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Banking supervision, monetary policy and risk-taking: Big data evidence from 15 credit registers

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Banking Supervision, Monetary Policy and Risk-Taking: Big Data Evidence from 15 Credit Registers*

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Abstract

We analyse the effects of national versus supranational banking supervision on bank risk-taking, and its interactions with monetary policy. For identification, we exploit: (i) a new, proprietary dataset based on 15 European credit registers; (ii) the institutional change in European banking supervision; (iii) high-frequency monetary policy surprises; (iv) cross-country difference within and outside the euro area. First, supranational supervision reduces credit supply to firms with high credit risk, but strengthens credit supply to firms without loan delinquencies, especially for banks operating in stressed countries. Results are driven by two mechanisms: the country's institutional quality where banks operate, and bank-level systemic importance. Second, there are important complementarities between monetary policy and supervision: centralised supervision offsets high credit risk-taking induced by accommodative monetary policy, but not credit supply to more productive firms. Overall, we show that using multiple credit registers – first time in the literature – is crucial for external validity.

JEL codes: E02; E52, E58, G01, G21, G28.

Keywords: Banking, supervision, monetary policy, AnaCredit, euro area crisis.

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1 Introduction

Public regulation is widespread in modern societies, with governments prevalently intervening throughout the marketplace (Stigler, 1971; Tirole, 2014). However, enforcement of policy requires effective supervision (Laffont and Tirole, 1993). Supervision of banks is considerably more challenging than for other industries (Dewatripont and Tirole, 1994; Myers and Rajan, 1998) due to the opacity and complexity of bank assets (Morgan, 2002). Bank lobbying activities and revolving doors between banks and their regulators, further aggravate the difficulty of the supervisory process, especially from larger banks (Johnson and Kwak, 2010; Acemoglu and Robinson, 2013).

There is a general consensus among academics and policy-makers that the 2008 financial crisis highlighted the limitations of the prevailing supervisory framework in preventing excessive risk-taking and ensuring the resilience of the banking system to large adverse shocks. These limitations fostered a debate on changes to the institutional arrangements and practices (Dewatripont and Freixas, 2012; Freixas, Laeven and Peydró, 2015), including, prominently, the potential benefits of supranational supervision (Draghi, 2018). Although local (national) supervisors may have better information than more centralised (supranational) supervisors, they may be more prone to local capture because of different supervisory incentives. In addition, supranational supervision might also take more into account systemic effects (Hayek, 1945; Agarwal et al., 2014; Carletti et al., 2016; Hakenes and Schnabel, 2014; Laffont and Martimort, 1999; Repullo, 2017; Constâncio, 2013).

Following the outbreak of the financial crisis, also the role of monetary policy in stabilising the economy and supporting its recovery changed and ramped up substantially (Bernanke, 2018). With nominal interest rate approaching their effective lower bound in many developed countries, monetary authorities launched a wide set of non-standard policy measures. Notable examples of non-standard measures employed are quantitative easing, negative rates, liquidity provision measures, and forward guidance (see Rostagno et al., 2019). Indeed, the timeliness and the variety of these interventions led many researchers and commentators to conclude that central banks were *the only game in town* (El-Erian, 2016). Especially in Europe, given the prominence of bank-intermediated credit over non-bank credit, the effectiveness of the new set of measures crucially depends on the banking sector. Key channels through which monetary policy influence the real economy rely on the credit, bank lending and risk-taking channels (Bernanke and Gertler, 1995; Kashyap and Stein, 2000; Rajan, 2005; Adrian and Shin, 2010; Allen and Rogoff, 2011; Borio and Zhu, 2012; Brunnermeier and Sannikov, 2013, 2016). Moreover, as monetary and supervision policies may both influence bank risk-taking behaviour, the interaction of these policies might change their individual channels of transmission. Analysing whether the two policies are ultimately complementary or substitute is therefore of key importance to enhance our understanding on the overall effectiveness of central bank policies.

To empirically identify the effects of these policies, we exploit several unique data sources as well as institutional features of the euro area. More specifically, we use (i) a new, unique, supervisory dataset consisting of the credit registers for 15 countries; (ii) the institutional change leading to the centralisation of bank supervision for some banks; (iii) data on cross-country variations in financial distress (and economic conditions), institutional quality as well as in supervisory regime (both within euro area and also compared to non-euro area countries); (iv) monetary policy surprises retrieved form high-frequency responses in financial markets to unprecedented monetary policy actions.

In brief, we show that transferring the supervisory authority over banks to a supranational institution on average reduces the supply of credit to firms with very high ex-ante and ex-post credit risk, while fostering the supply of credit towards firms with no loan delinquencies. Economic and statistical effects are stronger for banks operating in stressed countries. Exploiting heterogeneity across banks and countries, we find that our results are driven by two main mechanisms: the quality of the institutions of the country where banks operate and their systemic importance. In other words, lenient behaviour towards bank risk-taking is more significantly influenced by structural institutional weaknesses rather than country-specific cyclical developments (such as higher financial distress). In addition, the architecture of bank supervision has a greater impact on the risk sensitivity of credit supply for systemically important banks. Our results do not support the hypothesis that local regulators are captured by just "locally" large banks. Moreover, we find strong complementarities between supervisory policy and monetary policy. Centralised supervision tends to offset high credit risk-taking induced by a more accommodative monetary policy, but not the more productive risk-taking.

In the remainder of the introduction, we provide a more detailed preview of the paper, including a deeper discussion on the novelty of our paper in relation to the literature.

Preview of the paper. In this study we analyse the impact of banking supervision on the supply of credit, and its interactions with monetary policy. More specifically, we analyse whether transferring supervisory responsibilities to a supranational entity matters for bank credit supply and risk-taking. In addition, since monetary policy easing may induce banks to change their risk bearing capacity and risk appetite, in line with the risk-taking channel of monetary policy (e.g. Adrian and Shin, 2010), we also characterise the interaction between supervision and monetary policy.

Banking supervision involves monitoring banks to evaluate whether they comply with banking regulation or whether they are engaged in unsafe and unsound risky practices and, if so, whether they take appropriate actions to correct such practices (see e.g. Eisenbach et al., 2017). The supervisory process is difficult as banks are complex and potentially opaque institutions (Myers and Rajan, 1998; Morgan 2002; Eisenbach et al., 2017; Gai et al., 2019).

We exploit 15 European credit registers comprising a unique confidential granular dataset collected in the context of the preparatory phase of the AnaCredit project by the European System of Central

Banks. This represents the only loan-level dataset available for many countries, covering both Euro area and non-Euro area European countries. Data frequency is biannual, covering loans to non-financial firms over the period from June-2012 to December-2017. The total number of observations is large: more than 280 million observations.[1] We collapse our big data at the *bank-borrower-time* level, with information on e.g. loan volume, bank size, NPL, borrower risk and industry. Our dataset includes granular information on exposures in default, defined as loans in arrears over at least 90 days, which we use to construct measures of borrower risk. This information is crucial for investigating banks' incentives for gambling for resurrection via loan ever-greening (see e.g. Rajan, 1994; Caballero, Hoshi and Kashyap, 2008).

Given the significant cross-country heterogeneity in the euro area, we first analyse separately two groups of countries: "stressed" and "non-stressed".[2] In addition to institutional (structural) differences, the group of stressed countries was particularly affected by the sovereign debt crisis, resulting in higher borrower risk and in disproportionate holdings of low quality legacy assets. This is important as banking theory (e.g. Freixas and Rochet, 2008) argues that there are higher incentives for excessive risk-taking, e.g. gambling for resurrection via loan ever-greening, when there are weaker fundamentals or in periods of financial distress. We also analyse whether our results are driven by the heterogeneous exposure to (i) the (more cyclical) financial crisis, as proxied by the sovereign CDS of each country in the sample, or (ii) different (more structural) institutional quality, as proxied by World Bank country level indicators.[3] For example, supervision in countries with weaker institutional quality may benefit from conferring certain functions to external executive agencies, e.g. via a supranational supervisor (Epstein and O'Halloran, 1999; Acemoglu, Johnson, and Robinson, 2005). Both country-specific measures have substantial variation across all the euro area countries, and also within stressed and non-stressed countries. We also use information from credit registers of European but non euro area participating countries in order to investigate the robustness of our findings in the form of a placebo test, since there was no change in the institutional setting of bank supervision in those countries.

We use bank size variation across countries and within countries to shed light on the incentive structure of supervisors. Bank supervisors might in principle have distorted incentives and be prone to

[1] The actual number of observations that we use in the estimation is lower reflecting the cleaning of data, the collapse of the data at *bank-borrower-time* level (e.g. there are multiple loans from the same bank to the same firm in the same period in the original data), as well as different controls in the empirical strategy (e.g. different fixed effects). See Section 2.

[2] Notice that, in the context of the euro area analysis, research and policy assessments are normally conducted by grouping countries into these two exact categories. We define as "stressed" countries those whose 10-year sovereign yield exceeded 6% (or, equivalently, four percentage points above the German yield) for at least one quarter in our sample period. Specifically, throughout the paper, the term stressed countries refers to Italy, Spain, Ireland, Portugal and Slovenia; non-stressed countries are instead Germany, France, Austria, Belgium, Malta, Lithuania, Latvia and Slovakia. We also exploit non-euro-area countries, in particular Romania and Czech Republic (see in next pages). Due to confidentiality constraints, we can only show the results for groups of countries (stressed and non-stressed) but not country-specific (nor bank-specific) results.

[3] See https://info.worldbank.org/governance/wgi/.

regulatory capture (Johnson and Kwak, 2010; Igan and Lambert, 2019). The "revolving doors" between supervising authorities and supervised banks, the intense lobbying activities, and the disproportionate size of banks in a given country may lead local supervisors to pursue the private interests of the regulated industry and be more lenient towards certain banks. The size of the bank might indeed play a central role. We measure bank size in both relative and absolute terms. In relative terms, banks operating in a given country are directly compared with each other. In absolute terms, each bank is compared with the intermediaries operating in all the countries included in the sample. This means that a bank can be considered large in relative terms when the banking sector of the specific country where it operates is very fragmented or when the size of country is small compared to the one of the bank. In a small country, for example, the biggest bank may not be very large in absolute terms, but (relative to the country) still may be too big to fail and hence have disproportionate local power and influence. Moreover, very large banks in absolute terms may have a systemic importance and hence supranational supervisors may take into consideration more risk-taking effects due to e.g. spillover effects (Beck and Wagner, 2016; Allen and Gale, 2000).

Local supervisors may also be more lenient towards weak banks, as bank failures can have large negative consequences on the local economy as well as on their reputation (Kane, 1989; Dewatripont and Maskin, 1995; Mishkin 2001; Rochet, 2009; Martynova, Perotti and Suarez, 2019). In the empirical analysis we will use bank NPL as a proxy for bank weakness. This is because asset quality has been a major problem and a supervisory priority in Europe, with the total amount of non-performing exposures reaching a peak of more than €1 trillion at the end of 2014 and only gradually (albeit steadily) declining thereafter.

The sample period used in the empirical analysis covers a key institutional change in Europe. In November 2014, the Single Supervisory Mechanism (SSM) became operational, a crucial step towards the European Banking Union. We assess the effects of this institutional change by exploiting the associated heterogeneity in the time and cross-sectional dimension, since the change affected only a subset of euro area banks. Supranational banking supervision through the SSM inherited several prudential tools from local authorities of participating Member States – the National Competent Authorities (NCAs) – which can be activated to ensure the safety and soundness of the European banking system. Moving responsibilities from the national to the supranational authority comes with a potentially different set of incentives between the local and supranational authority that could, for example, reduce the supervisory capture or supervisory forbearance mentioned above. But there are other changes associated with the new institutional setting, linked to e.g. the reduced geographical and cultural proximity, and hence potentially more limited information available to the new supervisor.

During our sample period, there have also been unprecedented monetary policy actions with the introduction and subsequent recalibrations of (targeted) long-term liquidity provision operations, quantitative easing programmes and negative interest rate policy (Rostagno et al., 2019). In order to

measure the impact of monetary policy on credit supply, we use the surprise component of each policy action using high-frequency movements across a wide spectrum of maturities of the risk-free interest rates around official policy meetings of the ECB Governing Council. Moreover, as countries differ in local economic conditions (e.g. GDP and inflation), the transmission of monetary policy shock may heterogeneously affects euro area countries.

Exploiting the granularity of data at the *borrower-bank-time* level is crucial to exhaustively control for multiple sources of unobserved heterogeneity when analysing bank risk-taking. First, as different banks (e.g. with different risk appetite) may be matched with different borrowers (e.g. in terms of credit-worthiness), bank*firm fixed effects are essential to control for persistent (non-random) bank-firm lending relationships. Moreover, firm*time fixed effects control exhaustively for time-varying unobserved borrower fundamentals, proxying e.g. for firm-level credit demand, growth opportunities and risk. As firm*time fixed effects require firms to borrow from at least two banks in a given period, we also use sector*time (and country*time) fixed effects to control for time-varying firm fundamentals using all firms in our sample. Since banks have different fundamentals and balance sheet characteristics, we also control for bank*time fixed effects, which are crucial as they fully capture not only observed time-varying characteristics such as bank profits, capital and liquidity, but also unobserved ones (e.g. business models and risk appetite). Overall, only a credit register allows for this type of identification. In addition, to check whether our results hold at a more macro level we aggregate the results at the *sector-bank(country)-time* level. Moreover, as the effects may be different across countries (e.g. with different institutional quality), multiple credit registers are critical for external validity. Furthermore, monetary policy surprises and changes across time and banks in the institutional setting of banking supervision are key for identification. Importantly, the euro area setting offers all these crucial elements for the identification of the main questions of the paper.

Our results suggest that supranational (rather than local) banking supervision reduces the supply of credit towards firms with very high ex-ante risk (worse credit history/current defaults), and also towards firms that tend to default more ex-post, i.e. firms with previous and current delinquent loans which do not improve over time, consistently with a reduction in excessive bank risk-taking. Moreover, centralised supervision increases the supply of credit to firms without delinquent loans and has no effects (statistically and economically) on the supply of credit towards more productive firms. In our analysis, “excessive” risk-taking does not mean a level of risk-taking over and above the theoretically optimal one, but rather an increase in the supply of credit towards firms with a large share of their loans in default that do not improve over time. This particular high credit risk-taking has a negative connotation in theoretical models and in banking crises (e.g. Rajan, 1994; Caballero, Hoshi, Kashyap, 2008; Akerlof et al., 1993; Freixas and Rochet, 2008); and moreover, in our analysis we contrast it with credit supply to more productive firms (proxied by the ratio between labour productivity and average personnel costs).

Estimated effects are economically strong and quantitatively larger in stressed countries. Centralised bank supervision leads to a reduction in credit supply to a firm with a 1 standard deviation decrease in credit quality by around 8% in stressed countries and 5% in other countries, respectively. However, centralised supervision does not impair credit supply to healthy firms, it can actually increase the supply of credit to firms without delinquent loans by 11% to 15%. Overall, effects are more robust in stressed countries than in the other countries.

To further understand why results are stronger in stressed countries, we exploit country-level measures of institutional quality (structural-based hypothesis) versus financial distress (cyclical-based hypothesis) across all countries available in the dataset. Our estimates suggest that weaker institutional quality drives the results. Centralized supervision reduces risk-taking especially in countries with weaker ex-ante institutions, rather than in countries with higher sovereign CDS, i.e. country with weaker cyclical developments. Note that while these variables are correlated (about -0.5) they still provide distinct information. Importantly, the level of CDS is not statistically significant even when we do not control for the institutional quality, while the latter one is always significant (independently on whether the regression include also the CDS).

Moreover, within both stressed and non-stressed countries, the effects are substantially stronger for very large banks (e.g. over Euro 300, 400, 500 billion of total assets, or even beyond), but are not statistically or economically different for the largest bank in each country. Note that, as some of the countries included in the sample are relatively small, the largest bank in a small country would be considered large only relatively to the country size but not in absolute terms. In addition, the reduction in risk-taking is not affected by the level of bank risk/weakness (proxied by ex-ante NPL). Taking these results together, our analysis suggests that another mechanism underlying the enhanced effectiveness of the centralised supervision is its ability to influence the behaviour of very large banks in absolute terms that can ultimately generate systemic risk (*systemic hypothesis*). The results do not support, instead, a competitive hypothesis contemplating the capture of local supervisors by banks which are just locally more important or have weaker balance sheets (*capture hypothesis*).[4] Note that this mechanism is centred on large banks; however, for the average bank, the mechanism at work is consistent with the supranational institution reducing more excessive risk-taking when banks operate in a country with weaker institutions, as discussed above.

We conduct a series of robustness checks to assess the internal and external validity of our results. Effects on excessive bank risk-taking are similar if we only include banks around the threshold to be centrally supervised (i.e., 3 banks above and 3 below the threshold, which is the minimum number of banks supervised by the ECB's SSM in a country). Moreover, results are completely absent for banks

[4] Note that the largest bank in a small country would be supervised by the ECB after the supervision reform, but we do not find a decrease in risk-taking by these banks after the institutional reform, which suggests that these banks were not having a special treatment when they were only supervised by local supervisors.

operating in European Union countries outside the euro area (therefore not subject to the change in the institutional setting of bank supervision), which serves as a placebo test. In addition, although the official establishment of the central supervisory authority took place in November 2014, banks had information on the regulatory change since October 2013, i.e. when the SSM Regulation was published and a comprehensive assessment of the supervised institutions (comprising an asset quality review and a stress test) was announced. Therefore, we test for the actual date since when centrally supervised banks changed their risk-taking behaviour. Our results show that the change in the behaviour of the credit supply of centrally supervised banks operating in stressed countries took place when the supranational authority became operational in 2014.

Finally, we study the interaction between supervision and monetary policy. We find that monetary policy easing (identified through high-frequency monetary policy surprises) increases credit supply to firms with very high ex-ante (and ex-post) credit risk, consistent with high credit risk-taking due to expansive monetary policy. However, the change in the allocation of responsibilities in supervision towards a supranational entity limits this (more "excessive") bank risk-taking. This complementary role of monetary and supervision policies are significant for all banks, but the economic effects is stronger for the very large banks (consistent with the previous results on the impact of supervision). Moreover, we find that the decrease in risk-taking induced by centralised supervision following a monetary policy easing does not lead to a compression in credit supply to more productive firms. These results emerge as particularly important as they show that, while a more expansionary monetary policy leads to some risk-taking through an easing in financing conditions, which may be an intended policy consequence (Adrian and Shin, 2010; Brunnermeier and Sannikov, 2013, 2020), supranational banking supervision reduces the more excessive risk-taking, but not the more productive one.

Contribution to the literature. We now review in more detail our contribution to the literature, which spans banking supervision (including institutional design), the bank-lending and risk-taking channels of monetary policy and, importantly, the interaction between monetary and supervision policies.

First, we start with our contribution to the literature on banking supervision. In a path-breaking paper, Agarwal et al. (2014) analyse supervisory decisions of U.S. banking federal versus state supervisors and find that federal regulators are systematically tougher than state regulators on reporting past risk.[5] Our paper addresses a different but related question, thereby providing novel insights. We show how supranational supervision heterogeneously influences subsequent credit supply by reducing credit supply to firms with very high credit risk, while increasing credit supply to firms

[5] In theory, supranational supervision may overcome coordination failures connected to the supervision of the large multinational banks (Calzolari et al. 2019, Beck et al. 2013); in addition, the allocation of supervisory powers and responsibilities may also influence bank decisions (Dell'Ariccia and Marquez, 2006).

with lower loans delinquency rate.[6] Our paper moreover provides evidence on the underlying mechanisms through which supervision affects credit supply and risk-taking decisions by banks. Specifically, we find that the main drivers of the results associated to the change in the supervisory responsibility (from national to supranational) are related to the quality of the institutions in the country where banks operate (Acemoglu, Johnson, and Robinson, 2001) and to the systemic importance of banks rather than to the capture of local supervisors (Carletti et al., 2016; Repullo, 2017). More generally, the implications of our analysis go beyond the particular setting of supervision, providing more general insights on why (new) institutions matter (Acemoglu, Johnson, and Robinson, 2005).

Second, we contribute to the large literature on the bank lending and risk-taking channels of monetary policy (e.g. Bernanke and Blinder, 1988 and 1992; Kashyap and Stein, 2000; Adrian and Shin, 2010; Brunnermeier and Sannikov, 2013, 2020; Jimenez, Ongena, Peydró and Saurina, 2012 and 2014; Dell'Ariccia, Laeven and Suarez, 2017) by showing how the transmission of monetary policy through credit supply and bank risk-taking depends on the specific supervisory architecture. To the best of our knowledge we are the first to show that monetary policy and bank supervision tend to complement each other. Importantly, the reduction in banks' risk-taking driven by centralised supervision is concentrated on the more ("excessively") risky exposures, but not in more productive sectors.

Third, more generally, a key contribution (that goes beyond bank supervision, monetary policy and risk-taking) consists of analysing all economic questions posed in our paper using multiple credit registers. This is crucial not only for identification but also for assessing the heterogeneous effects across countries, for the first time in the literature, to our knowledge. We show that some important research and policy questions – although not all of them – yield very different results depending on the group of countries analysed. We find, for example, similar effects for the largest banks across stressed and non-stressed countries, but substantial cross-country differences in the effects of supervision on risk-taking due to different (average) institutional quality at the country level. Moreover, the results on the higher sensitivity to systemic banks highlight that the relative size of countries and banks influences both supervisory and monetary policy outcomes. External validity is important for testing theories and policy analysis, and local estimates from single countries cannot always be generalised. The large empirical literature on the credit and bank lending channels (for banking, macro-finance, and monetary policy) has analysed *all* questions using single credit registers (e.g. Mian, 2006; Khwaja

[6] There is a growing recent literature focusing on the link between prudential supervision and bank lending decisions. Specifically, various studies conclude that stricter regulatory oversight can lead to an expansion in lending (Granja and Leuz, 2017) and a reallocation of loans away from firms with negative equity (Bonfim et al. 2019). In general, a lower level of supervisory attention leads to an increase in banks' willingness to take risk (Kandrac and Schlusche, 2019). Focusing on heterogeneity across banks, some studies find that because large banks receive more attention from supervisors they tend to hold less risky loans and are less sensitive to industry-specific fluctuations (Hirtle, Kovner and Plosser, 2018; and Eisenbach, Lucca and Townsend 2016).

and Mian, 2008; Amiti and Weinstein, 2011), with previous literature even working with more aggregate data.[7] To our knowledge this is the first study using multiple credit registers.

The rest of the paper is organized as follows. Section 2 presents the data used in the empirical analysis. In Section 3 we discuss the empirical strategy and results, including the associated mechanism and the interactions with monetary policy. In Section 4 we offer concluding remarks.

2 Big Data

The analysis uses a unique confidential granular credit dataset collected in the context of the preparatory phase of the AnaCredit project by the European System of Central Banks. Importantly, this is the only credit register dataset available for more than one country and it covers both euro area and non-euro area European countries. The euro area countries included are: Austria, Belgium, Germany, Spain, France, Ireland, Italy, Lithuania, Latvia, Malta, Portugal, Slovenia and Slovakia. Some countries are excluded from the analysis due to data quality and availability issues (these are Ireland, Latvia, France, Malta and Slovenia). The European countries outside the euro area included in the dataset are the Czech Republic and Romania.

Data collection is biannual and covers the period from June-2012 to December-2017. The total number of observations is very large: more than 280 million observations. This makes the dimension of the dataset unique and it thereby represents the most comprehensive dataset on loan contracts used in banking, as previous analysis has been conducted using a single credit register. Moreover, the dataset includes information on important bank and borrower characteristics such as credit volume (including both drawn and undrawn committed credit), ex-post defaults, ex-ante risk, the sector of activity of the borrowers, bank size and NPL ratios.

Table A.1 shows, for each country, the reporting threshold of the individual credit register, the initial number of observations available in the dataset and the final number of observations remaining after cleaning and harmonising the data by dropping inconsistent information and reporting errors.[8] Moreover, the dataset is restricted to exposures to non-financial corporations and to (drawn and undrawn) lending, dropping debt securities. Finally, we harmonise the unit of observation to borrower-bank-time, as some credit registers do not report different loans between the same firm and bank in a time period.

Given the significant heterogeneity in the euro area economies, we conduct the empirical analysis separately for two groups of countries: financially "stressed" (Italy, Portugal, and Spain) and "non-

[7] Aggregate data have severe limitations when the scope of the analysis is to identify causal relationships. For example, using only bank-level data (as done, for example, in the highly influential work by Kashyap and Stein, 2000) it is not possible to identify changes in bank lending driven by demand and supply conditions.

[8] To be precise, we drop banks with less than 100 borrowers, banks for which information on borrower quality is missing for more than half the observations and banks where more than 90% of exposures are reported as non-performing.

stressed" (Austria, Belgium, France, Germany, Lithuania and Slovakia). We define as "stressed" – that is, subject to high sovereign stress – countries whose 10-year sovereign yield exceeded 6% (or, equivalently, four percentage points above the German yield) for at least one quarter in our sample period. This classification is normally used in ECB and academic analyses. In addition, we test the robustness of our results using a placebo test on the two non-euro area EU countries in our data set which did not experience a change in the institutional setting of banking supervision.

Table 1 reports the descriptive statistics for the main variables used in the empirical analysis over the available sample for the two groups of countries. Significant cross-country heterogeneity emerges when looking at the average loan volumes (the total loans and credit lines at the borrower level in euro thousands) with the credit granted in stressed countries being substantially lower than the one in non-stressed countries: 500 vs. 1700 thousand euro, respectively. This difference in part reflects the higher reporting thresholds in non-stressed countries (as reported in Table A.1). As we explain below, results are robust to different thresholds.

Borrower quality indicates, for each borrower, the ratio between credit exposures in arrears and total credit exposures. The definition of arrears is homogenous across countries and refers to the delayed principal amount and/or the delayed interest payments that are past due more than 90 days. In line with the difference in the economic performance of the two groups of countries, the mean default frequency is larger for stressed countries (5%) than for non-stressed countries (3%).

Centralised supervision is a dummy variable that takes value one for banks supervised at supranational level after November 2014, and zero for banks supervised at country level. Monetary policy shocks are the first principal component of the monetary policy surprises obtained from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample, and are extracted from the Euro Area Monetary Policy Event-Study Database – EA-MPD (see also Section 3 for more details). The negative average values indicate that the sample period is characterised by more accommodative policy even though it still covers a broad range of easing and tightening events (see Figure 3 for more details). The NPL ratio measures, for each bank, the share of non-performing loans to total loans. This measure is substantially higher in stressed countries than in non-stressed countries. The average bank in stressed countries has an NPL ratio for corporate loans of about 20% (note that the NPL ratio for total assets would be lower). The picture is completely different for the banks operating in non-stressed countries, where the NPL ratio is about 5% with also a much smaller standard deviation.

[Insert Table 1 here]

Finally, the table also shows summary statistics for the two main variables used in the empirical analysis to proxy for bank size. The first one is the market share of the bank in each sector (Size). The second one is a dummy variable capturing possible non-linearities for very large banks

(Large). More precisely, this dummy variable takes a value of 1 if the total assets of the bank are larger than Euro 500bn, i.e. about the size of Lehman Brothers when it collapsed in September 2008. Moreover, in the empirical analysis we investigate the sensitivity of the results to changes in the threshold used for total assets in the definition of this dummy variable, in particular 200, 300, 400 and beyond 500 bn. Productivity is defined as the ratio between labour productivity (measured as the ratio of value added over number of employees) and average personnel costs and represents a cost-adjusted measure of sectoral labour productivity for each sector in each country. The table shows that on average labour productivity is lower in stressed countries. Sovereign CDS spreads reached an average of close to 230 basis points in countries more affected by the sovereign crisis, while for other countries it averaged just over 60 basis points. Institutional quality is proxied by the World Bank's Worldwide Governance Indicators and evaluated in 2011, before the start of the sample in order to ensure that it is not affected by the change in the institutional setting. More specifically, the measure of institutional quality is defined as the mean across the six dimensions of governance available: voice and accountability, regulatory quality, political stability and absence of violence, rule of law, government effectiveness and control of corruption. In turn, the measure used for each of these indicators is the percentile rank among all countries, ranging from 0 to 100.

3 Empirical analysis

This section presents the empirical strategy and the results of the paper. It is divided into four subsections. In the first subsection, the analysis focuses on the effects of the institutional setting of banking supervision, and the associated allocation of responsibilities (centralised vs. country-level supervision), on lending decisions and risk-taking of euro area banks. The second and third subsections focus on the robustness analysis and the mechanisms underlying our main findings, respectively. The last subsection concentrates on the interaction between banking supervision and monetary policy.

3.1 Risk taking and banking supervision

In this subsection we outline the empirical strategy and present our findings on the implications for bank risk-taking behaviour of the institutional design of supervision. We ask whether the level of direct supervision – either centralised (i.e. conducted by a supranational authority) or local (i.e. conducted by a national regulatory authority) – influences bank credit supply, including risk-taking.

On the 4th of November 2014, centralised supervision became operational in the euro area through the establishment of the Single Supervisory Mechanism (SSM). Since then, while the local authorities of participating countries – the National Competent Authorities (NCAs) – continue to supervise banks that are classified as "less significant", the European Central Bank (ECB) is responsible for direct supervision over the so-called "significant institutions". For a bank to be included in the list of significant institutions supervised by the SSM it should respect any of the following criteria: (i) total

assets exceed €30 billion; (ii) the ratio of total bank assets over GDP of the participating Member State exceeds 20%; (iii) the bank is among the three largest credit institutions in a participating Member State; (iv) total assets exceed €5 billion and the ratio of its cross-border assets in more than one other participating country to its total bank assets is above 20%; (v) the institution has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility.

Supranational banking supervision through the SSM inherited several prudential tools from national supervisory authorities which can be activated to ensure the safety and soundness of the European banking system. These tools include carrying out supervisory reviews (including stress tests), conducting on-site inspections and investigations, granting or withdrawing banking licences, authorising banks' acquisitions of qualifying holdings, ensuring compliance with EU prudential rules, setting higher capital requirements ("buffers") in order to counter financial risks, and imposing corrective measures and sanctions. There are however potential improvements in the effectiveness of the overall supervisory process, following the new institutional setting that are connected to the reallocation of responsibilities among supervisory authorities.

The new competent authority is likely to have a different incentive structure that could influence the risk-taking behaviour of banks. A supranational institution could limit the so-called regulatory capture. The local supervisor might have a different objective function which attributes a higher importance to the stabilizing effect of bank lending on the local economy, and therefore be more reluctant to promote an aggressive cut in risk taking by banks, which would increase their resilience at the cost of firm failures with the associated implications for employment. This may depend on the overall financial distress of the country (proxied by the CDS of the sovereign). Moreover, local supervisors might be more vulnerable to agency problems either because supervised banks are more likely to be a future career option ("revolving door") or because they are more susceptible to lobbying activities. Differently, a supranational institution is more likely to internalise the externalities that very large banks can have on the whole euro area (including other countries). See e.g. Laffont and Tirole, 1991; Laffont, 1999; Agarwal et al., 2014; Repullo, 2017; Igan and Lambert, 2019. More generally, as supervisory institutions also depend on the quality of institutions in a country, effects of supranational supervision could be different depending on the average quality of institutions at the country level (e.g. Epstein and O'Halloran, 1999; Acemoglu, Johnson, and Robinson, 2005), as measured e.g. by the World Bank (World Bank's Worldwide Governance Indicators). In addition, the central supervisor is also likely to benefit from broader and more efficient resources (Draghi, 2018).

With this change in the institutional setting in mind, the main question we want to answer is the following: does centralised supervision, as opposed to country-level supervision, influence bank credit supply and risk-taking behaviour? Econometrically, the model specification that we use to answer this question is the following:

$$Loans_{b,f,t} = \alpha^{FE} + \delta BQ_{f,t-1} + \theta Sup_{b,t-1} + \lambda\left(BQ_{f,t-1} \times Sup_{b,t-1}\right) + \epsilon_{b,f,t} \quad (1)$$

The dependent variable ($Loans_{b,f,t}$) is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" at time "t". The explanatory variable $BQ_{f,t-1}$ is a measure of borrower quality constructed for each borrower as the ratio between credit exposures in arrears and total credit exposures. This measure ranges between zero – when firms have no arrears – and one – when all of the firm's exposures are in arrears.[9] In addition, the model also includes a variable that accounts for the level of supervision of each individual bank. More specifically, $Sup_{b,t}$ is a dummy variable that takes value 1 for banks directly supervised by the SSM ($bank\ b \in SSM$) after November 2014 and zero otherwise:

$$Sup_{b,t} = \begin{cases} 1 \ if\ b \in SSM\ and\ t \geq November\ 2014 \\ 0 \qquad\qquad\qquad \text{otherwise} \end{cases}$$

Moreover, the specification also includes an interaction term between the level of supervision and borrower quality $\left(BQ_{f,t-1} \times Sup_{b,t-1}\right)$. The main hypothesis we want to test is whether the risk-taking behaviour of banks is affected by the change in the allocation of responsibilities between national and supranational supervisors. If banks reduce credit supply to borrowers with lower credit quality once they become supervised by the SSM, then we expect a negative coefficient on the interaction term ($\lambda < 0$).

The empirical analysis uses an extensive set of fixed effects to control for possible confounding factors. In case they are not absorbed by other fixed effects, all specifications include country-time fixed effects, that account for all possible observed and unobserved heterogeneity due to country-specific factors. These comprise differences in the macro outlook, including demand conditions varying at country level, as well as other potential (time-varying) differences across countries. Bank or bank*time fixed effects control for time-invariant and time-varying unobserved bank-specific characteristics, respectively, e.g. business models or balance sheet characteristics (Jiménez et al., 2014).

A different set of fixed effects is used to identify whether a change in lending dynamics is driven by supply (bank-related) or demand (firm-related) factors. Firm or firm*time fixed effects control for firm-specific characteristics. Importantly, considering firm*time fixed effects translates into controlling for time-varying unobserved firm characteristics (including proxies for firm-level demand, growth opportunities and risk factors), thereby ensuring that the results capture bank (credit supply side) variation (see Khwaja and Mian, 2008). A possible caveat of including firm*time fixed effects is that this restricts the analysis to firms with multiple lending relationships. Figure 1 shows the share of borrowers with multiple lending relationships, ranging from 10 to just below 50%. Panel B of the

[9] An alternative is to construct a dummy variable that takes the value one if a firm has a least one exposure in arrears, and zero otherwise. Results do not change.

figure shows that in terms of credit volume the share of multiple lending relationships is significantly higher, ranging from around 40 to close to 90%. In order to capture also firms with single lending relationships, we also estimate specifications using sector*time – rather than firm*time – fixed effects to account for unobserved heterogeneity in demand and risk across sectors. The sectors of economic activity are grouped according to the 2-digit NACE2 industrial classification (i.e. we have 99 sectors).

[Insert Figure 1 here]

Finally, bank-firm fixed effects control for possible (time-invariant) non-random matching between lenders and borrowers. The inclusion of these fixed effects implies that our estimates are identified by the time variation in lending within a bank-firm relationship. An example for why these controls are important is that a bank's ex-ante assessment of the creditworthiness of a borrower may persistently differ from that of another bank: a bank might simply believe that a firm is relatively safe (or have private information on it) and thereby be more willing to lend to it. At the same time, a firm might have a persistent preference towards a specific bank. That is, these bank-firm fixed effects account for lending relationships (Freixas and Rochet, 2008).

Note that in our empirical model we exploit the change in the supervisory process from national to supranational, for treated versus non-treated banks (the latter remained supervised at the country level), and control also for bank*time fixed effects (in addition to the other fixed effects). Given that the key variable of interest is at the bank level, we cluster standard errors at bank level for the benchmark regressions.[10] The main results are reported in Table 2 and Table 3. The different set of fixed effects used in each specification is reported at the bottom of the table.

[Insert Table 2 and 3 here]

As Table 2 shows, the effect of centralised banking supervision ($Sup_{b,t-1}$) on credit supply is positive for firms without ex-ante defaults. Estimated effects are 11% higher credit supply volume in stressed countries, statistically significant with or without firm-time fixed effects, while in non-stressed countries estimated effects imply higher credit supply by 6% (though insignificant) with sector-time fixed effects and 15% (significant) with firm-time fixed effects). For the other variables, which are not absorbed by bank-time fixed effects, Table 2 (bank fixed effects) and Table 3 (bank-time fixed effects) show similar results.

In Table 3, we find that the estimated coefficient for the change in the sensitivity of bank credit to a deterioration in borrower quality (BQ) is negative and significant in all specifications. Moreover, the reduction in the supply of credit to ex-ante riskier firms is amplified after banking supervision becomes centralised (i.e., the interaction term shown in the table is negative). More in detail, the coefficients in columns 1 and 5 of Table 3 indicate that the centralisation of bank supervision leads to

[10] Results are robust to double clustering at bank and firm level.

a reduction in credit supply to a firm with maximum *ex-ante* risk by 43% in stressed countries and 36% in other countries. Note that this result compares firms with credit quality at opposite extremes. For a 1 standard deviation change in credit quality, the corresponding figures are close to 8% in stressed countries and 5% in other countries, respectively. These results are based on specifications which control for firm demand at the country*time and sector*time level, so that they include also firms with single lending relationships. In Columns 2 and 6 we instead control fully for unobserved heterogeneity at the firm*time level to better identify credit supply with heterogeneous results across country groups. For stressed countries, while the size of the coefficient on the interaction term (λ) is reduced compared to the previous specification, its magnitude and statistical significance remain high. Conversely, for non-stressed countries, the coefficient in this specification is not economically or statistically significant.[11]

Having established that centralised supervision leads to a decrease in credit supply to borrowers with lower credit quality, as proxied by worse credit history, we investigate whether the ex-post performance of loans is also better for centrally supervised banks. In practice, this amounts to substituting the ex-ante measure of borrower quality in equation (1), $BQ_{f,t-1}$, with the ex-post measure $BQ_{f,t+1}$. In this case, a negative sign of the interaction term $\left(BQ_{f,t+1} \times Sup_{b,t-1}\right)$ would indicate that centralised bank supervision results in a contraction in credit supply towards firms that turned out to default more ex-post. The results shown in columns 3 and 4 for banks operating in stressed counties and column 7 for banks operating in non-stressed countries support this hypothesis: the shift from local to supranational supervision leads banks to originate less credit supply towards firms with higher ex-post realised defaults.[12] Results for non-stressed countries are weaker and less robust, in particular when controlling for firm-time fixed effects (column 8). Overall, the results are very similar to ex-ante risk, suggesting that centralised supervision largely acts by reducing excessive forbearance and loan ever-greening rather than just the provision of credit to troubled firms with temporary liquidity problems.

While the reduction in risk-taking due to centralised banking supervision contributes to improve banks' resilience, its broader macroeconomic impact is not necessarily positive if riskier firms are also those contributing more to economic growth. It is therefore important to assess whether the change in the supervisory setting also leads to a decrease in credit supply to more productive firms. This is implemented in the specification shown in equation (2) below, where $Prod_{c,s,t}$ is a cost-adjusted measure of sectoral labour productivity for each sector in each country. A negative coefficient on the

[11] Our results do not change when we test for relevance of the differences in reporting thresholds across countries by estimating our model on a sample restricted to loan exposures above e.g. 350 thousand euro (results available upon request).

[12] Results are similar if we extend the horizon considered to identify ex-post defaults to 2 periods, which corresponds to 1 year (not reported).

interaction term $Prod_{c,s,t} \times Sup_{b,t-1}$ would imply that centralised supervision leads to a decrease in credit supply towards more productive firms.

$$Loans_{c,b,s,f,t} = \alpha^{FE} + \rho Prod_{c,s,t} + \theta Sup_{b,t-1} + \delta BQ_{f,t-1} + \lambda \left(BQ_{f,t-1} \times Sup_{b,t-1}\right) + \tau \left(BQ_{f,t-1} \times Prod_{c,s,t}\right) + \sigma \left(Prod_{c,s,t} \times Sup_{b,t-1}\right) + \Omega X_{b,f,t-1} + \epsilon_{c,b,s,f,t} \quad (2)$$

Table 4 confirms that centralised supervision reduces bank credit supply to ex-ante riskier borrowers $\left(BQ_{f,t-1} \times Sup_{b,t-1} < 0\right)$. Crucially, banks' preference to lend to more productive firms is not influenced by the centralisation of bank supervision $\left(Prod_{c,s,t} \times Sup_{b,t-1}\right)$ is not differently from 0). These results hold independently of whether banks operate in stressed or in non-stressed countries. Note that the estimated coefficients tend to be positive, though small and not statistically significant, therefore, if anything, providing weak evidence that centralised supervision might actually lead to an increase in credit supply to more productive firms.[13]

[Insert Table 4 here]

Moreover, there is an interesting interaction between credit performance and the productivity of the sector where firms operate. While on average banks extend less lending to borrowers with higher credit risk (BQ<0), this effect is mitigated when firms operate in a more productive sector $\left(BQ_{f,t-1} \times Prod_{c,s,t} > 0\right)$. In other words this result indicates that, for a given level of firm riskiness, banks tend to extend more credit to those operating in higher value added sectors. This difference is relevant not only statistically but also economically. For the same level of risk, the lending to a firm operating in a sector with a level of productivity that is 1 standard deviation above the mean is found to increase by 5%.

3.2 Robustness

In the wake of the financial crisis there has been a thorough revision of the regulatory framework for banking supervision. This is not a major concern for our results as the bulk of regulatory changes apply to all banks and not only to those who then became centrally supervised. In any case, since the actual implementation of such changes was (and to some extent is still being) gradually phased in, it partially overlaps with the process of institutional change that resulted in the establishment of centralised supervision in the euro area. Moreover, while the centralised supervisory authority became fully operational in November 2014, banks learned that they would become centrally supervised in October 2013, when the SSM Regulation was published. Since these factors could have already

[13] These results do not depend on the particular measure of productivity that we use (not reported).

influenced bank behaviour, we further investigate the exact timing of the change in the risk-taking behaviour of centrally supervised banks. More specifically, we estimate equation (1) for alternative timings of the effective start of centralised bank supervision, thereby defining $Sup_{b,t}$ as follows:

$$Sup_{b,t} = \begin{cases} 1 & \forall\, t \geq 2013H1, \ldots., 2015H1 \\ 0 & \text{otherwise} \end{cases}$$

Figure 2 reports the estimated coefficients for the interaction terms $BQ_{f,t-1} \times Sup_{b,t}$ estimated for the different periods based on a specification that includes the same fixed effects as in column 2 of Table 3. The chart documents the results for stressed countries since the coefficient of interest is not statistically (or economically) significant in the same specification for non-stressed countries. Results show that banks operating in stressed countries significantly reduced their credit supply towards firms with higher ex-ante credit risk (proxied by credit delinquencies) since 2014Q4. Importantly, the estimated coefficient for the impact of supervision on risk-taking ($BQ \times Sup$) up to 2014H1 is not significant in statistical or economic terms (though in the case of 2014:H1 there is a reduction in lending but not statistically significant). Differently, results are significant since the operationalisation of centralised supervision in 2014H2.

[Insert Figure 2 here]

Our main results consider all credit commitments by banks therefore including both drawn and undrawn credit (e.g. undrawn credit lines) in order to fully capture lending decision by banks. However, one might wonder whether results would change in case only actually drawn credit is considered, i.e. the volume of loans outstanding. Table A.2 in the appendix shows that, although the main results would not qualitatively change, the size of the coefficient is reduced thereby highlighting the importance of taking into account the full volume of committed lending. Again, results are stronger for banks in stressed countries.

As discussed above, bank size is one of the main criteria used to define the set of institutions subject to centralised supervision. We therefore define a further robustness exercise where we focus the analysis on a subset of banks which, despite limited size heterogeneity, are assigned to different supervisory authorities. This subset includes the 3 largest locally supervised banks and the 3 smallest centrally supervised ones for each country. The choice of 3 banks is motivated by the fact that the regulation defines this as the minimum number of centrally supervised banks in each country. The results of this exercise are shown in columns 1-4 of Table 5. Results are strong and again significant for the stressed countries only.

[Insert Table 5 here]

Despite the broad range of controls used in the analysis, a potential source of concern for our conclusion is that results might not be driven by the introduction of centralised supervision but rather

by some correlated unobserved characteristics in the cross-section *and* the time dimension. If this were the case, one would expect to find the same results for banks with similar characteristics observed over the same time period but not subject to the centralisation of bank supervision. We therefore present a placebo test replicating the analysis shown in Table 3 for banks operating in European countries where bank supervision remained local (Romania and Czech Republic). Applying the criteria described above, we identify three banks in each of these countries which would be centrally supervised if the country were part of the SSM. Results reported in Table 5, column 5 and 6, show that there are no significant differences in behaviour between this set of banks and that which would anyway have remained locally supervised. In fact, the estimated coefficients for banks in EU but not euro area have the opposite sign as the euro area banks though not statistically significant. In other words, banks operating in non-euro area countries did not experience any change in their risk-taking behaviour around the time when centralised supervision was introduced in the euro area.

Finally, in Table 6 we analyse whether there is supervisory arbitrage, i.e. banks that continue being supervised only by local supervisors increase risk-taking, offsetting the reduction of credit supply to higher risk firms by centrally supervised banks. To do this we analyse *firm level credit* (from all banks), as a complement to the results on *bank-firm (loan) level* data. In this analysis, the variable $Sup_{f,t-1}$ is the share of each firm's loans that is provided by banks supervised at the supranational level in the previous period. As we can see from Table 6, the key estimated coefficients for the two variables are negative and (economically and statistically) significant, thereby suggesting no supervisory arbitrage by banks not directly supervised by the ECB. In fact, some coefficients are larger in absolute value, thereby indicating that when ECB supervised banks cut credit supply to high credit risk firms after 2014:H2, locally supervised banks complement (rather than substitute) this cut, especially for firms with ex-ante defaults (columns 1, 2, 5, 6), and to a smaller extent for the ones with ex-post defaults (columns 3, 4, 7, 8).

[Insert Table 6 here]

3.3 The mechanisms

Having established that centralised banking supervision leads to a reduction in high credit risk taking (without curtailing credit supply to more productive firms and even supporting credit supply to firms without delinquencies), we exploit the mechanisms underlying our main results. First, we investigate why results are more relevant for stressed countries. Second, we assess the role of banks' systemic relevance versus the one of national supervisors being more prone to regulatory capture by locally relevant banks.

Cross-country heterogeneity could be driven by structural differences in the quality of institutions or by more cyclical differences in the exposure to (financial) crisis episodes. On the one hand, the benefits of centralised supervision may be more relevant for countries with weaker institutions (see

e.g. Epstein and O'Halloran, 1999; Acemoglu, Johnson, and Robinson, 2005). On the other hand, exposure to crises can also play a relevant role, as it weakens the financial position of banks and borrowers, increasing incentives for forbearance by local supervisors (see e.g. Freixas and Rochet, 2008; Carletti et al., 2016; Repullo, 2017).

We test these hypotheses using the following specification:

$$\begin{aligned} Loans_{b,s,t} = \alpha^{FE} &+ \beta_1\left(BQ_{c,s,t-1} \times Sup_{b,t-1} \times CDS_{c,t-1}\right) \\ &+ \beta_2\left(BQ_{c,s,t-1} \times Sup_{b,t-1} \times Institutional\ Quality_{b,t_0}\right) \\ &+ \Omega X_{b,s,t-1} + \epsilon_{b,s,t} \end{aligned} \tag{3}$$

To exploit the variation of *all countries*, the model encompasses all euro area countries available in the dataset. Moreover, since the main variables of interest in this exercise are at the country level and differences in reporting thresholds (e.g. Germany 1 million euros and Spain 6,000 euros) affect the number of firms of each country if we run all countries in the same regression, we run the regressions on a dataset aggregated at bank(country)-sector-time level. In the specification above, exposure to financial crises is proxied by each country's sovereign CDS spread. Institutional quality is instead proxied by the World Bank's Worldwide Governance Indicators and evaluated before the start of the sample in order to avoid endogeneity concerns (e.g. the new supervisor affecting the country overall institutional quality).[14] The vector X contains all lower level interactions among $\mathrm{BQ}_{\mathrm{f,t-1}}, \mathrm{Sup}_{\mathrm{b,t-1}}$, $CDS_{c,t-1}$ and $Institutional\ Quality_{b,t_0}$; α^{FE} is a vector of fixed effects for each pair country*time, bank*time and sector*time.

The results of the exercise are shown in Table 7. The first column shows that the main result presented in the previous sections – that centralised bank supervision reduces bank credit risk taking – holds also when estimating the model for all countries together and when aggregating the dataset at the bank(country)-sector-time level.

In columns 2-4 we investigate the role of each variable individually before including both in the same regression (columns 5 and 6). Ideally the second approach is more informative, as it isolates the impact of CDS *conditional* on institutional quality and *vice versa*. However, for transparency we show also the simpler models in order to address concerns about multicollinearity, as the variables are correlated (with a coefficient of correlation close to -0.5).

We use two alternative definitions of CDS. Columns (2) and (5) show the impact of the CDS spread before the start of the sample (CDS_{t_0}), easing concerns about potential endogeneity whereby centralised supervision could contribute to a reduction in sovereign risk. This could be explained by

[14] The measure of institutional quality is defined as the mean across the six dimensions of governance available: voice and accountability, regulatory quality, political stability and absence of violence, rule of law, government effectiveness and control of corruption. In turn, the measure used for each of these indicators is the percentile rank among all countries, ranging from 0 to 100. See https://info.worldbank.org/governance/wgi/.

lowering the risk of the banking system and thereby decreasing the state's implicit liabilities either due do expectations of bank bailouts or more generally decreased the probability of financial crises. Columns (3) and (6) use a time-varying measure of the CDS spread (CDS_{t-1}), allowing the model to capture the cyclical dimension of this variable.

[Insert Table 7 here]

Overall, we find that the CDS spread is in general not significant, so the results suggest that the exposure to crisis episodes is not a key driver of the cross-country heterogeneity. The measure of institutional quality, on the other hand, is both statistically and economically significant in all specifications (either alone or when we include CDS interactions). Centralised bank supervision decreases the supply of credit to high credit risky firms by 13% for a one standard deviation decrease in institutional quality.[15] In other words, the results suggest that centralised supervision reduces high credit risk-taking especially for banks operating in jurisdictions with weak institutional quality, rather than for countries suffering a financial crisis.

The second mechanism relates to the different incentive structures associated to each institutional setting (centralised vs local supervision). We study two competing hypothesis.

According to the first hypothesis, supranational supervisors are less likely to be captured by banks – the *capture hypothesis*. The incentive structure of local supervisors might induce a more lenient attitude toward bank risk-taking, and this is likely to be less relevant for a supranational supervisor (Agarwal et al., 2014, Carletti, Dell'Ariccia and Marquez, 2016; Repullo 2017). More generally, new institutions may promote better economic outcomes via different incentives (e.g. King and Levine, 1993; Hall and Jones, 1999; and Acemoglu, Johnson, and Robinson, 2001 and 2005). At the same time, local supervisors might have superior information on banks' loan portfolios, including whether borrowers appear weak due to temporary liquidity constraints (ex-ante but not ex-post credit problems) or are indeed insolvent (generalized the ideas from Hayek (1945)).

According to the second hypothesis, centralised supervisors might be more effective in reducing bank excessive risk-taking due to their incentives to internalise potential externalities, which are particularly relevant for systemic banks – the *systemic hypothesis*. Local supervisors are more likely to focus on domestic costs and benefits, but excessive risk taking by systemic banks can have important consequences abroad (see e.g. Beck et al. 2013 and Calzolari et al. 2019). The potential for such externalities is particularly relevant for very large banks. At the same time, the largest bank in each country is not necessarily systemic for the euro area as a whole, reflecting on different incentives for a local versus a supranational supervisor. Therefore, by exploiting different measures of bank size, as

[15] Results are broadly unchanged if instead of the broad measure of institutional quality we take a narrower measure including only indicators related to regulatory quality (not reported).

we have explained earlier in the paper and we discuss further below, we can disentangle the different mechanisms.

The specification used to test these hypotheses takes the following form:

$$\begin{aligned} Loans_{b,s,f,t} = \alpha^{FE} &+ \beta_1\left(NPL_{b,t-1} \times BQ_{f,t-1} \times Sup_{b,t-1}\right) \\ &+ \beta_2\left(Size_{b,s,t-1} \times BQ_{f,t-1} \times Sup_{b,t-1}\right) \\ &+ \beta_3\left(Large_b \times BQ_{f,t-1} \times Sup_{b,t-1}\right) + \Omega X_{b,f,t-1} + \epsilon_{b,s,f,t} \end{aligned} \quad (4)$$

Where bank size is proxied by the market share of the bank in each sector ($\text{Size}_{\text{b,s,t}-1}$) and possible non-linearities for very large banks are captured by a dummy variable (Large_{b}), which takes value 1 if the total assets of the bank are larger than Euro 500bn, i.e. about the size of Lehman Brothers when it collapsed in September 2008. Banks' non-performing loan ratio ($\text{NPL}_{\text{b,t}-1}$) is the volume of non-performing loans granted as a share of total lending for bank "b" at time "t-1". Notice that the vector X contains all lower level interactions among $\text{NPL}_{\text{b,t}-1}$, $\text{BQ}_{\text{f,t}-1}$, $\text{Sup}_{\text{b,t}-1}$, $\text{Size}_{\text{b,s,t}-1}$ and Large_{b}. Moreover, we estimate the same specification for alternative definitions of the variable Large_{b} in Table 9.

The estimates in Table 8 show that the impact of centralised bank supervision on risk-taking does not depend on bank NPL or the continuous measure of bank size. Importantly, the reduction in risk taking due to centralised bank supervision is substantially stronger for the very large banks (most notably in stressed countries if we include firm-time fixed effects).[16]

[Insert Table 8 here]

We assess the robustness of these findings by estimating the same model using alternative definitions of "Large", including banks with total assets exceeding Euro 200bn, 300bn, 400bn, and 500bn (results above this threshold are very similar). Moreover, we dig deeper into the mechanism that drives the results by assessing the role played by the largest bank in each country. Table 9 reports the estimated coefficients of the triple interaction BQ*Sup*Large for stressed countries under these different definitions of the variable "Large" (in two different subsamples), based on a total of 20 different regressions. That is, each number corresponds to an estimated coefficient in a different regression with a different measure of large bank; moreover, results in the first two columns are obtained using the entire sample whereas those in the last two columns use a restricted sample including only the same number of centrally and locally supervised banks.

The coefficient of interest does not change substantially for alternative definitions of very large banks in absolute terms, implying that the results in Table 8 are not driven by the exact definition used

[16] Notice that the table clearly shows a robust result on a positive association between weak banks (the ones with higher NPL) and weak borrowers (the one with worse credit history), as identified by the positive coefficient on *NPL*BQ*. For the influence of non-performing loans on bank lending decisions, see Altavilla et al. (2019).

to identify very large banks, though results suggest non-linearity effects.[17] As shown in Table 9, significant differences in behaviour are not found for banks with total assets higher than 200 billion euros (the estimated coefficient is half of the one in Table 8), but they are robust for total assets higher than 300, 400 or 500 billion, all with similar estimated coefficients. However, results are strikingly different when we focus on the largest bank in each country, as all the coefficients for the variable "Largest bank in country" are very small and not statistically significant. Note that the largest bank in a small country would be supervised by the ECB after the supervision reform, but we do not find a decrease in risk-taking by these banks after the institutional reform, which suggests that these banks were not having a special treatment when they were only supervised by local supervisors. Differently, for the largest banks in the euro area (over 300 billion euros), there is a reduction in credit risk taking after the supranational supervision.

[Insert Table 9]

Overall, results in Table 8 and 9 provide information on the relative importance of the two competing hypotheses outlined above. The estimates show that there is limited support for the *capture hypothesis* since the centralisation of banking supervision does not increase the risk sensitivity of credit supply for weaker banks (as proxied by higher NPL ratios), or a continuous measure of bank size, or for banks that are just very large for the local supervisor but not necessarily for the central supervisor (largest bank in each country). At the same time, the results provide support for the *systemic hypothesis*, since the reduction in risk taking due to centralised bank supervision is particularly significant for the very large banks, most notably in stressed countries (banks larger than 300, 400, 500 billion or beyond). These last results are centred on large banks, so the mechanism at work is for banks in the tail; however, as shown earlier in this subsection, for the average bank, the mechanism at work is consistent with the supranational institution reducing excessive risk-taking to a greater extent for banks operating in a country with weaker (overall or regulatory) institutions.

3.4 Banking supervision and monetary policy interactions

In this subsection we analyse how banking supervision interacts with monetary policy in affecting bank credit supply, including risk-taking. In particular, the question we address is whether banks shift their credit supply to ex-ante riskier borrowers following periods of monetary policy accommodation, and how these effects interact with different institutional designs of banking supervision.[18]

[17] For the results on non-stressed countries (see Table A.3), results are again significant when we do not include firm-time fixed effects. Moreover, results are not economically and statistically significant for the largest bank in non-stressed countries, similarly as in stressed countries.

[18] For the risk-taking channel of monetary policy, see Adrian and Shin (2010); also Jiménez, Ongena, Peydró and Saurina (2014), and the references therein. For monetary policy rates and bank risk-taking, see also Diamond and Rajan (2012). For the bank lending channel, see e.g. Kashyap and Stein (2000). See also the Introduction.

Measuring the effects of monetary policy shocks in an environment where the central bank has announced and implemented both conventional and unconventional policies poses special challenges. This is because we cannot rely on a single interest rate to proxy the amount of policy accommodation provided by the monetary authority. In fact, while conventional monetary policy moves the front end of the yield curve, unconventional measures might exert a larger impact on longer maturities (Altavilla et al., 2019).

Therefore, to fully capture the amount of policy accommodation provided by the central bank we proceed as follows. We construct a variable, $Shock^{MP}$, that measures the principal component of all monetary policy surprises from high-frequency intraday data on risk-free (overnight index swap, OIS) rates with different maturities, ranging from 1 month to 10 years. These surprises are calculated by measuring changes in risk free rates in a narrow time window around official monetary policy communications.[19] More precisely, for each Governing Council meeting, we first measure the realised policy surprise as the principal component of interest rate changes from 15 minutes before the press release to 15 minutes after the press conference, and then we cumulate them to match the frequency of the credit registers.

Figure 3 shows the indicator of policy surprises obtained, where positive (negative) numbers indicate a monetary policy tightening (easing). Although the measure fluctuates around zero, events associated with important policy announcement are clearly visible: the introduction of forward guidance in July 2013, the introduction of negative rates in June 2014, the allotment of the first targeted longer-term refinancing operations (TLTRO) in September 2014 and the announcement of the expanded asset purchase programme (APP) in January 2015 are all instances where the negative values of the surprise indicator correctly point to events associate with substantial monetary policy accommodation. There are also many tightening shocks as Figure 3 shows.

[Insert Figure 3 here]

We use this variable to study whether monetary policy easing has an amplification effect on the credit risk-taking behaviour of European banks, and whether centralised banking supervision affects this relationship. The model specification takes the following form:

$$\begin{aligned} Loans_{b,s,f,t} = {} & \alpha^{FE} + \delta BQ_{f,t-1} + \theta Sup_{b,t-1} + \lambda\left(BQ_{f,t-1} \times Sup_{b,t-1}\right) + \mu Shock_{t-1}^{MP} \\ & + \psi\left(Shock_{t-1}^{MP} \times BQ_{f,t-1}\right) + \phi\left(Shock_{t-1}^{MP} \times Sup_{b,t-1}\right) \\ & + \eta\left(Shock_{t-1}^{MP} \times BQ_{f,t-1} \times Sup_{b,t-1}\right) + \Omega X_{b,f,t-1} + \epsilon_{b,s,f,t} \end{aligned} \quad (5)$$

Where $X_{b,f,t-1}$ includes all remaining double and triple interactions. The above model can be used to test whether monetary policy easing increases credit supply towards riskier firms ($\psi < 0$) and

[19] The surprises are from the Euro Area Monetary Policy Event-Study Database (EA-MPD) developed by Altavilla et al. (2019).

whether centralised supervision offset this effect ($\eta > 0$). In other words, monetary accommodation might lead to a relative increase in risk-taking that can however be mitigated or fully offset by centralised supervision. Finally, we assess whether the relationship between risk-taking and the monetary policy stance differs across banks, analogously to that between risk-taking and centralised supervision.

Table 10 reports the results for the different specifications varying according to the set of fixed effects introduced in the model as done in the previous tables. The first two rows of the table confirm the two main results obtained in Table 3. First, in both stressed and non-stressed countries bank lending is sensitive to borrower credit risk ($\delta < 0$). Second, centralised supervision reduces the credit supply to high credit risk firms (i.e., increases this sensitivity), especially in stressed countries ($\lambda < 0$).

[Insert Table 10 here]

Moreover, the results also show that, following monetary policy easing, banks increase their credit supply towards firms with very high ex-ante credit risk ($\psi < 0$). This result is in line with the presence of a risk-taking channel of monetary policy. Moreover, this effect is offset by centralised supervision ($\eta > 0$). However, there is no reduction in credit supply for more productive firms (Table A.4). Our previous results, indicating that centralised supervision curtails high credit risk-taking (consistent with loan ever-greening) without reducing lending towards more productive firms, suggest that the two policies do not conflict but rather complement each other.

The final exercise is motivated by our previous finding that centralised banking supervision has a greater influence on the risk sensitivity of systemically important banks (*systemic hypothesis*). We augment the model in equation 4 in order to investigate if also the interaction between bank supervision and monetary policy is different for *Large* banks. Results are reported in Table 11.

[Insert Table 11 here]

Although differing in terms of size of the estimated coefficients, the results for stressed and non-stressed countries appear to be qualitatively similar. As above, independently of where a bank operates, monetary policy easing tends to increase risk-taking, as banks supply more credit to very risky borrowers, and centralised banking supervision compresses this monetary policy induced risk-taking. The introduction of the non-linear term for bank size plays a significant role and sheds further light on the heterogeneous transmission of monetary policy across banks. Also for this set of banks, centralised supervision tends to compress the credit supply originated toward very risky borrowers, i.e. $\left(Large_b \times BQ_{f,t-1} \times Sup_{b,t-1}\right) < 0$. Importantly, while the risk-taking channel of monetary policy is stronger for largest banks $\left(Large_b \times BQ_{f,t-1} \times Shock_{t-1}^{MP}\right) < 0$, centralised supervision is again able to compress this high level of risk-taking, $\left(Large_b \times BQ_{f,t-1} \times Shock_{t-1}^{MP} \times Sup_{b,t-1}\right) > 0$, thereby

confirming the role of supervision in complementing monetary policy in particular for the very large banks.

4 Conclusions

The financial crisis highlighted the limitations of the prevailing supervisory framework in preventing excessive risk-taking and ensuring the resilience of the banking system to large adverse shocks. This fostered a debate on changes to the institutional setting, including the potential benefits of supranational supervision.

In this paper we analyse the effects of national *versus* supranational banking supervision on bank risk-taking behaviour, and its interactions with monetary policy. For empirical identification, we exploit: (i) a new, proprietary dataset based on 15 European credit registers; (ii) the institutional change in European banking supervision; (iii) high-frequency monetary policy surprises; (iv) differences across euro area countries, also vis-à-vis non-euro area countries.

We establish two main results. First, supranational supervision reduces credit supply to firms with very high ex-ante and ex-post credit risk, while stimulating credit supply to firms without loan delinquencies. The economic relevance and statistical significance of these results is higher for banks operating in stressed countries. We find that our results are driven by two mechanisms: the quality of the institutions of the country where banks operate, and the systemic importance of banks. The second result is that there are important complementarities between monetary policy and supervision. Centralised supervision offsets high credit risk-taking induced by a more accommodative monetary policy. However, it does not offset lending to more productive firms. Overall, we show that using multiple credit registers – first time in the literature – is crucial for external validity.

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Table 1: Descriptive statistics

	Stressed Countries			Non-Stressed Countries		
	Mean	**St.Dev.**	**# obs.**	**Mean**	**St.Dev.**	**# obs.**
Loan volume (Loans)	516	12,078	48,507,843	1,716	15,649	8,526,222
Borrower Quality (BQ)	0.05	0.19	45,828,620	0.03	0.16	7,396,700
Centralised Supervision (Sup)	0.34	0.47	48,507,843	0.50	0.50	8,526,222
NPL ratio (NPL)	0.20	0.10	48,507,843	0.05	0.04	8,526,222
Size	5.35	6.22	48,507,691	15.13	11.41	8,526,194
Large	0.16	0.36	48,507,843	0.07	0.26	8,526,222
Productivity (Prod)	217.71	183.91	40,171,006	240.69	173.54	6,496,651
Monetary Policy Shock ($Shock^{MP}$)	-1.04	4.22	48,507,843	-1.15	4.25	8,526,222
Sovereign CDS spread (CDS)	227.37	163.23	48,501,648	62.14	56.56	8,525,908
Institutional Quality (InstQ)	71.39	4.71	48,501,648	87.22	4.27	8,525,908

Note: The table reports the descriptive statistics for the main variables used in the empirical analysis. The abbreviations used in equations and regression tables are shown in parenthesis. Loan volume is the total amount of drawn and undrawn credit at the bank-borrower-time level in thousands of euros. Borrower quality indicates, for each borrower, the ratio between exposures in arrears and total exposures. Centralised supervision is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. Monetary policy shock is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. Productivity is defined as the ratio between labour productivity (measured as the ratio of value added over number of employees) and average personnel costs at the country-sector-time level. Size is the market share of the bank in each sector in each period. Large is a dummy variable that takes value 1 if the total assets of the bank are larger than Euro 500bn. The NPL ratio measures for each bank and time period the share of non-performing exposure to total exposure.

Table 2: Supervision, bank credit supply and risk-taking

	Stressed Countries		Non Stressed Countries	
	(1)	(2)	(3)	(4)
$Sup_{b,t-1}$	0.110*	0.110*	0.0578	0.155**
	(0.0616)	(0.0642)	(0.0652)	(0.0698)
$BQ_{f,t-1}$	-0.0450	-	-0.0997**	-
	(0.0456)		(0.0439)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.447***	-0.358***	-0.446***	-0.272***
	(0.0673)	(0.104)	(0.112)	(0.0963)
N	39,820,155	29,866,102	6,263,603	2,916,268
R-squared	0.682	0.751	0.830	0.859
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (Borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. Sup (Centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. Data are at semi-annual for the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank and firm level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 3: Banking supervision and risk-taking

	Stressed Countries				Non-Stressed Countries			
	i = -1		i = 1		i = -1		i = 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t+i}$	-0.246*	-	-0.135***	-	-0.185***	-	-0.0510*	
	(0.0245)		(0.0488)		(0.0424)		(0.0278)	
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.434***	-0.268***	-0.440***	-0.200**	-0.363***	-0.0450	-0.255***	0.101
	(0.0666)	(0.0954)	(0.0598)	(0.0872)	(0.108)	(0.0980)	(0.0571)	(0.0937)
N	40,626,537	30,703,723	41,181,446	31,393,573	6,879,163	3,672,419	6,866,876	3,672,058
R-squared	0.704	0.771	0.707	0.772	0.815	0.845	0.826	0.846
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	Y	N	Y	N	Y	N	Y
Sector*Time	Y	-	Y	-	Y	-	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (Borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. In columns 1, 2, 5, and 6, i=-1 indicates that the regression includes an ex-ante measure of borrower quality ($BQ_{f,t-1}$) while in columns 3, 4, 7, and 8, i=1 indicates that the regression includes an ex-post measure of borrower quality ($BQ_{f,t+1}$). Sup (Centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. Data are at semi-annual for the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 4: Bank supervision and productivity

	Stressed countries				Non-Stressed Countries			
	i = -1		i = 1		i = -1		i = 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t+i}$	-0.0756*		-0.174***		-0.146***		-0.0563*	
	(0.0401)		(0.0557)		(0.0443)		(0.0253)	
$BQ_{f,t+i}$ x $Sup_{b,t+1}$	-0.429***	-0.285***	-0.448***	-0.202**	-0.394***	-0.00276	-0.256***	0.0386
	(0.0659)	(0.0942)	(0.0651)	(0.0899)	(0.112)	(0.120)	(0.0513)	(0.0972)
$Prod_{s,t+i}$	-0.213***		-0.251***		0.349***		-0.100	
	(0.0408)		(0.0445)		(0.104)		(0.0994)	
$BQ_{f,t+i}$ x $Prod_{s,t+i}$	0.288***		0.0995**		0.246**		0.399***	
	(0.0812)		(0.0414)		(0.107)		(0.0812)	
$Prod_{s,t+i}$ x $Sup_{b,t-1}$	0.0426	-0.0115	0.0546	0.0113	-0.0220	0.176	0.116**	0.189
	(0.0383)	(0.0351)	(0.0381)	(0.0392)	(0.0635)	(0.140)	(0.0580)	(0.151)
N	37,753,379	28,374,474	32,123,122	24,285,787	5,750,158	2,713,259	4,676,219	2,182,565
R-squared	0.714	0.779	0.728	0.789	0.835	0.867	0.855	0.873
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	Y	N	Y	N	Y	N	Y
Sector*Time	Y	-	Y	-	Y	-	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. Sup (centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. Prod (productivity) is defined as the ratio between labour productivity (measured as the ratio of value added over number of employees) and average personnel costs at the country-sector-time level. Data are at semi-annual for the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 5: Robustness: restricted sample for euro area banks (6 banks per country) and placebo test based on non-euro area countries and banks

	Stressed Countries		Non-Stressed Countries		EU non EA	
	i = -1	i = 1	i = -1	i = 1	i = -1	i = 1
	(1)	(2)	(3)	(4)	(5)	(6)
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.338**	-0.167*	-0.000281	-0.0618	0.361	0.385
	(0.155)	(0.088)	(0.194)	(0.151)	(0.250)	(0.217)
N	1,474,985	1,533,704	227,494	225,952	349,429	319,001
R-squared	0.857	0.861	0.871	0.868	0.826	0.829
Fixed effects						
Bank*Firm	Y	Y	Y	Y	Y	Y
Firm*Time	Y	Y	Y	Y	Y	Y
Bank*Time	Y	Y	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (Borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. . In columns 1, 3, and 5, *i=-1* indicates that the regression includes an ex-ante measure of borrower quality ($BQ_{f,t-1}$) while in columns 2, 4, and 6, *i=1* indicates that the regression includes an ex-post measure of borrower quality ($BQ_{f,t+1}$). Sup (Centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. EU non EA includes Romania and Czech Republic that are in the European Union (EU) but not in the euro area (EA). Data are at semi-annual frequency covering the period 2012H1 – 2017H2 and, for each country, the sample includes the 3 smallest centrally supervised banks and the 3 largest non-centrally supervised banks. For EU non EA countries, centrally supervised banks are defined fictitiously based on the SSM significance criteria. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 6: Banking supervision and risk-taking: arbitrage from locally supervised banks?

	Stressed Countries				Non-Stressed Countries			
	i = -1		i = 1		i = -1		i = 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t+i}$	-0.171***	-0.169***	-0.0368***	-0.0353***	-0.0901***	-0.117***	-0.0453***	-0.0458***
	(0.00325)	(0.00324)	(0.00327)	(0.00324)	(0.0112)	(0.0110)	(0.00988)	(0.00972)
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.548***	-0.519***	-0.233***	-0.214***	-0.849***	-0.703***	-0.212***	-0.213***
	(0.00399)	(0.00401)	(0.00322)	(0.00324)	(0.0140)	(0.0139)	(0.0105)	(0.0107)
N	22,684,097	22,684,097	22,684,097	22,684,096	8,136,177	8,136,174	8,136,177	8,136,176
R-squared	0.806	0.807	0.832	0.834	0.812	0.813	0.768	0.771
Fixed effects								
Country*Time (ct)	Y	Y	Y	Y	Y	Y	Y	Y
Firm (f)	Y	Y	Y	Y	Y	Y	Y	Y
Sector*Time (st)	N	Y	N	Y	N	Y	N	Y

Note: The dependent variable is the firm-level (log-)credit granted (drawn and undrawn) to firm "f" operating in sector "s" at time "t" by *all* banks "b". BQ (Borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. In columns 1, 2, 5, and 6, i=-1 indicates that the regression includes an ex-ante measure of borrower quality ($BQ_{f,t-1}$) while in columns 3, 4, 7, and 8, i=1 indicates that the regression includes an ex-post measure of borrower quality ($BQ_{f,t+1}$). Sup (Centralised supervision) is the share of each firm's loans which is provided by banks supervised at supranational level (i.e. directly by the ECB) after November 2014. Data are at semi-annual for the period 2012H1 – 2017H2. "Y" and "N" imply that fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 7: (Structural) Institutional quality *vs.* (cyclical) exposure to crisis hypotheses

	Baseline	CDS_0	CDS_{t-1}	Institutional quality	Institutional quality	
					CDS_0	CDS_{t-1}
	(1)	(2)	(3)	(4)	(5)	(6)
$BQ_{c,s,t-1}$	-0.499***	-0.466***	-0.521***	-0.577***	-0.491***	-0.491***
	(0.0300)	(0.0286)	(0.0309)	(0.0464)	(0.0659)	(0.0513)
$BQ_{c,s,t-1}$ x $Sup_{b,t-1}$	-1.070***	-1.298***	-1.756***	-2.070***	-2.178***	-1.828***
	(0.247)	(0.331)	(0.613)	(0.510)	(0.507)	(0.515)
$BQ_{c,s,t-1}$ x $CDS_{c,i}$		-0.000389***	-0.00123***		0.000244	-0.000869**
		(0.0000689)	(0.000221)		(0.000253)	(0.000377)
$BQ_{c,s,t-1}$ x $InstQ_{c,2011}$				0.0109***	-0.0321***	-0.0182***
				(0.00364)	(0.00798)	(0.00621)
$BQ_{c,s,t-1}$ x $Sup_{b,t-1}$ x $CDS_{c,i}$		-0.000655	-0.00514		0.00165**	0.00649
		(0.000827)	(0.00424)		(0.000811)	(0.00424)
$BQ_{c,s,t-1}$ x $Sup_{b,t-1}$ x $InstQ_{c,2011}$				0.0928***	0.128***	0.131***
				(0.0344)	(0.0414)	(0.0440)
$BQ_{i,s,t-1}$ x $InstQ_{c,2011}$ x $CDS_{c,i}$					-0.000153***	-0.000146***
					(0.0000467)	(0.0000531)
N	639,713	639,713	639,713	639,713	639,713	639,713
R-squared	0.710	0.710	0.710	0.710	0.710	0.710
Fixed effects						
Country*Time	Y	Y	Y	Y	Y	Y
Bank*Time	Y	Y	Y	Y	Y	Y
Sector*Time	Y	Y	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firms in sector "s" at time "t". BQ (borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. Sup (centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. CDS is each country's sovereign spread. InstQ is Institutional Quality, proxied by the World Bank's Worldwide Governance Indicators. Data are at semi-annual covering the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 8: Systemic banks *versus* local capture hypotheses

	Stressed Countries				Non-Stressed Countries			
	i = -1		i = 1		i = -1		i = 1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t+i}$	-0.171***	-	-0.173***	-	-0.194***	-	-0.184***	-
	(0.0402)		(0.0479)		(0.0460)		(0.0360)	
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.365***	-0.218**	-0.400***	-0.197***	-0.282***	-0.0276	-0.219***	0.0724
	(0.0506)	(0.0903)	(0.0516)	(0.0754)	(0.0987)	(0.135)	(0.0592)	(0.101)
$NPL_{b,t-1}$ x $BQ_{f,t+i}$	1.932***	2.106***	1.299***	1.670***	1.441***	2.244***	1.460***	2.054**
	(0.333)	(0.496)	(0.401)	(0.427)	(0.468)	(0.859)	(0.385)	(0.811)
$NPL_{b,t-1}$ x $BQ_{f,t+i}$ x $Sup_{b,t-1}$	1.17	1.031	0.97	0.308	-0.492	0.471	0.856	1.287
	(0.956)	(0.916)	(0.783)	(0.811)	(0.772)	(1.552)	(0.546)	(1.106)
$Size_{b,s,t-1}$ x $BQ_{f,t+i}$	0.000203	-0.00448	0.0006	-0.00234	0.00197	0.00268	-0.00148	-0.000256
	(0.00354)	(0.00516)	(0.00389)	(0.00394)	(0.00300)	(0.00623)	(0.00272)	(0.00508)
$Size_{b,s,t-1}$ x $BQ_{f,t+i}$ x $Sup_{b,t-1}$	0.00421	-0.000585	0.00478	-0.000975	0.00700	-0.00531	-0.00402	-0.0122**
	(0.00470)	(0.00833)	(0.00487)	(0.00745)	(0.00459)	(0.00757)	(0.00320)	(0.00531)
$Large_b$ x $BQ_{f,t+i}$	0.358***	0.305*	0.503***	0.398**	0.327***	0.0132	0.648***	-0.342
	(0.0944)	(0.178)	(0.165)	(0.171)	(0.0979)	(0.346)	(0.0385)	(0.221)
$Large_b$ x $BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.470**	-0.319*	-0.404**	-0.219*	-0.824***	-0.0537	-0.367***	0.152
	(0.207)	(0.190)	(0.182)	(0.126)	(0.160)	(0.469)	(0.0938)	(0.305)
N	39,811,038	29,856,793	36,120,663	27,285,698	6,262,908	2,915,490	5,642,723	2,641,856
R-squared	0.705	0.773	0.716	0.780	0.835	0.866	0.851	0.869
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	Y	N	Y	N	Y	N	Y
Sector*Time	Y	-	Y	-	Y	-	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. In columns 1, 2, 5, and 6, *i=-1* indicates that the regression includes an ex-ante measure of borrower quality ($BQ_{f,t-1}$) while in columns 3, 4, 7, and 8, *i=1* indicates that the regression includes an ex-post measure of borrower quality ($BQ_{f,t+1}$). Sup (centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. Size is the market share of the bank in each sector in each period. Large is a dummy variable that takes value 1 if the total assets of the bank are larger than Euro 500bn. The NPL ratio measures for each bank and time period the share of non-performing exposure to total exposure. Data are at semi-annual covering the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 9: Systemic banks *vs.* local capture, robustness: 20 different individual regressions for each alternative measure of large banks (stressed countries)

	Full sample		Restricted Sample	
> 200 bn	-0.215**	0.206	-0.174	0.112
	(0.109)	(0.142)	(0.111)	(0.159)
> 300 bn	-0.425***	-0.198	-0.396***	-0.388*
	(0.147)	(0.178)	(0.147)	(0.196)
> 400 bn	-0.438**	-0.325*	-0.407**	-0.513***
	(0.190)	(0.176)	(0.190)	(0.192)
> 500 bn	-0.470**	-0.319*	-0.443**	-0.508**
	(0.207)	(0.190)	(0.206)	(0.196)
Largest bank in country	0.00383	0.0388	0.000374	0.0158
	(0.147)	(0.107)	(0.138)	(0.153)
N	39,811,038	29,856,793	26,535,557	17,059,229
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank*Time	Y	Y	Y	Y

Note: The specification used is identical to that in Table 8 but with different definitions of the variable *Large*. That is, the dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t", where the bank operates in stressed countries. The table reports the estimated coefficients (from 20 different regressions) of the triple interaction *BQ*Sup*Large* for stressed countries under different definitions of the variable "Large". These definitions (indicated in the first column) include banks with total assets exceeding Euro 200bn, 300bn, 400bn, and 500bn, or the largest bank in each country (Largest bank in country). Results in first two columns are obtained using the entire sample whereas those in last two columns use a restricted sample including only the same number of centrally and locally supervised banks. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table 10: Bank supervision and monetary policy

	Stressed Countries		Non Stressed Countries	
	(1)	(2)	(3)	(4)
$BQ_{f,t-1}$	-0.422***		-0.254***	
	(0.0626)		(0.0534)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.527***	-0.328*	-0.248*	-0.113
	(0.125)	(0.198)	(0.133)	(0.178)
$BQ_{f,t-1}$ x $Shock^{MP}_{t-1}$	-0.0170**		-0.0168***	
	(0.00713)		(0.00583)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$ x $Shock_{t-1}^{MP}$	0.0403***	0.0535**	0.0222***	0.0278**
	(0.0154)	(0.0233)	(0.00811)	(0.0125)
N	39,811,038	29,856,793	6,262,908	2,915,490
R-squared	0.705	0.773	0.835	0.866
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank*Time	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. Sup (centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. $Shock^{MP}$ is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. Data are at semi-annual covering the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

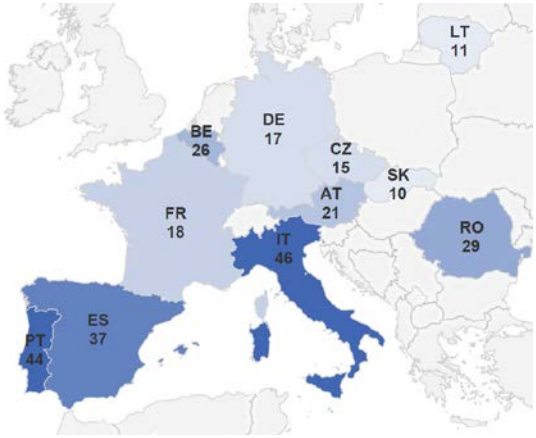
Table 11: Bank supervision, monetary policy, and large banks

	Stressed countries				Non-stressed countries			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BQ_{f,t-1}$	-0.0280	-0.0588*	-0.0599*		-0.0881	-0.146***	-0.152***	
	(0.0510)	(0.0264)	(0.0324)		(0.0597)	(0.0457)	(0.0453)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.428***	-0.367***	-0.362***	-0.207*	-0.401***	-0.319***	-0.312***	-0.086*
	(0.0622)	(0.0553)	(0.0552)	(0.112)	(0.117)	(0.0977)	(0.0975)	(0.045)
$BQ_{f,t-1}$ x $Shock_{t-1}^{MP}$	-0.0209**	-0.0143***	-0.0112***		-0.0219***	-0.0275***	-0.0249***	
	(0.00486)	(0.00463)	(0.00432)		(0.00508)	(0.00719)	(0.00712)	
$BQ_{f,t-1}$ x $Sup_{b,t-1}$ x $Shock_{t-1}^{MP}$		0.0175	0.0370**	0.0475**		0.0165**	0.0117*	0.0372*
		(0.0101)	(0.0159)	(0.0241)		(0.0083)	(0.00518)	(0.0197)
$Large_b$ x $BQ_{f,t-1}$	0.268**	0.328**	0.361**	0.211	0.291***	0.314***	0.328***	0.145
	(0.131)	(0.149)	(0.141)	(0.190)	(0.0791)	(0.0933)	(0.0881)	(0.316)
$Large_b$ x $BQ_{f,t-1}$ x $Sup_{b,t-1}$		-0.580***	-0.627***	-0.434**		-0.813***	-0.831***	-0.4798*
		(0.208)	(0.202)	(0.205)		(0.163)	(0.158)	(0.255)
$Large_b$ x $BQ_{f,t-1}$ x $Shock_{t-1}^{MP}$		-0.0136	-0.0465***	-0.0223*		-0.0122	-0.033*	-0.141***
		(0.00929)	(0.00841)	(0.0119)		(0.0148)	(0.0178)	(0.0460)
$Large_b$ x $BQ_{f,t-1}$ x $Shock_{t-1}^{MP}$ x $Sup_{b,t-1}$			0.0513***	0.0452***			0.0208*	0.164***
			(0.00886)	(0.0146)			(0.0108)	(0.046)
N	39,811,038	39,811,038	39,811,038	29,856,793	6,262,908	6,262,908	6,262,908	2,915,490
R-squared	0.705	0.705	0.705	0.773	0.835	0.835	0.835	0.866
Fixed effects								
Bank*Firm	Y	Y	Y	Y	Y	Y	Y	Y
Firm*Time	N	N	N	Y	N	N	N	Y
Sector*Time	Y	Y	Y	-	Y	Y	Y	-
Bank*Time	Y	Y	Y	Y	Y	Y	Y	Y

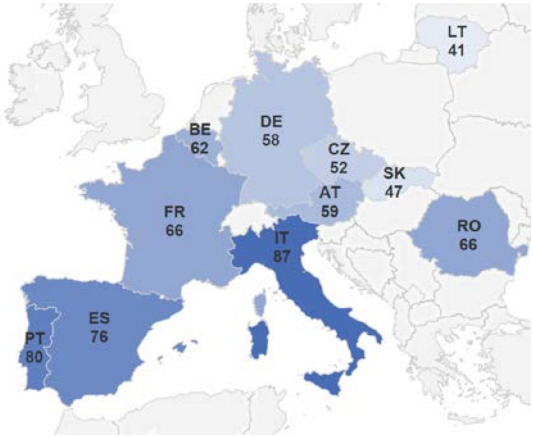
Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. Sup (centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. $Shock^{MP}$ is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. Large is a dummy variable that takes value 1 if the total assets of the bank are larger than Euro 500bn. Data are at semi-annual for the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Figure 1: Share of firms with multiple lending relationships

As % of total borrowers

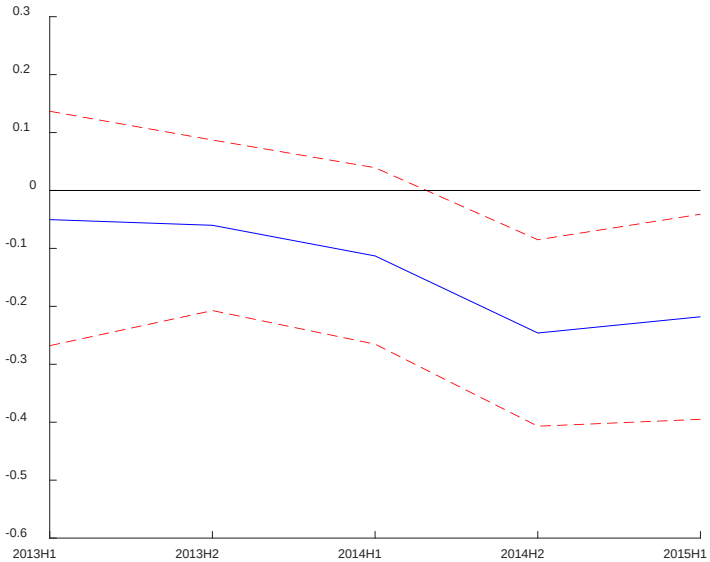


As % of total credit



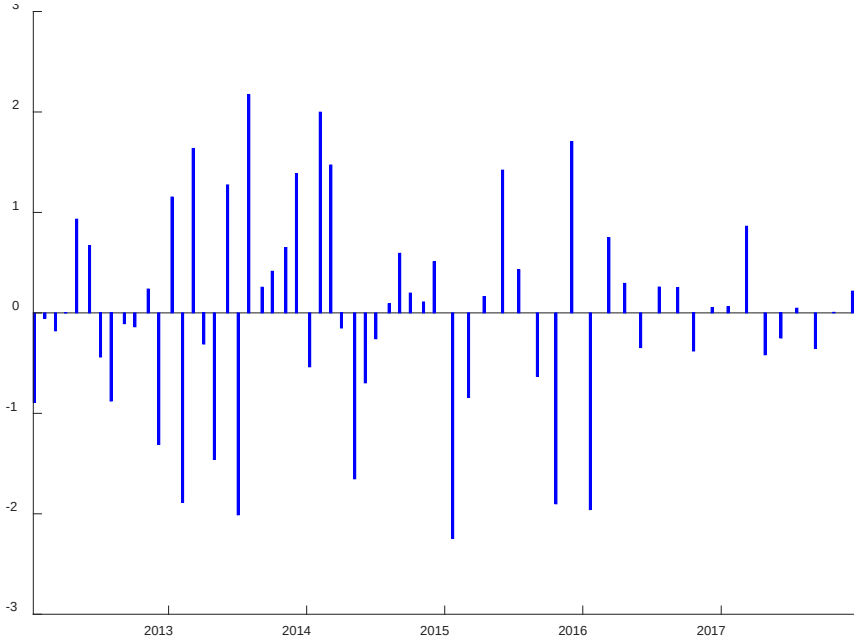
Notes: The chart reports for each country included in the dataset the share of non-financial corporations with multiple lending relationships as a share of the total number of borrowers (left panel) and of total lending (right panel).

Figure 2: Robustness on the timing of banking supervision



Notes: Estimated coefficient of the interaction BQ*Sup from equation (1), based on different dates for the effective start of bank supervision. The specifications control for Bank*time, Bank*firm, and Firm*time fixed effects (Country*time and sector*time fixed effects are spanned by the previous effects).

Figure 3: Monetary policy surprises



Note: the figure shows the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during dates of policy announcements as included in the Euro Area Monetary Policy Event-Study Database. Positive (negative) values indicate policy tightening (easing).

Appendix

Table A.1: Sample composition

	Reporting Threshold	Initial Sample (in million)	# of banks Original Sample	Final Sample (in million)	# of banks Final Sample
Austria	350,000	1.4	1601	0.5	65
Belgium	0	13.3	144	6.2	36
Germany	1,000,000	11.1	1828	4.7	498
Spain	6,000	23.6	283	16.7	133
France	25,000	37.7	522	24.8	295
Ireland	500	4.3	4	-	-
Italy	30,000	148.2	1576	28.2	731
Lithuania	290	0.3	166	0.3	11
Latvia	0	12.7	109	-	-
Malta	5,000	0.1	26	-	-
Portugal	50	8.8	198	6.2	107
Slovenia	0	0.2	26	-	-
Slovakia	0	0.9	30	0.6	11
Romania	4,440	20.2	96	2	52
Czech Republic	0	4.8	41	1.5	18

Note: The table reports for each country the reporting threshold of the individual credit register, the initial number of observation available in the dataset and the final number of observation obtained after cleaning and harmonising the data, as well as collapsing the data at the lender-borrower-time period.

Table A.2: Robustness: Credit drawn

	Stressed Countries		Non-Stressed Countries	
	i = -1	i = 1	i = -1	i = 1
	(1)	(2)	(3)	(4)
$BQ_{f,t-1}$ x $Sup_{b,t-1}$	-0.230***	-0.241***	-0.0658	0.00577
	(0.0706)	(0.0830)	(0.0569)	(0.0532)
N	25,407,607	26,098,126	2,945,492	2,929,344
R-squared	0.900	0.900	0.940	0.942
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	Y	Y	Y	Y
Bank*Time	Y	Y	Y	Y

Note: The dependent variable is the (log-)credit drawn by bank "b" to firm "f" operating in sector "s" at time "t". BQ (Borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. . In columns 1, and 3, i=-1 indicates that the regression includes an ex-ante measure of borrower quality ($BQ_{f,t-1}$) while in columns 2, and 4, i=1 indicates that the regression includes an ex-post measure of borrower quality ($BQ_{f,t+1}$). Sup (Centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. Data are at semi-annual for the period 2012H1 – 2017H2. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table A.3: Systemic banks *vs.* local capture, robustness: 20 individual regressions for each alternative measure of large banks (non-stressed countries)

	Full sample		Restricted Sample	
> 200 bn	-0.740***	-0.162	-0.707***	-0.187
	(0.157)	(0.246)	(0.154)	(0.243)
> 300 bn	-0.785***	0.287	-0.749***	0.277
	(0.166)	(0.493)	(0.164)	(0.481)
> 400 bn	-0.785***	0.287	-0.749***	0.277
	(0.166)	(0.493)	(0.164)	(0.481)
> 500 bn	-0.824***	-0.0537	-0.790***	-0.0724
	(0.160)	(0.469)	(0.156)	(0.445)
Largest bank in country	-0.188	0.529	-0.184	0.562
	(0.194)	(0.362)	(0.188)	(0.368)
N	6,262,908	2,915,490	5,663,549	2,342,131
Fixed effects				
Bank*Firm	Y	Y	Y	Y
Firm*Time	N	Y	N	Y
Sector*Time	Y	-	Y	-
Bank*Time	Y	Y	Y	Y

Note: This table is identical as Table 7, but with different definitions of the variable *Large*, and identical to Table 8, but for non-stressed countries instead. That is, the dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t", where the bank operates in non-stressed countries. The table reports the estimated coefficients (from 20 different regressions) of the triple interaction *BQ*Sup*Large* for stressed countries under different definitions of the variable "Large". These definitions (indicated in the first column) include banks with total assets exceeding Euro 200bn, 300bn, 400bn, and 500bn, or the largest bank in each country (Largest bank in country). Results in first two columns are obtained using the entire sample whereas those in last two columns use a restricted sample including only the same number of centrally and locally supervised banks. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.

Table A.4: Bank supervision, monetary policy and productivity

	Stressed Countries		Non-Stressed Countries	
	(1)	(2)	(3)	(4)
$BQ_{f,t+i}$	-0.0755*		-0.144***	
	(0.0406)		(0.0446)	
$BQ_{f,t+i}$ x $Sup_{b,t-1}$	-0.447***	-0.285***	-0.419***	-0.00266
	(0.0679)	(0.0942)	(0.113)	(0.120)
$Prod_{s,t-1}$	-0.213***		0.219***	
	(0.0415)		(0.0770)	
$BQ_{f,t+i}$ x $Prod_{s,t-1}$	0.279***		0.249**	
	(0.0794)		(0.108)	
$Prod_{s,t-1}$ x $Sup_{b,t-1}$	0.0478	0.0106	-0.00656	0.172
	(0.0383)	(0.0330)	(0.0597)	(0.126)
$MP_{c,t+i}$ x $BQ_{f,t+i}$	-0.00732***		-0.00998***	
	(0.00282)		(0.00291)	
$MP_{c,t+i}$ x $Prod_{s,t-1}$	-0.000819		-0.00515	
	(0.00340)		(0.00984)	
$MP_{c,t+i}$ x $BQ_{f,t+i}$ x $Prod_{s,t-1}$	-0.00744		0.0258	
	(0.00570)		(0.0254)	
$MP_{c,t+i}$ x $Sup_{b,t-1}$ x $Prod_{s,t-1}$	-0.000293	0.00197	0.00557	0.0111
	(0.00313)	(0.00382)	(0.00737)	(0.00682)
N	37,753,379	28,374,474	5,750,158	2,713,259
R-squared	0.714	0.779	0.835	0.867
Fixed effects				
Bank * Firm	Y	Y	Y	Y
Firm * Time	N	Y	N	Y
Bank * Time	Y	Y	Y	Y
Sector * Time	Y	N	Y	N

Note: The dependent variable is the (log-)credit granted (drawn and undrawn) by bank "b" to firm "f" operating in sector "s" at time "t". BQ (borrower quality) indicates, for each borrower, the ratio between exposures in arrears and total exposures. Sup (centralised supervision) is a dummy variable that takes value one for banks supervised at supranational level (i.e. directly by the ECB) after November 2014. $Shock^{MP}$ is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. Data are at semi-annual covering the period 2012H1 – 2017H2. "-" implies that the fixed effects are spanned by other effects, while "Y" and "N" imply that those fixed effects are included, and not included, respectively. Standard errors clustered at bank level in parentheses: * p<0.1, ** p<0.05, *** p<0.01.