions of minority interests excluded - All existing Deductions - Additional Deductions (e.g. deferred tax assets)	4.5%

Source: ECB Financial Stability Review December 2010.

Table 2: Comparison of Affected and other banks

	All banks	Affected banks	Others	before 2014		after 2014	
				Affected banks	Others	Affected banks	Others
VARIABLES							
TIER1 ratio (%)	17.53	10.63	19.51	9.712	18.89	12.08	20.26
Log of Bank Total Assets	13.05	13.67	12.87	13.56	12.79	13.83	12.97
Loans to Asset ratio (%)	79.95	81.57	79.49	83.79	81.44	78.09	77.16
Deposit to Asset ratio (%)	64.34	53.64	67.42	48.62	60.55	61.53	75.57
Operating cost over total asset (%)	2.542	2.162	2.652	2.255	2.675	2.016	2.625
NPL ratio (%)	9.161	10.15	8.876	5.751	4.681	17.07	13.86
Bad Loans ratio (%)	7.542	8.684	7.213	5.934	4.903	13.01	9.958
Bank: Return on Equity (%)	2.478	0.443	3.064	1.404	3.539	-1.068	2.499
Number of banks	659	162	497				

Source: Supervisory data.
Affected banks are defined as those having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution.

Table 3: Comparison of affected and non-affected bank-firm relationships

				Before 2014			After 2014		
	All	Non-affected	Affected	Non-affected	Affected	Diff	Non-affected	Affected	Diff
VARIABLES									
Firm characteristics									
Log of Total Assets	7.750	7.700	7.929	7.712	7.911	0.199	7.687	7.952	0.265
Rating (Score from 1 to 9)	4.929	4.907	5.008	5.070	5.198	0.128	4.721	4.762	0.041
Firm age (years)	19.96	19.98	19.89	18.67	18.59	-0.08	21.48	21.58	0.1
Firm age (log years)	2.762	2.766	2.751	2.691	2.675	-0.016	2.851	2.849	-0.002
Number of bank relationships of the firm	4.018	3.914	4.391	3.933	4.385	0.452	3.893	4.399	0.506
Labour Cost	1721	1602	2149	1520	1982	462	1697	2365	668
Labour Cost (log)	5.000	4.989	5.041	4.918	4.950	0.032	5.070	5.158	0.088
Investments	727.3	668.2	939.9	718.5	1018	299.5	610.8	838.9	228.1
Investments (log)	3.056	2.997	3.270	3.081	3.315	0.234	2.901	3.213	0.312
Firm-Bank relationship characteristics									
Total granted loan in 000 EUR	858975	842423	918510	886766	936564	49798	791751	895099	103348
Total amount Firm owed to Bank in 000 EUR	566324	540239	660149	568445	673744	105299	508008	642521	134513
Long Term loan in 000 EUR	468408	445954	549171	457917	556683	98766	432284	539430	107146
Log of Total Loan	12.48	12.45	12.57	12.52	12.62	0.1	12.37	12.50	0.13
Changes in Log of Total Loan (%)	-5.072	-4.709	-6.380	-5.595	-6.588	-0.993	-3.696	-6.110	-2.414
Short term interest rate on outstanding credit lines (%)	5.675	5.740	5.383	6.063	5.723	-0.34	5.321	4.830	-0.491
Credit owed to the Bank over credit granted by the Bank	55.51	54.00	61.05	54.28	60.62	6.34	53.70	61.57	7.87
Firm-Bank relation eligible for EU SME Supporting Factor	0.141	0.146	0.123	0.138	0.115	-0.023	0.155	0.134	-0.021
Dummy taking value 1 if new relation	0.142	0.140	0.146	0.140	0.148	0.008	0.141	0.145	0.004
Length of firm-bank relationship (years)	7.100	7.013	7.407	6.254	6.833	0.579	7.861	8.150	0.289
Number of firms	543,382	484,683	214,469	409,821	175,833		372,677	146,930	
Observations	6,575,251	5,144,895	1,430,356	2,743,824	807,561		2,401,071	622,795	

Sources: Credit Register and Cerved Group data.
Affected firm-bank relationships are relationships involving banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution.

Table 4: H1 - Credit Supply

	(1)	(2)	(3)
Panel (a): Committed credit (delta log)			
$RBC_t * Affected_b$		-1.483***	-1.515***
		(0.0808)	(0.0832)
RBC_t	-0.381***	-0.0644	
	(0.117)	(0.119)	
Observations	6575251	6575251	6575251
R^2	0.260	0.260	0.261
Prov-Date FE	No	No	Yes
Firm-Bank FE	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm
Panel (b): Short Term Rate			
$RBC_t * Affected_b$		0.224***	0.159***
		(0.00880)	(0.00908)
RBC_t	0.215***	0.174***	
	(0.00646)	(0.00671)	
Observations	4197519	4197519	4197519
R^2	0.794	0.794	0.798
Prov-Date FE	No	No	Yes
Firm-Bank FE	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm

Notes: The Table reports results for the ordinary least squares estimation of equation 1. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Affected_b$ is a dummy variable that equals 1 for banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: H1 - Credit Supply for SMEs

	(1)	(2)	(3)
	Panel (a): Committed credit (delta log)		
$RBC_t * Affected_b$		-1.513***	-1.552***
		(0.0823)	(0.0848)
RBC_t	-0.492***	-0.171	
	(0.119)	(0.120)	
Observations	6345772	6345772	6345772
R^2	0.262	0.262	0.263
Prov-Date FE	No	No	Yes
Firm-Bank FE	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm
	Panel (b): Short Term Rate		
$RBC_t * Affected_b$		0.218***	0.150***
		(0.00906)	(0.00936)
RBC_t	0.219***	0.179***	
	(0.00658)	(0.00684)	
Observations	4034493	4034493	4034493
R^2	0.793	0.793	0.796
Prov-Date FE	No	No	Yes
Firm-Bank FE	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm

Notes: The Table reports results for the ordinary least squares estimation of equation 1 for the subsample of SMEs (firms whose annual sales are less than 50 million). RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Affected_b$ is a dummy variable that equals 1 for banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: H2 - Risk-mitigating effect

	(1) Credit Growth	(2) Loan Rate	(3) Credit Growth	(4) Loan Rate
$RBC_t * Affected_b * Micro_i$	-1.961***	0.262***		
	(0.104)	(0.0129)		
$RBC_t * Affected_b * Other_i$	-1.067***	0.0822***		
	(0.117)	(0.0115)		
$RBC_t * Affected_b * LowRisk_i$			0.327*	-0.100***
			(0.179)	(0.0215)
$RBC_t * Affected_b * MedRisk_i$			-1.438***	0.130***
			(0.108)	(0.0116)
$RBC_t * Affected_b * HighRisk_i$			-2.835***	0.341***
			(0.154)	(0.0169)
Observations	6575251	4197519	5926396	3884583
R^2	0.261	0.798	0.250	0.793
Prov-Date FE	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm	Firm

Notes: The table reports the coefficients estimated using least squares. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Affected_b$ is a dummy variable that equals 1 for banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution. $Micro_i$ is a dummy identifying firms with less than 10 employees and $Other_i$ firms with at least 10 employees. $LowRisk_i$ is a dummy taking value 1 for firms with a score from Cerved Group below 3 (sound firms, low risk), $MedRisk_i$ equals 1 for firms with a score between 3 and 6 (medium risk) and $HighRisk_i$ identifies firms with a score above 7 (financially fragile firms, high risk). Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: H4 - The effect of Bank exposure on Firm credit and investment

VARIABLES	(1) Credit growth	(2) Loan rate	(3) Investment (log)
$RBC_t * Exposed_i$	-0.848***	0.0559***	-0.0503***
	(0.142)	(0.0158)	(0.00790)
Z-Score==2	-1.424***	-0.0636***	-0.0663***
	(0.155)	(0.0130)	(0.00723)
Z-Score==3	-2.725***	-0.0393***	-0.128***
	(0.162)	(0.0138)	(0.00774)
Z-Score==4	-3.461***	0.0253*	-0.187***
	(0.163)	(0.0141)	(0.00787)
Z-Score==5	-5.309***	0.164***	-0.234***
	(0.173)	(0.0147)	(0.00837)
Z-Score==6	-7.682***	0.296***	-0.269***
	(0.180)	(0.0151)	(0.00867)
Z-Score==7	-9.984***	0.428***	-0.298***
	(0.182)	(0.0153)	(0.00880)
Z-Score==8	-16.69***	0.638***	-0.356***
	(0.205)	(0.0167)	(0.00973)
Z-Score==9	-30.38***	1.077***	-0.508***
	(0.328)	(0.0226)	(0.0154)
Unscored	-11.89***	0.860***	-0.321***
	(0.371)	(0.0405)	(0.0217)
Log of Total Assets	-6.047***	-0.418***	0.0793***
	(0.0907)	(0.00746)	(0.00465)
Observations	2996516	1893309	2530589
R^2	0.228	0.786	0.651
Prov-Date FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

Notes: The Table reports results for the ordinary least squares estimation of equation 2. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Exposed_i$ is the average share of loans that firm i takes from 2009 to 2013 from affected banks, i.e. banks having the average tier 1 ratio pre-Reform below the first quartile of the distribution. Z-scores are dummies corresponding to the riskiness scores provided by Cerved group, whereby higher scores reflect higher riskiness. Standard errors are clustered at the sector level. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Excluding banks using IRB

	H1		H2		H3	
	Loan	Rate	Loan	Rate	Loan	Rate
	(1)	(2)	(3)	(4)	(5)	(6)
$RBC_t * Affected_b$	-0.406***	0.0435***				
	(0.0960)	(0.0103)				
$RBC_t * Affected_b * LowRisk_i$			0.719***	-0.161***		
			(0.197)	(0.0228)		
$RBC_t * Affected_b * MedRisk_i$			-0.530***	0.0165		
			(0.122)	(0.0129)		
$RBC_t * Affected_b * HighRisk_i$			-0.875***	0.182***		
			(0.167)	(0.0181)		
$RBC_t * Tier1RatioBelow10PCT_b$					0.517***	0.163***
					(0.163)	(0.0198)
$RBC_t * Tier1RatioFrom10To25PCT_b$					-1.044***	0.0435***
					(0.117)	(0.0120)
$RBC_t * Tier1RatioFrom25To50PCT_b$					-0.440***	0.0709***
					(0.104)	(0.0105)
Observations	4208211	2316363	3811416	2167292	4208211	2316363
R^2	0.274	0.823	0.265	0.819	0.274	0.823
Prov-Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm	Firm	Firm	Firm

Notes: The table reports the coefficients estimated for a sample excluding banks allowed to use the internal ratings-based (IRB) method for supervisory purposes. For Columns (1), (3), and (5) the dependent variable is log change over a 1 year period of the loan granted by bank b to firm i. For Columns (2), (4), and (6) the dependent variable is the short-term interest rates paid by firm i to bank b. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Affected_b$ is a dummy variable that equals 1 for banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution. $LowRisk_i$ is a dummy taking value 1 for firms with a score provided by Cerved Group below 3 (sound firms, low risk), $MedRisk_i$ equals 1 for firms with a score between 3 and 6 (medium risk) and $HighRisk_i$ identifies firms with a score above 7 (financially fragile firms, high risk). $Tier1RatioBelow10PCT_b$ identifies banks with a pre-reform average tier 1 ratio below the 10^{th} percentile of the distribution, $Tier1RatioFrom10To25PCT_b$ bank with average tier 1 ratio between the 10^{th} and the 25^{th} and $Tier1RatioFrom25To50PCT_b$ bank with average tier 1 ratio between the 25^{th} and the 50^{th}. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Excluding BCC

	H1		H2		H3	
	Loan	Rate	Loan	Rate	Loan	Rate
	(1)	(2)	(3)	(4)	(5)	(6)
$RBC_t * Affected_b$	-1.789***	0.0848***				
	(0.0947)	(0.00969)				
$RBC_t * Affected_b * LowRisk_i$			-0.212	-0.0741***		
			(0.201)	(0.0232)		
$RBC_t * Affected_b * MedRisk_i$			-1.926***	0.0741***		
			(0.122)	(0.0122)		
$RBC_t * Affected_b * HighRisk_i$			-2.583***	0.184***		
			(0.176)	(0.0181)		
$RBC_t * Tier1RatioBelow10PCT_b$					-0.967***	0.0382**
					(0.167)	(0.0191)
$RBC_t * Tier1RatioFrom10To25PCT_b$					-2.916***	0.0581***
					(0.112)	(0.0111)
$RBC_t * Tier1RatioFrom25To50PCT_b$					-1.866***	-0.0973***
					(0.0935)	(0.00875)
Observations	5629221	3775870	5091969	3495914	5629221	3775870
R^2	0.260	0.806	0.249	0.801	0.260	0.806
Prov-Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm	Firm	Firm	Firm

Notes: The table reports the coefficients estimated for a sample excluding all cooperative banks (BCCs). For Columns (1), (3), and (5) the dependent variable is log change over a 1 year period of the loan granted by bank b to firm i. For Columns (2), (4), and (6) the dependent variable is the short-term interest rates paid by firm i to bank b. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Affected_b$ is a dummy variable that equals 1 for banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution. $LowRisk_i$ is a dummy taking value 1 for firms with a score provided by Cerved Group below 3 (sound firms, low risk), $MedRisk_i$ equals 1 for firms with a score between 3 and 6 (medium risk) and $HighRisk_i$ identifies firms with a score above 7 (financially fragile firms, high risk). $Tier1RatioBelow10PCT_b$ identifies banks with a pre-reform average tier 1 ratio below the 10^{th} percentile of the distribution, $Tier1RatioFrom10To25PCT_b$ bank with average tier 1 ratio between the 10^{th} and the 25^{th} and $Tier1RatioFrom25To50PCT_b$ bank with average tier 1 ratio between the 25^{th} and the 50^{th}. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Only BCC

	H1		H2		H3	
	Loan	Rate	Loan	Rate	Loan	Rate
	(1)	(2)	(3)	(4)	(5)	(6)
$RBC_t * Affected_b$	-0.156	0.000515				
	(0.213)	(0.0297)				
$RBC_t * Affected_b * LowRisk_i$			0.677	-0.124**		
			(0.412)	(0.0553)		
$RBC_t * Affected_b * MedRisk_i$			-0.329	-0.00564		
			(0.262)	(0.0348)		
$RBC_t * Affected_b * HighRisk_i$			-0.194	0.0987**		
			(0.340)	(0.0457)		
$RBC_t * Tier1RatioBelow10PCT_b$					-0.342	0.425***
					(0.437)	(0.0939)
$RBC_t * Tier1RatioFrom10To25PCT_b$					0.338	0.113***
					(0.259)	(0.0379)
$RBC_t * Tier1RatioFrom25To50PCT_b$					0.586***	0.172***
					(0.201)	(0.0340)
Observations	946221	253197	823246	228508	946221	253197
R^2	0.253	0.829	0.237	0.822	0.253	0.829
Prov-Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm	Firm	Firm	Firm

Notes: The table reports the coefficients estimated for a subsample including only cooperative banks (BCCs). For Columns (1), (3), and (5) the dependent variable is log change over a 1 year period of the loan granted by bank b to firm i. For Columns (2), (4), and (6) the dependent variable is the short-term interest rates paid by firm i to bank b. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Affected_b$ is a dummy variable that equals 1 for banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution. $LowRisk_i$ is a dummy taking value 1 for firms with a score provided by Cerved Group below 3 (sound firms, low risk), $MedRisk_i$ equals 1 for firms with a score between 3 and 6 (medium risk) and $HighRisk_i$ identifies firms with a score above 7 (financially fragile firms, high risk). $Tier1RatioBelow10PCT_b$ identifies banks with a pre-reform average tier 1 ratio below the 10^{th} percentile of the distribution, $Tier1RatioFrom10To25PCT_b$ bank with average tier 1 ratio between the 10^{th} and the 25^{th} and $Tier1RatioFrom25To50PCT_b$ bank with average tier 1 ratio between the 25^{th} and the 50^{th}. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Banks' Capital Headroom

	H1		H2		H3	
	Loan	Rate	Loan	Rate	Loan	Rate
	(1)	(2)	(3)	(4)	(5)	(6)
$RBC_t * LowCapitalHeadroom_b$	-1.219***	0.0971***				
	(0.0859)	(0.00919)				
$RBC_t * LowCapitalHeadroom_b * LowRisk_i$			0.339*	-0.180***		
			(0.177)	(0.0228)		
$RBC_t * LowCapitalHeadroom_b * MedRisk_i$			-1.352***	0.0834***		
			(0.109)	(0.0117)		
$RBC_t * LowCapitalHeadroom_b * HighRisk_i$			-2.047***	0.261***		
			(0.152)	(0.0176)		
$RBC_t * CapitalHeadroomBelow10PCT_b$					-0.589***	0.0289
					(0.158)	(0.0239)
$RBC_t * CapitalHeadroomFrom10To25PCT_b$					-1.938***	0.0992***
					(0.0985)	(0.00997)
$RBC_t * CapitalHeadroomFrom25To20PCT_b$					-1.280***	-0.0194**
					(0.0840)	(0.00838)
Observations	6574466	4029232	5914405	3724583	6574466	4029232
R^2	0.258	0.807	0.247	0.802	0.258	0.807
Prov-Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm	Firm	Firm	Firm

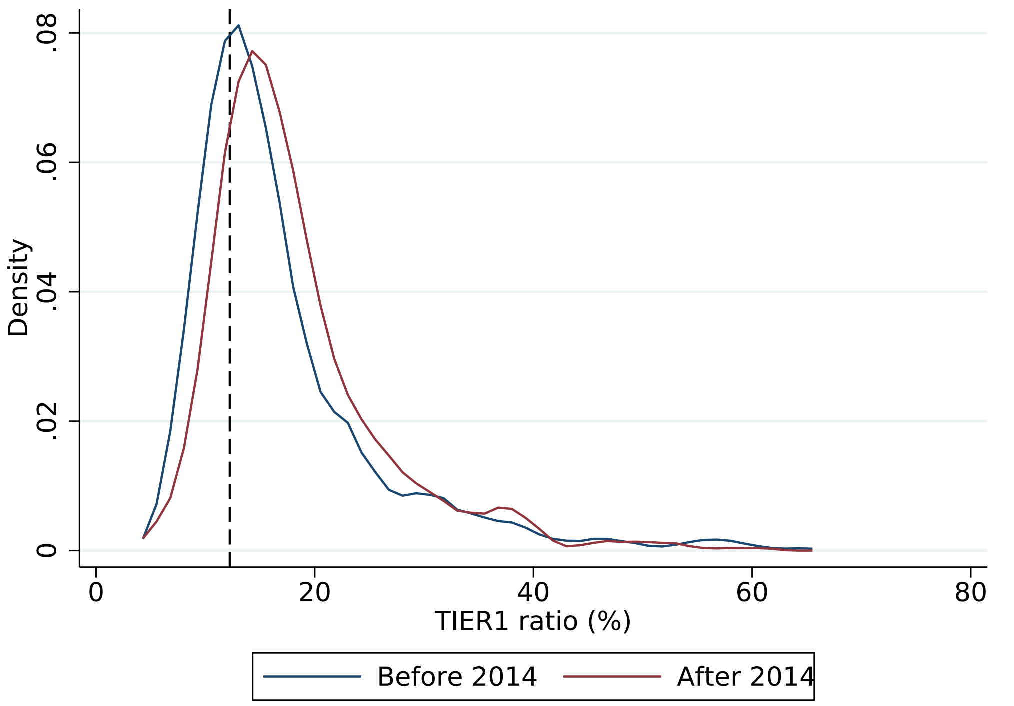
Notes: The table reports the coefficients estimated using least squares. For Columns (1), (3), and (5) the dependent variable is log change over a 1 year period of the loan granted by bank b to firm i. For Columns (2), (4), and (6) the dependent variable is the short-term interest rates paid by firm i to bank b. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. Capital headroom is considered as the difference between a bank's capital requirements and its capital ratio. $LowCapitalHeadroom_b$ is a dummy taking value 1 for banks having a capital headroom below the 25^{th} percentile of the distribution. $CapitalHeadroomBelow10PCT_b$ identifies banks with capital headroom below the 10^{th} percentile of the distribution, $CapitalHeadroom10To25PCT_b$ bank with capital headroom between the 10^{th} and the 25^{th} and $CapitalHeadroomFrom25To50PCT_b$ bank with capital headroom between the 25^{th} and the 50^{th}. $LowRisk_i$ is a dummy taking value 1 for firms with a score provided by Cerved Group below 3 (sound firms, low risk), $MedRisk_i$ equals 1 for firms with a score between 3 and 6 (medium risk) and $HighRisk_i$ identifies firms with a score above 7 (financially fragile firms, high risk). Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table 12: Short Sample

	H1		H2		H3	
	Loan	Rate	Loan	Rate	Loan	Rate
	(1)	(2)	(3)	(4)	(5)	(6)
$RBC_t * Affected_b$	-1.463***	0.0633***				
	(0.110)	(0.00792)				
$RBC_t * Affected_b * LowRisk_i$			-0.210	-0.0408**		
			(0.241)	(0.0200)		
$RBC_t * Affected_b * MedRisk_i$			-1.599***	0.0594***		
			(0.144)	(0.0101)		
$RBC_t * Affected_b * HighRisk_i$			-2.159***	0.138***		
			(0.199)	(0.0142)		
$RBC_t * Tier1RatioBelow10PCT_b$					-1.147***	-0.0465***
					(0.193)	(0.0162)
$RBC_t * Tier1RatioFrom10To25PCT_b$					-2.342***	0.0271***
					(0.133)	(0.00905)
$RBC_t * Tier1RatioFrom25To50PCT_b$					-1.558***	-0.152***
					(0.113)	(0.00800)
Observations	2534531	1526094	2282989	1409733	2534531	1526094
R^2	0.357	0.876	0.350	0.875	0.357	0.876
Prov-Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Firm	Firm	Firm	Firm	Firm	Firm

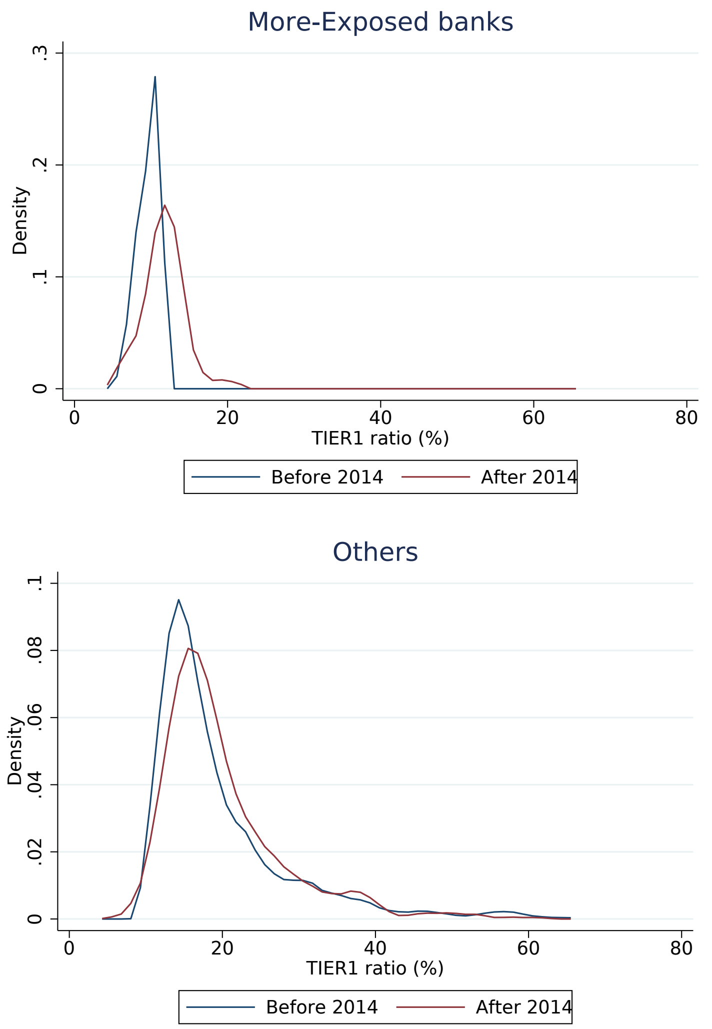
Notes: The table reports the coefficients estimated for the period 2012-2016. For Columns (1), (3), and (5) the dependent variable is log change over a 1 year period of the loan granted by bank b to firm i. For Columns (2), (4), and (6) the dependent variable is the short-term interest rates paid by firm i to bank b. RBC_t is a dummy taking value 1 since 2014, i.e. the implementation date of risk-based capital reform (Basel III) in Italy. $Affected_b$ is a dummy variable that equals 1 for banks having the average tier 1 ratio between 2008 and 2013 below the first quartile of the distribution. $LowRisk_i$ is a dummy taking value 1 for firms with a score provided by Cerved Group below 3 (sound firms, low risk), $MedRisk_i$ equals 1 for firms with a score between 3 and 6 (medium risk) and $HighRisk_i$ identifies firms with a score above 7 (financially fragile firms, high risk). $Tier1RatioBelow10PCT_b$ identifies banks with a pre-reform average tier 1 ratio below the 10^{th} percentile of the distribution, $Tier1RatioFrom10To25PCT_b$ bank with average tier 1 ratio between the 10^{th} and the 25^{th} and $Tier1RatioFrom25To50PCT_b$ bank with average tier 1 ratio between the 25^{th} and the 50^{th}. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1. Standard errors are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: TIER1 ratio



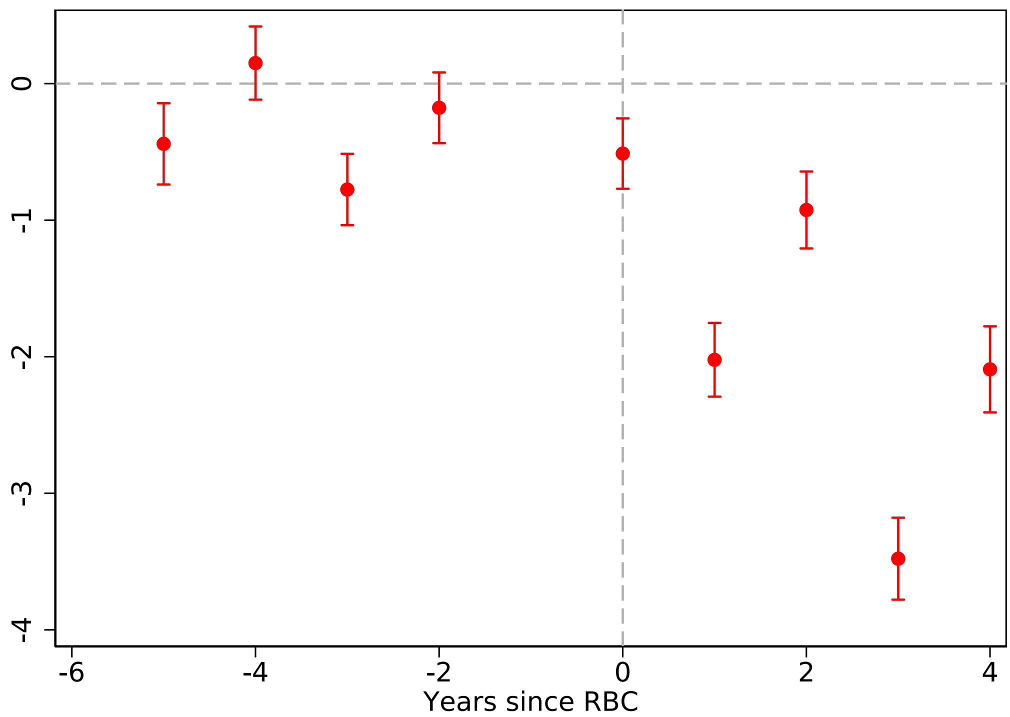
Notes: The vertical black dashed line signs the first quartile of the distribution.

Figure 2: TIER1 ratio - More-Exposed banks vs Others



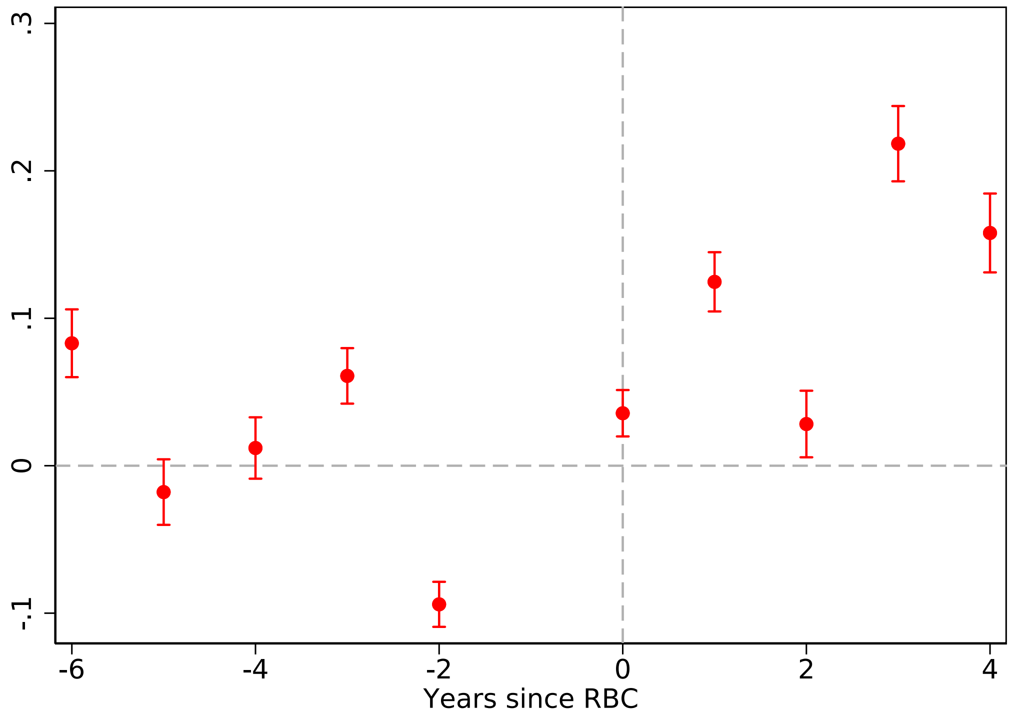
Notes: *Others* refers to banks having the average tier ratio pre-2014 above the first quartile of the distribution. *More-Exposed* banks refer to banks having the average tier ratio pre-2014 below the first quartile of the distribution.

Figure 3: Committed Credit (delta log)



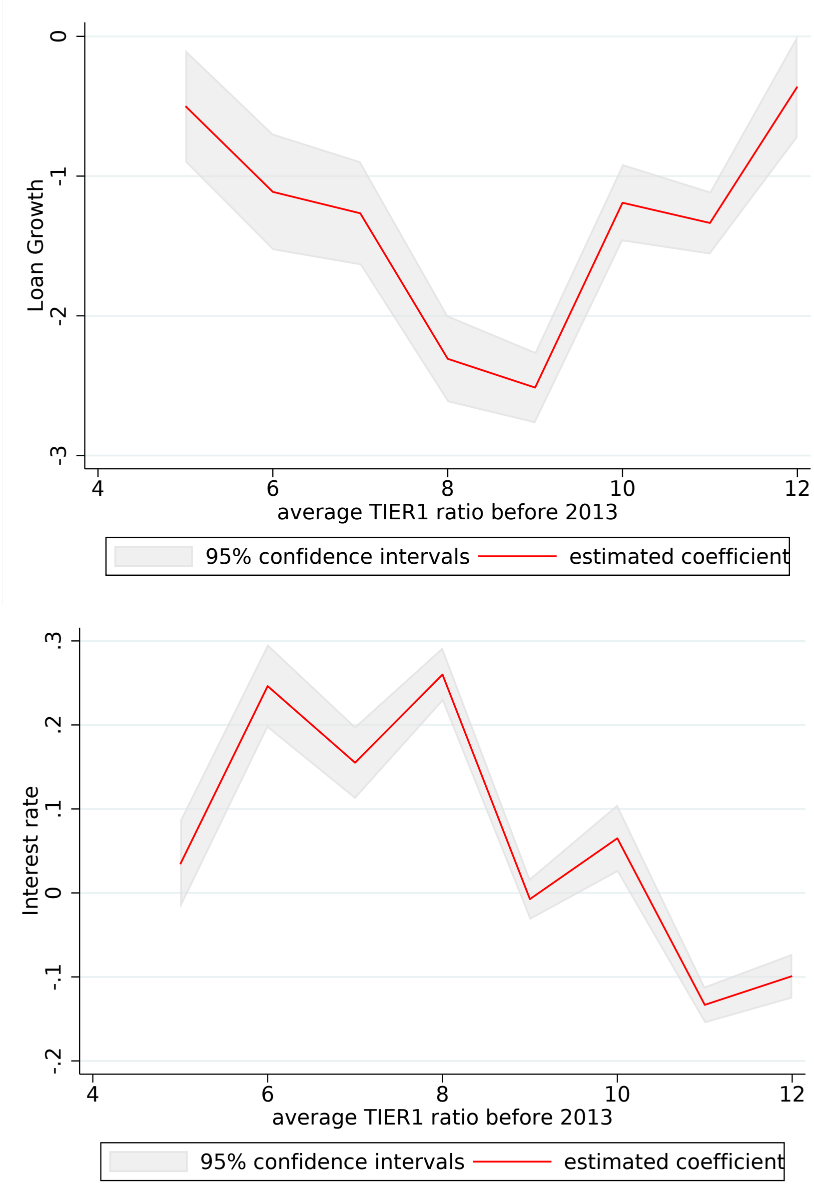
Notes: This figure plots the difference in yearly credit growth by banks that were more exposed to the regulatory reform and others. The coefficients are obtained from estimating year-by-year equation 1. The bars show 95 percent confidence intervals, $\tau = 0$ refers to the implementation of Basel III more stringent capital requirements in 2014, the period analyzed is 2009-2018.

Figure 4: Short term rate



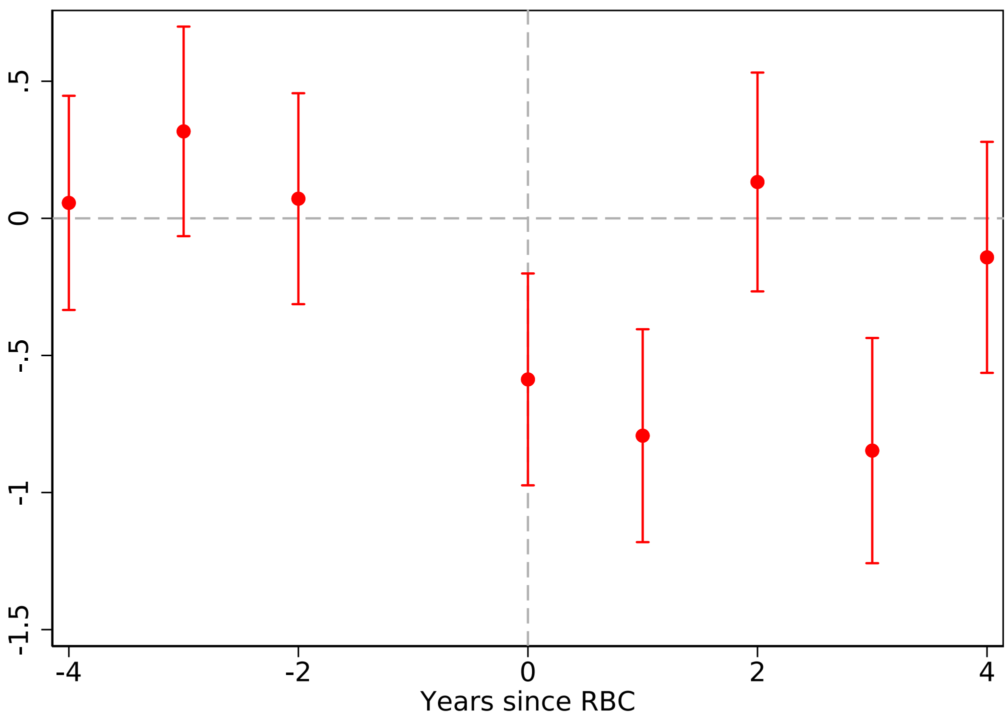
Notes: This figure plots the difference in short-term interest rate paied to banks that were more exposed to the regulatory reform and others. The coefficients are obtained from estimating year-by-year equation 1. The bars show 95 percent confidence intervals, $\tau = 0$ refers to the implementation of Basel III more stringent capital requirements in 2014, the period analyzed is 2009-2018.

Figure 5: Forced safety effect



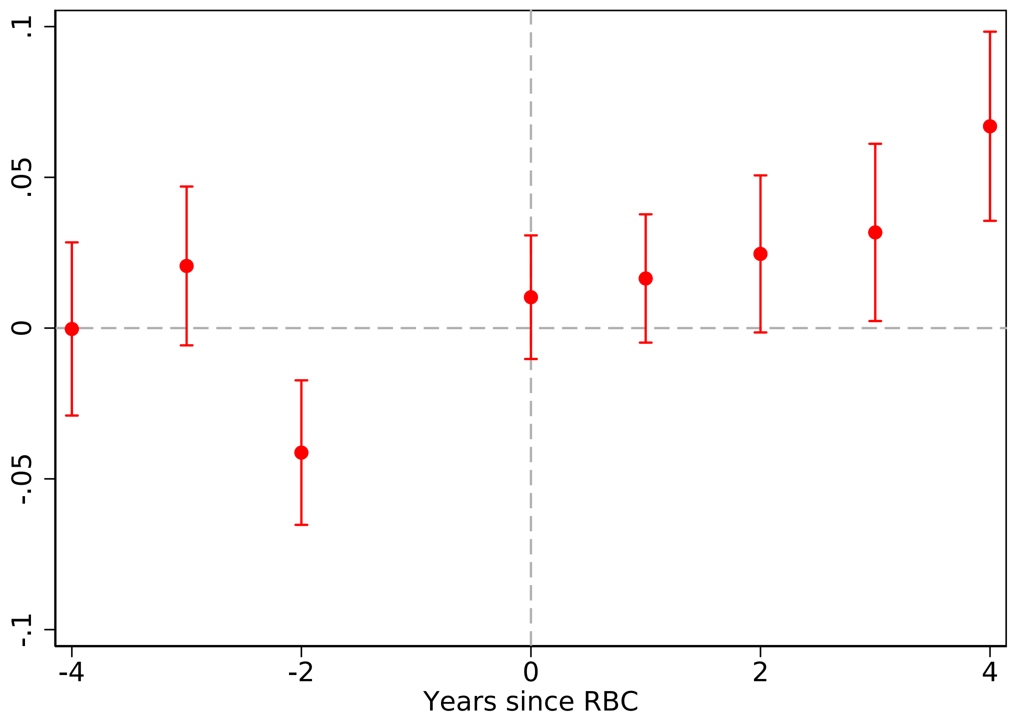
Notes: This figure plots the estimated difference in credit growth (upper panel) and in interest rate (lower panel) as a function of the average tier capital ratio between 2008 and 2013.

Figure 6: Firm level Credit



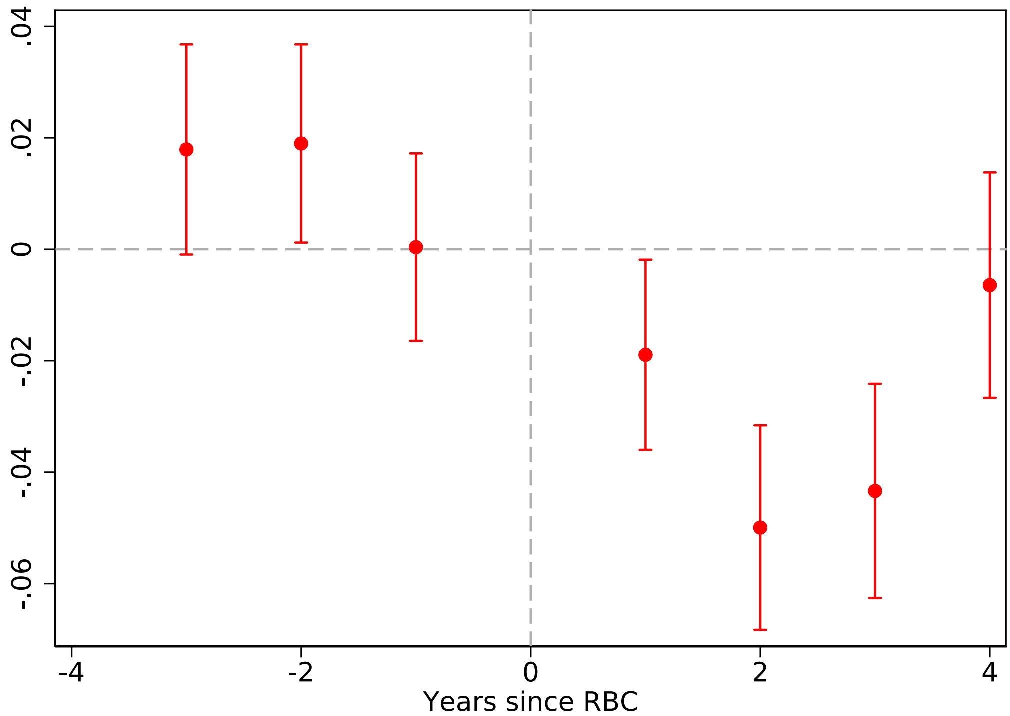
Notes: This figure plots the difference in yearly credit growth between firms exposed to the regulatory reform due to their main bank and others. The bars show 95 percent confidence intervals, $\tau = 0$ refers to the implementation of Basel III more stringent risk based capital (RBC) requirements in 2014, the period analyzed is 2009-2018.

Figure 7: Firm level Loan rate



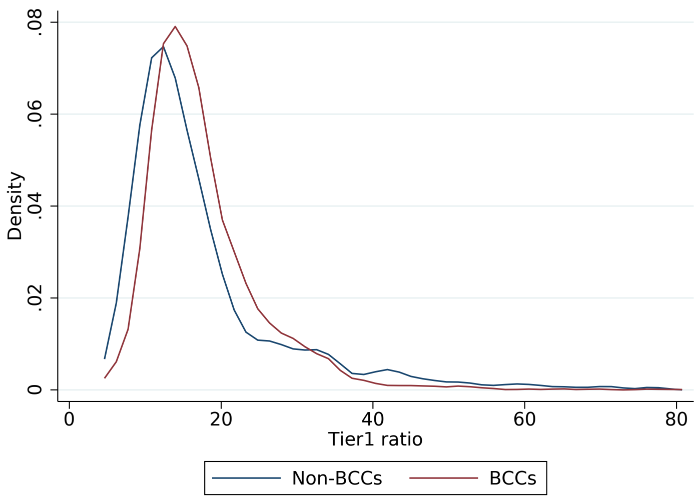
Notes: This figure plots the difference in interest rate between firms exposed to the regulatory reform due to their main bank and others. The bars show 95 percent confidence intervals, $\tau = 0$ refers to the implementation of Basel III more stringent risk based capital (RBC) requirements in 2014, the period analyzed is 2009-2018.

Figure 8: Investment (t+1)



Notes: This figure plots the difference in investment between firms exposed to the regulatory reform due to their main bank and others. The bars show 95 percent confidence intervals, $\tau = 0$ refers to the implementation of Basel III more stringent risk based capital (RBC) requirements in 2014, the period analyzed is 2009-2018.

Figure 9: TIER1 ratio - BCCs vs No-BCCs



Notes: *BCCs* refers to cooperative banks (banche di credito cooperativo), *Non-BCCs* to other banks.