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JEL Classification: G21, G28

Keywords: Banking, Supervision, lending, investment, Intangibles

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Out with the New, In with the Old? Bank Supervision and the Composition of Firm Investment*

Miguel Ampudia† Thorsten Beck‡ Alexander Popov§

Abstract

Using exogenous variation generated by the creation of the Single Supervisory Mechanism (SSM) in the euro area, we find that relative to firms borrowing from banks remaining under national supervision, firms borrowing from SSM-supervised banks reduce intangible assets and increase tangible assets and cash holdings. These effects do not pre-date the supervisory reform, do not obtain in non-SSM jurisdictions, and coincide with reductions in long-term debt and labor productivity. The reallocation of investment away from intangible assets is stronger in innovation-intensive sectors, suggesting that centralized bank supervision can slow down the shift from the capital-based to the knowledge-based economy.

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1 Introduction

Does stability breed or hinder growth? Numerous papers have tackled various aspects of this question, providing opposing answers and conflicting policy implications. At the one extreme, Ramey and Ramey (1995) show that in countries where long-run GDP growth is less volatile, it is also higher on average. They argue that by reducing future uncertainty, stability-enhancing policies increase the return to investment, and from there, long-term growth rates. At the other extreme, Ranciere, Tornell, and Westermann (2008) show that countries in which long-run GDP growth is higher also tend to experience more frequent systemic crises. They argue that both development and crises are driven by the same economic force—risk taking—and that policy makers who clamp down on the sources of instability will pay a price in terms of lower growth.

In this paper, we contribute to this debate by studying the effect of one well-defined stability-relevant policy (the introduction of centralized bank supervision in the euro area) on one well-defined growth mechanism (corporate investment). After the Global Financial Crisis and sovereign debt crisis of the late 2000s and early 2010s, respectively, regulators enacted a number of reforms aimed at improving the resilience of European banks. The centerpiece of this drive was the introduction of the Single Supervisory Mechanism (SSM) in Frankfurt. Following an asset quality review and stress tests (together referred to as Comprehensive Assessment), a number of significant euro area banks became supervised by the SSM, while others remained under the supervision of their national authorities. Several recent studies have shown that the shift to centralized supervision resulted in stability-enhacing actions by the affected banks (Fiordelisi, Ricci and Stentella Lopes, 2017; Eber and Minoiu, 2017; Altavilla, Boucinha, Peydro and Smets, 2020). We use the announcement of the SSM in 2012 and its introduction in 2014 as a quasi-natural experiment to study the impact of a safer financial system on the performance of the real economy. We find that relative to firms borrowing from banks remaining under national supervision, firms borrowing from SSM-supervised banks reduce intangible assets and increase tangible assets and cash holdings. This effect is stronger in RD-intensive and innovation-intensive sectors. Our findings provide support for the notion that by increasing the stability of individual banks, centralized bank supervision can slow down the shift from the capital-based to the knowledge-based economy.

To assess the impact of this change in supervisory architecture, we match firm-level balance sheet data to firms' main lender across 188,600 unique firms and 294 banks in 10 euro area countries over the period 2010 to 2017. We use the Orbis-Bureau Van Dijk firm-level database, also known as Amadeus. The database has detailed firm-level balance sheet information on assets, employment, debt, and output across a large number of European countries. One of the main advantages of this dataset is that it allows us to distinguish between different types of assets (e.g., tangible, intangible, or current/cash). The database also includes information on each firm's main relationship bank(s), which we use to match firms and banks. For each bank, we determine whether they were affected by the implementation of the SSM or not (i.e., whether they moved to being centrally supervised after 2014, or remained supervised by national authorities). A big advantage of our data set is its representative coverage of SMEs, which tend to be informationally opaque and dependent on banks for their external financing, and therefore more likely to be affected by changing conditions at their creditor (e.g., Berger and Udell, 1998; Kashyap, Lamont, and Stein, 1994). Moreover, SMEs account for almost 99 percent of all firms and for two thirds of the aggregate economic activity in Europe. We use a difference-in-differences approach to identify the effect of the shift in bank supervision on the composition of investment for firms borrowing from affected, relative to firms borrowing from unaffected banks. A similar exercise would not be possible for the US where data on bank-firm relationships is generally not available, especially for privately held firms.

Theory provides contrasting hypotheses on the effect of centralised vs. decentralised supervision on bank lending and thus firm financing. On the one hand, Laffont and Tirole (1993) argue that local supervision results in better monitoring of firms. Colliard (2020) argues that local supervisors might be better able to extract information from banks than a centralized supervisor. Carletti, Dell'Ariccia, and Marquez (2021) point to lower incentives for local supervisors to collect information if supervisory decisions are centralized. If local supervisors provide more rigorous supervision than centralized supervisors, we would expect firms whose lenders change to centralized supervision to increase their investment, including into less collateralizable assets, such as intangible capital.

On the other hand, because bank supervision exhibits scale economies, centralized supervision might be more effective (Eisenbach, Lucca, and Townsend, 2016). Centralised supervision might be

better able to reduce the risk of banks arbitraging differences in regulatory stringency across countries (Dell'Ariccia and Marquez, 2006), and can increase supervisory independence (Rochet, 2008). If centralized supervisors are more effective in holding in check banks' risk-taking, banks under their supervision might tighten lending standards and increase collateral requirements, with negative implications for investment, especially in intangible assets, which are less collateralizable.

Our regression analysis shows, first, that relative to firms borrowing from banks that remained under the supervision of national authorities, firms borrowing from SSM-supervised banks experienced a significant reallocation across different types of investment. During the Comprehensive Assessment period (2013–2014) when banks' balance sheets were closely inspected in preparation for joining the SSM, affected firms relatively increased their investment in current assets (i.e., cash). Furthermore, during the period after the SSM took over (2015–2017), affected firms relatively increased their investment in tangible assets with respect to non-affected firms. At the same time, these same firms reduced investment in intangible assets (such as R&D) in relative terms, both during the Comprehensive Assessment period and during the SSM period.

These results are remarkably robust across specifications that account for non-similarities between "control" and "treated" firms, for time-varying firm-specific shocks, as well as for the unbalanced property of the panel and for model misspecification. It is robust to controlling for unobservable firm heterogeneity, for country-sector-specific trends, for time-variant firm characteristics, and for bank fixed effects.

We further find that the main effect is accompanied by an increase in firm-level employment in the long run. However, we also observe a decline in labor productivity during the SSM period. These findings suggest that a reduction in intangible investment can lead to a long-term productivity decline.

Moreover, we find that the decline in intangible investment is particularly pronounced in innovation-intensive sectors, especially during the early period of the SSM. Such industries are instrumental in contributing to productivity-driven long term growth in modern knowledge-based economies. In line with economic efficiency, they should see a steady stream of investment in intangible assets, such as R&D. Finding the opposite suggests that more intense bank supervision can force innovative firms to reallocate investment away from relatively risky projects, and thus slow down the shift from the

"old" to the "new" economy. This can have negative repercussions for economic growth, given the increasing reliance of advanced economies on intangible assets (Corrado and Hulten, 2010; Haskel and Westlake, 2017) and the limited contribution that banks can make to economic growth in economies that rely heavily on intangible assets (Beck, Dottling, Lambert, and van Dijk, 2020). On the other hand, a slower shift towards intangible assets might also slow the trend towards less effective monetary policy that has been document by Dottling and Ratnoviski (2020), due to the increasing importance of firms relying on intangible rather than tangible assets.

Our results are robust to two falsification tests. First, we find that there were no different trends across treatment and control firms before the announcement and the implementation of the SSM. Second, we show that the differences in investment patterns across firms borrowing from two distinct sets of banks are absent in jurisdictions which were not subject to a centralization of bank supervision. Specifically, we use a firm sample for Denmark, Hungary, and the UK—all three non-euro EU member states during the sample period—and identify banks that would have been subject to SSM supervision had these countries joined the banking union. Comparing firms borrowing from banks that would have been under SSM supervision and firms borrowing from banks that would have stayed under national supervision, we find no significant difference between these two groups after the implementation of the SSM. These results confirm that our findings are not driven by other global or regional events affecting banks of different sizes and systemic importance and their borrowers differently.

Finally, we show that corporate lending by banks that came under SSM supervision declined, both during the transition period and after the implementation of the SSM, compared to corporate lending by banks not subject to SSM supervision. We record the same effect when we use firm-level data on banks debt, and when we use a separate bank-level dataset on overall corporate borrowing. In the latter case, we also find that the decline in lending was larger for banks with relatively low capital before the announcement of the SSM. Our findings suggest that lending retrenchment might have been one channel through which firms were forced to adjust their investment. They also suggest that the negative effect of the supervisory reform in Europe on intangible investment may be a long-term trend, rather than a short-term feature of the initial stress tests.

In summary, our findings are consistent with hypotheses that posit a dampening effect of centralized

supervision on banks' lending, and thus a shift of firms' investment towards assets that are more easily collateralizable.[1] They are also consistent with theories that focus less on the distance between banks and supervisors and more on the positive effect of centralized supervision on the independence and rigor of bank supervisors.

Our paper contributes to several strands of research. First, our results inform the literature that has studied how the distance between supervisors and banks affects banks' risk-taking behavior. Recent empirical research has demonstrated the importance of supervisory architecture, and thereby of the distance between supervisors and banks, for bank lending and risk-taking (Agarwal, Lucca, Seru, and Trebbi, 2014). The significant relationship between supervisory architecture and the bank credit supply raises the question of whether this has also implications for the real sector. To our knowledge, our paper is the first to attempt to answer this question.

Second, our paper relates to the literature on optimal supervisory architecture. Beck, Todorov, and Wagner (2013) show that the timing of supervisory interventions is correlated with the share of a banks foreign shareholders, deposits, and assets. Behn, Haselman, Kick, and Vig (2017) show that bail-out decisions taken by German politicians sitting on the board of failing banks lead to inefficient bail-outs, implying that the proximity of public authorities to the bank is undesirable in this case. Calzolari, Colliard, and Loranth (2019) show that centralized supervision can induce multinational banks to change their legal structure, so as to extract more subsidies from deposit insurance. Boyer and Ponce (2012) caution that a central supervisor will be weaker against lobbying efforts than separate supervisors. Gornicka and Zoican (2016), Foarta (2018), and Segura and Vicente (2018) focus on the impact of bail-outs and recapitalizations in the Banking Union. Finally, Repullo (2018) theoretically assesses the optimal allocation of responsibilities, i.e., information collection and liquidation decisions, between a local and a central supervisor. While this literature focuses on the stability implications of the supervisory architecture, our paper focuses on the real effects of one specific change in this architecture whereby direct supra-national supervision of banks is introduced in a large and diverse economic area.

Third, our paper adds to a small but expanding literature on the effect of supervisory architecture

[1] See Falato, Kadyrzhanova, Sim, and Steri, 2021, for evidence that tangible assets are easier to use as collateral.

and actions on bank behavior. This literature has mostly exploited the US case where similar banks in close proximity, or even the same banks, can be supervised by different federal authorities, allowing for a discontinuity-type analysis. Using the exogenous variation stemming from the fact that state banks in the US are supervised by state or federal supervisors on a rotating basis, Agarwal, Lucca, Seru, and Trebbi (2014) show that federal supervisors are twice as likely as state supervisors to downgrade the bank they supervise, suggesting that local supervisors are more lenient than central supervisors.[2] Gopalan, Kalda, and Manela (2017) show that closing local branches of the federal authority responsible for supervising nationally-chartered banks in the US leads neighbouring banks to take significantly more risks, suggesting that geographic proximity increases supervisory efficiency. This finding is confirmed by Delis and Staikouras (2011) who show a negative relationship between the number of on-site inspections and bank risk in an international sample. Again for the US, Hirtle, Kovner, and Plosser (2020) find that the top-ranked banks that receive more supervisory attention hold less risky loan portfolios, are less volatile, and are less sensitive to industry downturns. Granja and Leuz (2017) document that the extinction of the thrift regulator (OTS) following Dodd-Frank led to stricter supervision of former OTS banks, and resulted in higher business lending. Kandrac and Schlusche (2021) show that the reduction in bank supervision and examination driven by experienced supervisors quitting their job increases bank risk taking, leading to risky lending, faster asset growth, and a greater reliance on low-quality capital. Finally, Ivanov and Wang (2020) show that following a supervisory rating downgrade of a specific syndicated loan, lead banks lower their internal risk assessments, decrease loan commitments, and exit lending relationships.

We are aware of only one other paper that uses European data to study the efficiency of bank supervision. Bonfim, Cerqueiro, Degryse, and Ongena (2020) exploit information on a unique series of authoritative on-site inspections of bank credit portfolios in Portugal to investigate how such inspections affect banks future lending decisions. They find that following an on-site inspection, a bank becomes significantly less likely to refinance a firm with negative equity, implying that more hands-on supervisors are less likely to tolerate zombie lending by commercial banks.

Our paper contributes to this literature in three distinct ways. First, we provide a comprehensive

[2]For corroborating evidence, see also Kang, Lowery, and Wardlaw (2015), Rezende (2016), and Danisewicz, McGowan, Onali, and Schaeck (2018).

analysis of the link between supervision and bank lending and risk taking in Europe, adding to a literature dominated by US studies. Second, we focus on a systematic change in supervisory architecture, moving banks that make up 80% of total banking sector assets in the euro area into a new supervisory framework, with a more prominent role for centralized rather than local (national) supervisors. Thus, relative to the analysis of on-site supervision of Portuguese banks, we exploit a continent-wide supervisory reform that makes it possible to describe empirical regularities that transcend an individual country. Finally, and crucially, we are the first to analyse the transmission of supervisory reform to firms' real decisions.

Finally, our paper also adds to a small empirical literature focusing specifically on the effect of the introduction of the SSM on banks' behavior in the euro area. Fiordelisi, Ricci, and Stentella Lopes (2017) show that banks that expected to come under the supervision of the SSM reduced their lending activities and increased their capital ratios in comparison with banks below the asset threshold for supervision by the SSM. This is in line with the findings of Eber and Minoiu (2016) who show that SSM-supervised banks reduced their asset size and reliance on wholesale debt over the period 2012-15, compared with banks that did not fall under the supervision of the SSM. It is also consistent with Altavilla, Boucinha, Peydro, and Smets (2020) who show that 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. Finally, our paper also relates to the work by Gropp, Mosk, Ongena, and Wix (2019) who find that the 2011 capital exercise by the European Banking Authority (an exercise similar to the Comprehensive Assessment that we study) induced some banks to increase their capital ratios by reducing their risk-weighted assets. Consequently, firms obtaining a larger share of their bank credit from the treated banks reduced overall investment. Our paper takes this literature one important step further by focusing on the effect of the announcement and introduction of the SSM on the composition of firms' investment. Our paper is thus the first to study how supervisory reform affects the mechanisms of economic growth in a bank-dependent economy.

2 Institutional setting

On 29 June 2012, the heads of government of all euro area countries issued a statement announcing that the Commission would present proposals for the creation of a Single Supervisory Mechanism (SSM), underpinned by the necessity to break the vicious circle between banks and sovereigns. The SSM was meant to be the first element of the so-called Banking Union, which would be complemented by a single resolution mechanism and a common deposit scheme. The regulation on the SSM mandates the European Central Bank to exercise prudential supervision of all banks located in the euro area, whether directly by the ECB's own supervisory arm for the significant banks, or indirectly by the national prudential supervisors but under the general guidance of the ECB for the less significant banks.

An important step in preparing the SSM to become fully operational was the Comprehensive Assessment that took place between November 2013 and October 2014. Before that, in October 2013, the criteria guiding the classification of euro area banks into *Significant Institutions* (SIs, supervised directly by the SSM) and *Less Significant Institutions* (LSIs, supervised by national authorities) was published.[3] With this, the 2014 Comprehensive Assessment, which included an asset quality review and stress test, was a financial health check of 130 banks in the euro area, covering approximately 82% of total bank assets. The results were published on 26 October 2014, and on 4 November the SSM was born.

As of 2020, the ECB directly supervises the 117 significant banks of the participating countries. The actual supervisory activities are conducted by joint supervisory teams (JSTs) involving both ECB staff and national supervisory staff. Less significant institutions continue to be supervised by their national supervisors, in close cooperation with the ECB.

3 Data

This section discusses the firm- and bank-level data we use to test the relationship between changes in the euro area supervisory framework and firms' investment behavior.

[3] See https://www.ecb.europa.eu/pub/pdf/other/notecomprehensiveassessment201310en.pdf.

3.1 Firm-level data

Our firm-level data come from the Orbis data set provided by Bureau van Dijk (BvD). Orbis contains financial and ownership data for more than 170 million firms from more than 100 countries worldwide. Financial data include balance sheet information and income statements, while ownership data contain information about the shareholders of the company. The database has been compiled since 2005 by BvD and is currently updated quarterly. Every vintage contains a history of up to ten years of financial information for an individual firm. BvD offers to link the latest vintage with historical vintages going back to 2005. The analysis in this paper is based on the vintage as of the second quarter of 2016 linked with all historical files available from BvD.

A common feature of Orbis is that financial information for a given firm and year is updated from one vintage to the next. When constructing the historical files, special care is taken to put the latest available information for any given year and company. The resulting data set contains many more firm-year observations than are available in the latest vintage alone. This is because the companies may drop out from the sample over time. For instance, there are about 30% more companies in the historical files compared to the latest vintage. The reason is that BvD deletes companies that do not report for a certain period from each vintage. Such companies are nevertheless included in the linked historical files, thereby reducing the survivorship bias that is present in a single vintage. At this stage, the data set contains about 100 million firm-year observations, but about a quarter of those relate to firms that have not provided financial information in any given year.

For our analysis, we focus on EU companies with financial data in the period $2010-2017$, and we work with unconsolidated accounts. We follow the downloading methodology and cleaning procedure described in Kalemli-Ozcan, Sorensen, Villegas-Sanches, Volosovych, and Yesiltas (2019) in order to ensure the database is nationally representative and contains minimal missing information. We first note that the number of firms varies significantly by country. For example, there are on average 372 firms per year in Cyprus, and 664,469 firms per year in France. Therefore, we make sure that we only analyse countries with good firm coverage in Orbis. To that end, we compare the number of firms in Orbis to official data on the number of firms per country in Eurostat. We find that while some countries are well represented in Orbis, some have very low coverage. Consequently, we drop countries

for which Orbis coverage relative to Eurostat is below 10%. These countries are the Czech Republic (8% coverage), Malta (4% coverage), Poland (3% coverage), and Cyprus (1% coverage). We are left with the remaining 24 EU countries.

In terms of firm-specific information, we make use of the following variables: tangible fixed assets, intangible fixed assets, other fixed assets, current assets, employment, long-term debt, short-term debt, cash flow, sales, and age. Our consistency checks make sure that balance-sheet identities hold within a small margin and entries are meaningful from an accounting point of view. Following Kalemli-Ozcan, Laeven, and Moreno (2018), we drop firm-year observations in which total assets, fixed assets, intangible fixed assets, sales, long-term debt, loans, creditors, other current liabilities, or total shareholder funds and liabilities have negative values. Furthermore, we drop firm-year observations for which some basic accounting identities are violated by more than 10 per cent. These identities ensure that (i) total asset match total liabilities, (ii) total assets match the sum of fixed assets and current assets, and (iii) current liabilities match the sum of loans, trade credit and other current liabilities.

We also drop country-specific sectors, such as agriculture and mining; sectors with high government ownership, such as public administration; and heavily regulated sectors, such as finance. For our analysis we retain only firms in Manufacturing (NACE Rev. 2 Section C), Construction (F), Wholesale and retail trade (G), Transportation and storage (H), Accommodation and food service activities (I), Information and communication (J), Professional, scientific and technical activities (M) and we drop firm-year observations if there are less than 10 firms in each NACE Rev. 2 digit 4 sector. We restrict our sample to firms which have at least one observation during the pre-Banking Union period (2010–2012), the Comprehensive Assessment period (2013–2014) and the SSM period (2015–2017), producing a balanced panel. Finally, we winsorize all variables at the 1% level.

In addition, the Orbis database provides, for each company, the name of the main bank the company conducts business with. This allows us to identify whether a company is related to a bank which became directly supervised by the SSM when it was established, or whether it is related to a bank which is only indirectly supervised by the SSM.

The bank relationship variable provided is a self-reported text variable and thus can contain typos. We manually check each observation to correct any reported typo (accents, upper vs lower

caps, etc.) to make sure the match with the list of directly and non-directly supervised banks is done properly. This variable is not available for all countries in the dataset. We also require that Significant Institutions and Less Significant Institutions are comparable in size and scope by dropping banks that have fewer than 25 firm connections in the dataset.

After applying all these procedures, in the core analysis we are left with 188,600 unique firms in 10 euro area countries (Austria, Estonia, France, Germany, Lithuania, Latvia, Luxembourg, Portugal, Slovenia, and Spain) over the sample period 2010−2017. These firms have a credit relationship with a total of 294 individual banks. Of these, 179 are Significant Institutions, and 115 are Less Significant Institutions. Within our sample, 77.6% of firms have a relationship with a Significant and 22.4% a relationship with a Less Significant Institution. Later, we also make use of firms in Denmark, Hungary, and the United Kingdom—all non-euro area countries—for falsification tests where we check whether our results obtain in non-SSM jurisdictions.

In Table 1, we summarize the main variables used in the analysis. Panel A shows that on average, during the full sample period (2010–2017), tangible and intangible assets decreased by 4.4 and 11.7%, respectively, while other fixed assets and current assets increased by 2.6 and 2.7% respectively. Firm-level employment stayed almost unchanged, while labor productivity increased by about 1.2%. Panel A also makes it clear that during the full sample period, the firms in our sample deleveraged substantially: overall debt declined by 6.8%, which is largely driven by a substantial decline in long-term debt (by 12.0%).

Panel B of Table 1 further demonstrates that during the pre-SSM period (2010–2012), there were important differences between firms associated with Significant Institutions (SSM banks), and firms associated with Less Significant Institutions (non-SSM banks). On average, firms with credit relationships with SSM banks are smaller in terms of assets, larger in terms of sales, have a lower debt-to-assets ratio, higher cash-to-assets ratio, and are older. These differences are statistically significant, and we use this information in robustness tests where we make sure that we compare firms that are otherwise similar and which differ only in that one group has a credit relationship with significant institutions, and the other with less significant institutions.

3.2 Bank-level data

We also make use of bank-level information from the ECB's Individual Balance Sheet Statistics (IBSI) dataset. This high-frequency data source contains end-of-month data on assets and liabilities, starting in August 2007, for 247 individual financial institutions in 18 European countries, comprising about 70 percent of the domestic banking sector. Banks are observed at an unconsolidated level, and therefore the dataset captures both domestic banks and affiliates of foreign banks active in a country. The data contains information on the stock of total lending, as well as on the stock of lending to various classes of customers, such as governments, non-financial corporations (NFCs) and households. Furthermore, the data allows us to distinguish between lending to domestic customers and customers from other euro area countries.

We focus on euro area countries with at least one significant and one less significant institution included in IBSI, where the institutions in both groups are comparable in size. This leaves us with 186 banks compared to 294 banks in the firm-level sample. These are based on 11 euro area countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Luxembourg, Malta, Netherlands, and Spain).

4 Empirical strategy

Using the data set just described, our goal is to study differences in investment behavior across firms, distinguishing between firms with credit relationships with banks directly and indirectly affected by the introduction of the Single Supervisory Mechanism (SSM). To limit potential endogeneity problems, we take all the independent variables in lags, except for the unobserved fixed effects. Consequently, we estimate the following panel regression model with multi-dimensional fixed effects:

$$\frac{I_{fbcst}}{K_{fcst-1}} = \beta_1 SI_{fbcs} \times Post2012_t + \beta_2 SI_{fbcs} \times Post2014_t + \mu_f + \phi_{cst} + \varepsilon_{fbcst}, \quad (1)$$

where I_{fbcst} is investment by firm f, borrowing from bank b, located in country c, operating in sector s in year t, and $K_{fbcst-1}$ is that same firm's stock of tangible capital at the end of the previous

year. I_{fbcst} is calculated as the year-on-year change in the firm's capital, $K_{fbcst} - K_{fbcst-1}$. We distinguish between four different types of capital. Specifically, *Tangible assets* denote assets such as buildings, machinery and equipment, while *Intangible assets* denote assets such as R&D and on-the-job training. The difference between the two types of assets is that tangible assets are preferred by banks in loan contracts, as unlike intangible assets, they are redeployable. *Other fixed assets* stand for other fixed assets on the firms' balance sheets which are neither tangible nor intangible, while *Current assets* stand for cash and other short term assets that are expected to be converted to cash within a year.

Turning to the explanatory variables, SI is a dummy variable equal to one if the firm is borrowing from a Significant Institution, i.e., from a bank which during the period 2013–2014 underwent the Comprehensive Assessment and was placed under the direct supervision of the Single Supervisory Mechanism in late 2014.

We interact the variable SI with time dummies to construct a differences-in-differences set-up. To account for the independent effects of the Comprehensive Assessment, which took place in 2013 and in 2014, and the implementation of the SSM, which took over direct supervision of SIs in November 2014, we include two time dummies. $Post2012_t$ is a dummy variable equal to one in 2013 and 2014. $Post2014_t$ is a dummy variable equal to one in 2015–2017. The pre-Banking Union period is thus 2010–2012. We choose 2012 as the last year of the pre- period because the list of significant versus less significant institutions was announced in March 2013, which is when the Comprehensive Assessment started for those.

In our main model, we directly address the possibility that within a firm, investment decisions may be correlated over time. Our original data is at the annual frequency. However, by estimating a model where changes in investment are observed within a firm for as much as 8 years in a row, we would be introducing the possibility of biased point estimates due to the presence of autocorrelated standard errors over time within a firm. To address concerns about autocorrelation, and following Bertrand, Duflo, and Mullainathan (2004), we estimate Equation (1) after first collapsing the underlying annual data into one observation per firm-period. More precisely, we aggregate information on the different types of investment under consideration into one pre-SSM observation (i.e., over the period 2010–

2012), one Comprehensive Assessment observation (i.e., over the period 2013–2014), and one post-SSM observation (i.e., over the period 2015–2017). We only use firms for which we have at least one underlying observation in each of the three periods.

While in most of the analysis we do not include firm controls on the right-hand side, in later robustness tests we control for variables such as the logarithm of total assets, the ratio of cash flow to total assets, the ratio of sales to total assets, the ratio of debt to total assets, and age. Its inclusion allows us to capture the independent impact of various firm-specific developments, such as shocks to overall debt, profits, cash flow, or assets. We also interact the firm controls with the dummies $Post2012$ and $Post2014$, to control for the time-varying effect of firm-specific controls on firms' investment patterns.

We include firm-fixed effects μ_f to control for unobservable firm-specific time-invariant factors explaining variation in investment behavior. The term ϕ_{cst} is an interaction of country, sector and period dummies, which absorbs any time-varying shocks to demand or to technology specific to a particular sector in a particular country during a particular year (e.g., construction services in Spain or production of heavy machinery in Germany in 2014). This allows us to control more tightly for the confounding effect of regional factors, such as demand or technology, on individual sectors. Identification is thereby achieved by comparing the average investment levels of two observationally equivalent firms in the same country borrowing from significant versus less significant financial institutions. Finally, ε_{fbcst} is the idiosyncratic error term. In all regressions, we cluster the standard errors at the country-period level.

We do not include the variable SI separately in the model specification above because its direct effect on investment is absorbed by the firm fixed effects. Analogously, we do not include the variables $Post2012$ and $Post2014$ on their own because their direct effect on investment is absorbed by the country-sector-year fixed effects.

The coefficients of interest are β_1 and β_2. A negative coefficient β_1 (β_2) would imply that all else equal, investment of a specific asset type declines for firms whose bank is now subject to SSM supervision, relative to firms whose lender is not subject to change in supervision, during the Comprehensive Assessment period (the SSM period). The point estimates of β_1 and β_2 thus measures the numerical

change in investment from switching the firm from the control group to the treatment group.

5 Empirical results

We first discuss our baseline results of the relationship between changes in the supervisory architecture and changes in firm investment, before presenting a number of robustness tests. We then explore variations of our baseline results across different sectors, and look into the interaction between changes in supervisory architecture, on the one hand, and changes in employment, labor productivity, and debt, on the other.

5.1 Baseline result

In Table 2, we present the baseline results of the paper; specifically, the results from four different versions of Model (1) where the dependent variable is, in turn growth in *Tangible assets*, *Intangible assets*, *Other fixed assets*, and *Current assets*. All regressions include firm fixed effects and country-sector-period fixed effects.

Column (1) of Table 2 reports the point estimate from Equation (1) where the dependent variable is the period-average annual growth in tangible assets. These are defined as buildings, machines, and equipment which are easy to collateralize and redeploy in case of firm bankruptcy. We find that tangible assets increased during both the Comprehensive Assessment period and the SSM period, for firms borrowing from SIs relative to firms borrowing from LSIs, although the effect is statistically significant only in the latter case. During the SSM period, tangible assets increased by about 0.26 percentage points. Given a mean value of -4.43% across our sample, the point estimate implies that during the SSM period, and relative to the pre-SSM period, total tangible capital declined by 5.9% percent less than it would have in the absence of the reform, for firms borrowing from banks that were affected by the reform.

The evidence also suggests that firms borrowing from SIs experienced a significant increase in current assets, during both the Comprehensive Assessment and the SSM periods (column (4)). These

are defined as cash and short-term assets that can be easily converted into cash. The data suggest that the growth in current assets accelerated by 0.43 percentage points during the Comprehensive Assessment period, and by 0.25 percentage points during the SSM period. Given a mean value of 2.67% across our sample, the point estimate implies that relative to the pre-SSM period, total current assets increased by 16.1% (by 9.4%) percent more than they would have in the absence of the reform, for firms borrowing from banks that were affected by the reform, during the Comprehensive Assessment (during the SSM) period.

The increase in tangible assets and in current assets is mirrored by a significant decline in intangible investment for firms borrowing from SSM-supervised bank, relative to similar firms with a credit relationship with banks supervised by national authorities, during both the Comprehensive Assessment period and the SSM period (column (2)). This investment is related to assets such as R&D that are difficult to collateralize as the bank cannot easily redeploy them. Given an average year-on-year decline in intangible investment in the full sample of 11.7 percentage points, the point estimates of -0.0053 (-0.0049) suggest that for firms borrowing from SSM-supervised banks, intangible investment declined by 4.5% (4.2%) more than for similar firms whose banks continued being supervised by a national authority.

Finally, we find that there is no significant change in other fixed assets, for the treatment relative to the control group (column (3)).

The totality of evidence presented in Table 2 suggests that after the announcement of the SSM, and relative to firms borrowing from Less Significant Institutions, firms borrowing from SSM-supervised banks first reallocated investment away from intangible assets and towards current assets, and then away from intangible assets and towards tangible physical assets. The evidence in Table 2 is consistent with the idea that the centralization of supervision following the announcement and implementation of the SSM was not necessarily associated with a decline in firm investment, but it did affect strongly the composition thereof. In particular, firms moved away from long-term intangible investment, such as investment in R&D, and towards investment in cash (during the Comprehensive Assessment period) and in physical assets (during the SSM period). At the same time, intangible investment is associated with TFP-enhancing activities, which are fundamental for economies at the forefront of technological

progress (e.g., Fernald and Jones, 2014; Corrado and Hulten, 2010). The evidence therefore suggests that centralized supervision may have pushed banks to support less the "new", knowledge-based economy and more the "traditional", capital-based economy.

Our findings are consistent with Gropp, Mosk, Ongena, and Wix (2019), but also suggest that when analysing the real effects of regulatory policies affecting banks' balance sheets, it is important to look at the composition of firms' investment, because different components of firms' assets can be affected differently.

We also need to mention that the explanatory power of the tests is quite high. In the range of four different specifications, the variation in attachment to particular sets of banks, together with firm fixed effects and country-sector-year fixed effects, explains between 36% and 44% of the variation in investment rates over time.

What is the aggregate effect? Take the decline in intangible investment that we document in Table 2, column (2). Around four-fifths of the firms in our sample are borrowing from SIs, and an SI firm has on average intangible assets that are a quarter higher than the intangible stock of a firm borrowing from an LSI. Therefore, the point estimate of -0.0049 implies that total intangible assets in the economy declined by 3.5% percent in the long-run, due to the introduction of the SSM.

5.2 Parallel trends

There are two sources of bias that may be compromising our analysis and that we need to address. The first bias is that the trends we capture precede the announcement and implementation of the SSM. In other words, firms borrowing from banks that switched from national to supra-national supervision were reallocating investment away from intangible and towards tangible assets already before the Banking Union. If so, then we are simply picking a continuation of longer-term trends.

The results in Table 2 mitigate the concerns that our findings are driven by trends independent of the change in supervisory architecture. We now test for the parallel-trends assumption, i.e., for whether the treatment and the control group were subject to the same trend in investment before the

treatment took place, or not. In practice, we estimate the following model:

$$\frac{I_{fbcst}}{K_{fcst-1}} = \beta_1 SI_{fbcs} \times Post2010_t + \mu_f + \phi_{cst} + \varepsilon_{fbcst}, \tag{2}$$

In this model, we only look at the pre-treatment period, and we split it into years 2009 and 2010 (pre-period) and years 2011 and 2012 (post-period). We then aggregate the data into one observation per period, and we compare investment rates across the two periods. If the same trends documented in Table 2 are already visible before 2012, then the parallel-trends assumption would be violated and our results would be compromised.

The point estimates from Equation (2) are reported in Table 3. They clearly suggest that there were no different trends across treatment and control firms before the announcement and the implementation of the SSM. While intangible assets were already declining over time before the announcement of the SSM in 2012 for firms that borrowed from future significant institutions, this relative decline was not significant at any acceptable statistical level. Similarly, both tangible and current assets were on the decline during this period for these firms relative to firms that borrowed from future less significant institutions, but this relative decline was again not statistically significant. Put differently, regardless of the overall trend in different types of investment, this trend was not different for firms borrowing from SIs relative to firms borrowing from LSIs.

Figure 1 plots the series of coefficients and corresponding 90% confidence intervals from estimating regressions analogous to Equation (1), in which we replace $Post2012$ and $Post2014$ with a sequence of year dummies spanning the estimation period. The point estimate is thus a difference-in-differences coefficient measuring the differential time effect for firms borrowing from Significant Institutions were investing at the same rate as firms borrowing from Less Significant Institutions. The reference year is 2012, the year of the introduction of the Banking Union. The timing evidence corroborates a causal interpretation of our results. The plot shows no evidence of pre-trends for any of the four types of assets, meaning that firms borrowing from SIs were investing at the same rate as firms borrowing from LSIs. After 2012, however, tangible assets and current assets increase, and intangible assets decline, for firms borrowing from SIs, compared to firms borrowing from LSIs.

5.3 Placebo test

The second source of bias may be that after 2013, tangible and current investment increased, and intangible investment declined, for all firms borrowing from SSM-eligible (i.e., larger) banks, regardless of whether the SSM actually took over the supervision of these banks. While both possibilities are not immediately defensible, we need to formally address them, before we can have full confidence in our findings.

In Table 4, we apply our empirical setting and estimation to European countries whose banks did not fall under the SSM from 2014 onward. We focus on Denmark, Hungary, and the UK, all of which have reasonable coverage, in terms of firms in Orbis as a share of all firms in the country according to Eurostat (for details, see Kalemli-Ozcan, Laeven, and Moreno, 2018). At the same time, none of these countries is a euro-area member state, meaning that its domestic banks did not move to being centrally supervised by the SSM after 2014. We then apply the SSM criterion to the banks which the firms in Orbis have a credit relationship with. 42 percent of the firms in this new sample are borrowing from one of the pseudo-SSM banks.

We then re-estimate Equation (1) on the same sample period, using the distinction significant versus less significant institution in the context of these four non-euro area countries. The estimates from these tests strongly suggest that, except for a decline in tangible investment during the CA period, there are no differences in investment pattern across the two groups of firms, before and after the start of the euro area's Banking Union. We conclude that the main results in our paper are indeed driven by the transition to centralized supervision, rather than by a global trend in investment reallocation by firms borrowing from large banks.

5.4 Matched sample

Controlling for firm-level heterogeneity, as we have done so far, may not be sufficient if the treatment and control sample are too different, based on observables. Indeed, Table 1 documents significant differences across firms, depending on which group of banks they have a credit relationship with. In particular, firms borrowing from banks that switched from being supervised by national supervisors

to being supervised directly by the SSM are smaller and have higher sales-to-assets and cash flow-to-assets ratios. Simply controlling for these on the right-hand side of the regressions might be insufficient if the distributions of these variables across treated and control samples do not overlap sufficiently (see Rosenbaum and Rubin, 1983).

To address this point, we proceed to apply a propensity-score matching criterion for choosing the treatment and control observations. In particular, for each firm, we calculate a propensity score based on pre-treatment observations (i.e. before 2012) of the following firm-level variables: the natural logarithm of total assets; the ratio of sales to assets; the ratio of cash flow to assets; and firm age. These are firm-specific variables that exhibit statistically significant differences across the two sub-sample of firms, according to Table 1. We then use this propensity score to match observations across groups, dropping observations where the propensity score is smaller than 0.05.

The estimates reported in Table 5 show that our results are confirmed in the matched sample. Even with this very restrictive approach, we continue finding that both during the Comprehensive Assessment period and during the SSM period, and relative to firms borrowing from banks supervised by national authorities, firms borrowing from SSM-supervised banks experienced a decline in intangible assets (column (2)), with this effect being significant at the 1% significance level. This is counterbalanced by an increase in tangible assets during the SSM period (column (1)), and by an increase in current assets during both the Comprehensive Assessment period and the SSM period (column (4)). The magnitudes of the estimated coefficient are similar to the ones in Table 2, further reassuring us that the results so far are not driven by firm-differences between the treatment and the control samples. We conclude that the broad reallocation of investment away from intangible capital and towards tangible assets and cash that we observe in the aftermath of the announcement of the SSM is not driven by comparing observationally dissimilar firms.

5.5 Robust model

We subject our estimates to a number of robustness tests, reported in the Appendix, aimed at making sure that the results reported in Table 2 are not an artefact of using a particular empirical set-up. To that end, we re-run Model 1 with firm-level controls, with alternative clustering schemes, with bank

fixed effects, allowing for the error terms in the individual equations to be correlated, and on annual data.

For a start, the model estimated in Table 2 may be mis-specified because we do not control for other firm-level characteristics that can be correlated with investment decisions. In particular, changes in investment may be a function of the firm's size, debt, or profitability. The country-sector-period fixed effects that we employ allow us to control for trends that are common across firms within a country-sector, therefore, we are accounting for unobservable country-sector trends (such as TFP growth in the textile industry in Greece). Nevertheless, many of the important trends that drive investment can be at the firm rather than country-sector level.

To that end, in Appendix Table 1 we re-estimate a version of Equation (1) which includes a set of firm-specific controls: the natural logarithm of total assets, the ratio of sales to assets, the ratio of total debt to assets, the ratio of cash flow to assets, and age. To address the possibility that these are jointly determined with investment, we measure these firm controls with a 1-year lag. Furthermore, we also include the interactions of these variables with the variables $Post2012$ and $Post2014$, though we do not report the coefficients. In this way, we allow for the possibility that the impact of, for example, debt overhang on intangible investment is different before and after the announcement of the SSM.

The evidence reported in Appendix Table 1 confirms the main results. After the introduction of centralized supervision, and relative to firms borrowing from banks that continued being supervised by national authorities, firms borrowing from SSM-supervised banks experience a decline in intangible fixed assets (column (2)), both during the Comprehensive Assessment period and during the SSM period. This decline is counterbalanced by an increase in current assets during the Comprehensive Assessment period (column (4)) and in tangible assets during the SSM period (column (1)).

Next, we note that our clustering scheme may be insufficiently conservative. It is possible that the standard errors are correlated across firms within countries, rather than within country-period, because of long-term factors. Alternatively, it is possible that the right clustering of the standard errors is at the bank-period level, because this is the unit of the shock induced by the supervisory reform.

In Appendix Tables 2 and 3, we report the estimates from Equation 1 where the standard errors are clustered at the country and bank-period level, respectively. In both cases, the main result of the analysis—the decline in intangible investment, both during the CA and the SSM period, at firms attached to Significant Institutions—continues to obtain. In both cases, this effect is counterbalanced by an increase in current assets, as well as an increase in tangible assets, albeit the latter effect is not statistically consistent across the two specifications.

Another way in which the model estimated in Table 2 can be misspecified is that in Equation (1) we do not control for other, non-SSM related shocks that may be affecting the level and composition of banks' credit supply. To address this possibility, in Appendix Table 4 we re-estimate Model (1) after including bank fixed effects, in addition to firm fixed effects and interactions of country, sector, and period dummies. The point estimates of the coefficients of interest in Equation (1) continue to confirm the main results of the paper: namely, investment in intangible assets by firms borrowing from SSM banks declined after the start of the SSM and persisted both during the Comprehensive Assessment period and the SSM period (column (2)), an effect significant at the 1%-level. In addition, the accompanying increase in tangible investment and in current assets continues to obtain, and both effects are significant, at the 10% and at the 1% statistical level, respectively.

The next concern is related to the fact that we have so far estimated Equation (1) for various types of investment, one equation at a time. The assumption implicit in this approach is that decisions on how to adjust a particular type of investment over time are taken in isolation. This may not necessarily be the case; in fact, it is fairly likely that the reallocation of investment is driven by a joint process, which at a minimum implies that the errors in the four different equations may be correlated. To account for this possibility, we estimate the four variants of Equation (1) reported in Table 2 using Seemingly Unrelated Regressions (SUR). This allows us to flexibly assume that the errors in the four equations are correlated. It also addresses the concern that the four different estimates in Table (2) are based on a different number of observations, e.g., 558,580 in the case of current assets, but only 201,287 in the case of intangible assets. This is because we only require that each firm in the regressions has at least one observation during each of the three periods under consideration (2010–2012, 2013–2014, and 2015–2017). At the same time, intangible assets are observed for fewer firms than current assets,

and are reported for fewer years, than tangible or current assets.

The estimates from the SUR are reported in Appendix Table 5. This time, the sample is balanced with 150,702 observations in each column. We continue finding a strong decline in intangible assets, accompanied by a strong increase in tangible assets, during both the CA and the SSM period. In both cases, the effect is significant at least at the 5% statistical level. At the same time, we find a significant decline in current assets during both periods, which is somewhat at odds with the evidence so far. We conclude that we can be fairly certain that the bank-supervision-induced long-run reallocation from intangible to tangible investment is not driven by failing to account for common shocks to the various types of investment.

Next, we note that our preferred Equation (1) is based on aggregated firm-specific data within three periods. This has resulted in three observations per firm out of possible eight. On the plus side, this allows us to flexibly deal with potential autocorrelation in the standard errors over time within a firm, which is consistent with the recommended approach in Bertrand, Duflo, and Mullainathan (2004). On the downside, our preferred approach has resulted in the loss of some information. We now run a version of Equation (1) where we still require that each firm has at least one observation in each of the three periods under consideration, but instead of collapsing the data, we use all possible observations over the course of 2010–2017.

We report the estimates from these alternative tests in Appendix Table 6 and find that even in this less restrictive specification, the estimates continue to lend strong support to the notion that supervisory reform is followed by a reallocation of investment. The evidence continues to suggest that relative to firms borrowing from less significant institutions, firms borrowing from SSM-supervised banks decreased significantly their investment in intangible assets during both the Comprehensive Assessment period and the SSM period (column (2)). At the same time, these same firms increased significantly their investment in tangible assets, especially during the SSM period (column (1)). They also increased significantly their current assets during the Comprehensive Assessment period (column (4)).

5.6 Industry heterogeneity

Is the effect we document in the paper identical across the different sectors of the economy? Or is it stronger for some sectors? One natural margin to examine in answering this question is the sector's technological composition of investment. For example, some sectors at the forefront of the modern economy (biotech, high-tech, robotics) rely more on intangible investment, such as R&D and human capital, and less on tangible investment, such as machines. Other, more traditional sectors (textile, timber) rely relatively more on tangible investment and to a lesser degree on innovation and human capital. The effect we document in this paper–a firm-level reallocation away from intangible and towards tangible investment–would have an even more profound effect if it took place in sectors that are technologically more suited to intangible asset growth.

To test for this possibility, we modify Equation (1) in the following way. First, we create a sector-level variable which denotes the sector's technological innovation intensity. To that end, we follow Hsu, Tian, and Xu (2014) and use data on R&D and patents for a global sample of firms to calculate a sector-specific proxy for innovation intensity. Then we interact this sectoral benchmark with the interaction of bank dependence and the *Post* dummy, as follows:

$$\begin{aligned} \frac{I_{fbcst}}{K_{fcst-1}} &= \beta_1 SI_{fbcs} \times Post2012_t + \beta_2 SI_{fbcs} \times Post2012_t \times Innovation_s \\ &+\beta_3 SI_{fbcs} \times Post2014_t + \beta_4 SI_{fbcs} \times Post2014_t \times Innovation_s \\ &+\mu_f + \phi_{cst} + \varepsilon_{fbcst}, \end{aligned} \tag{3}$$

where $Innovation_s$ is a sector-level benchmark that is common to all firms in the same sector. We omit the interactions $Innovation_s \times Post_t$ and $SI_{fbcs} \times Innovation_s$ because they are subsumed in the country x industry x period fixed effects. The coefficient β_2 (β_4) now measures the change in investment during the Comprehensive Assessment period (SSM period), for firms borrowing from affected versus non-affected banks, in innovation-intensive versus innovation-non-intensive sectors.

We borrow three proxies for $Innovation_s$ from Hsu, Tian, and Xu (2014). The first one, R&D, is calculated as the sum of all R&D expenses divided by total sales reported by public firms in an industry between 1976 and 2006, globally. The second one, *Patents*, is calculated as the sum of

all patents with the USPTO by non-government organizations or individuals in an industry between 1976 and 2006, globally. The third one, $High - tech$, is the cross-sectional median in of annual gross growth in R&D expenses in a industry between 1976 and 2006. All three proxies capture, in one way or another, a similar aspect of the sector's technology that is related to innovation, or intangibles-based growth. Finally, the underlying data are only available for the manufacturing sector, and as a result, the number of observations declines relative to the previous tests.

The estimates of Equation (3) are reported in Table 6. In this reduced sample of manufacturing sectors, we no longer find any effect of the supervisory reform on tangible assets or on current assets. At the same time, the evidence points to a strong reduction in intangible assets during the CA period, in particular in sectors that are innovation-intensive. This is true regardless of whether we define innovation intensity using data on R&D levels (Panel A), on patents (Panel B), or on R&D growth (Panel C). In two of the three cases, the decline is significant at the 1% statistical level, and at the 10% level in the third case. Our evidence thus suggests that the reallocation away from more towards less TFP-enhancing investment we documented in Table 2 is affecting the sectoral asset composition, too. As a result, more innovative sectors are moving away from assets that are to a larger degree associated with innovation. Given that in the long-run, around 60% of GDP growth is due to R&D investment, and around 0% due to physical capital accumulation (Fernald and Jones, 2014), our evidence suggests that stability-enhancing supervision may have adverse consequences for some of the channels of long-term growth.

5.7 Employment and labor productivity

In this subsection, we address two important questions. The first concerns the degree of complementarity between investment and employment. The extent to which capital and labor are complements or substitutes in production is typically driven by the firm's technology. At the same time there may be important differences among various types of investments. For example, in the presence of strong skill bias, labor should move in the same direction as intangible investment. In contrast, if labor is mostly low-skill, it will likely move in the same direction as investment in fixed assets, such as land, building, and machines. Moreover, the impact of supervisory reform on employment is an important

question on its own, and its answer provides additional insights to the welfare implications of the policy we study.

To address this issue, we now estimate the following model:

$$\begin{aligned} \Delta Employment_{fbcst} &= \beta_1 SI_{fbcs} \times Post2012_t + \beta_2 SI_{fbcs} \times Post2014_t \\ &+ \mu_f + \phi_{cst} + \varepsilon_{fbcst}, \end{aligned} \tag{4}$$

where the dependent variable is now the change in the firm's total employment. Note that Orbis does not allow us to distinguish between skilled and unskilled labor. As before, the main variable of interest is the interaction between an indicator variable equal to one if the firm has a credit relationship with a bank affected by the introduction of the SSM, and two indicator variables equal to one during 2012–2013 and after 2014, respectively, for all firms. The regressions also include firm and country-year fixed effects. The results from the estimation of Equation (4) are reported in column (1) of Table 7.

The estimates in Table 7 show a significant decline in employment during the period of the Comprehensive Assessment, and a significant increase in employment during the SSM period. Combined with the evidence reported in Table 2, our results suggest that there is a strong complementarity between physical capital and employment in the long run. At the same time, there is no such complementarity between employment and intangible capital, as they move in opposite directions during the SSM period. The evidence thus suggests that the SSM-instigated reallocation in firm investment, away from intangible and towards tangible assets, has material implications for labor demand, too, as tangible capital and employment move in lockstep in the long run.

Next, we address the question of whether the reallocation of investment away from intangible assets and towards tangible assets and cash has any effect on the firm's productivity. As a proxy for firm-specific productivity, we construct a variable *Labor productivity* by dividing the firm's output by

the firm's total employment. We therefore estimate the following equation:

$$\begin{aligned}\Delta \frac{Output_{fbcst}}{Employment_{fcst}} &= \beta_1 SI_{fbcs} \times Post2012_t + \beta_2 SI_{fbcs} \times Post2014_t \\ &+ \mu_f + \phi_{cst} + \varepsilon_{fbcst},\end{aligned} \tag{5}$$

The point estimates from Equation (5) are reported in column (2) of Table 7. They suggest that during the SSM period, labor productivity declined strongly and significantly. Given a sample average increase in labor productivity of 0.0118 during the full sample period, the point estimate of -0.0018 suggests that relative to firms borrowing from less significant institutions, labor productivity at firms borrowing from significant institutions declined by about 15.3%. Our results thus suggests that the reduction in intangible assets by firms borrowing from banks affected by the SSM can be associated with a reduction in productivity. This is independent of the fact that some types of assets (tangible and current) actually increase.

The results in Table 7 thus suggest that while the supervisory reform made banks safer, partly by leading them to adopt safer lending portfolios, this safety may have come at the expense of lower long-term growth, as proxied by a reduction in firm-level productivity.

5.8 Supervisory reform and the evolution of lending

So far, we have focused mostly on different investment types, as well as employment and productivity as outcome variables. To better understand the mechanisms, through which changes in supervisory architecture affects investment and productivity, we now turn to lending, first using firm-level and then bank-level data.

5.8.1 Analysis based on firm-level data

Our evidence so far raises the natural question of the channel whereby changes in the quality of supervision affect firm investment. One possibility is a reduction in bank lending. A stricter supervisor can ask banks to lower the risk of their asset portfolios. Banks may respond to this demand by shrinking their lending portfolio and increasing their (sovereign) bond portfolio (see Fiordelisi, Ricci, and

Stentella Lopes, 2017, for supporting evidence), which would account for the reduction in intangible investment at the firm level that we document. A second possibility is a change in the manner of lending. Banks may be extending the exact same amount of loans to non-financial corporations, but under stricter collateral rules. In this case, firms would be forced to change their investment pattern towards one where relatively more tangible assets are generated. This would account for both the increase in tangible investment and the decline in intangible investment that we document.

While the Orbis dataset does not include information on loan conditionality, we can test for changes in firm borrowing following the change in supervisory architecture. In addition to other types of financial information, firms report their overall indebtedness. We summarize this information in Table 1. We can now use it as an outcome variable and thus check for the impact of supervision on total debt, for treated relative to control firms.

To that end, we estimate the following equation:

$$\frac{Debt_{fbcst}}{Assets_{fcst-1}} = \beta_1 SI_{fbcs} \times Post2012_t + \beta_2 SI_{fbcs} \times Post2014_t + \mu_f + \phi_{cst} + \varepsilon_{fbcst}, \tag{6}$$

where the dependent variable is now the firm's total debt, the firm's short-term debt (maturity less than 1 year) or the firm's long-term debt (maturity more than 1 year), scaled by the firm's total assets. As before, the main variable of interest is the interaction between an indicator variables equal to one if the firm has a credit relationship with a bank affected by the introduction of the SSM, and two time indicator variables, *Post2012*, which is equal to one in 2013–2014, and *Post2014*, which is equal to one in 2015–2017, for all firms. The regressions also include firm and country-year fixed effects, and clustering is at the country-period level.

The results are reported in Table 8, and they provide some statistical evidence that borrowing declined for firms linked to banks subject to the change in supervisory architecture. The data point to an increase in short-term debt during the CA period (column (1)). Short term debt is also higher during the SSM period, but this effect is not statistically significant. At the same time, there is a pronounced decline in long-term debt during the SSM period (column (2)). Given a sample mean of -0.1197, the point estimates of -0.0059 implies a decline of 4.9% in long-term debt.

We conclude that there is some evidence in the data to support the idea that following the intensification of supervision, banks have increased short-term lending, and reduced long-term lending, to non-financial corporations. Given that intangible investment, such investment in R&D, is by definition long-term, the effect we document in Table 8 can partially explain the reduction in intangible investment that we document throughout the paper. At the same time, an effect that we cannot document—safer lending based more than before on tangible collateral—could be at play, too, helping to explain the increase in tangible assets at the firm level after the start of the SSM.

5.8.2 Analysis based on bank-level data

We now assess the impact of changes in the supervisory architecture on lending using bank-level data. To that end, we employ the IBSI dataset. As discussed in Section 3.2, this high-frequency data source contains end-of-month data on assets and liabilities, starting in August 2007, for 247 individual financial institutions in 18 European countries. The initial dataset thus corresponds to about 70 percent of the euro area's banking sector. The data contains information on the stock of total lending, as well as on the stock of lending to various classes of customers, in particular NFCs which are the main focus of our analysis. The data allow for a further distinction between lending to domestic customers and customers from other euro area countries.

We focus on euro area countries with at least one significant and one less significant institution included in IBSI, where the institutions in both groups are comparable in size. This leaves us with 186 banks across 11 euro-area countries, compared to 294 banks in the dataset which is based on Orbis. As in the tests so far, we study both the impact of the Comprehensive Assessment and of the SSM itself.

Our main variable of interest is the change in NFC Lending, defined as the period-on-period difference in the natural logarithm of total lending to domestic NFCs. As before, and to account for potential serial correlation, given that the underlying data are monthly, we follow Bertrand, Duflo, and Mullainathan (2004) and we aggregate the information into three periods. The first period is the pre-Comprehensive Assessment period, which covers the period between January 2010 and December 2012. The second period is the Comprehensive Assessment period, which covers the period between

January 2013 and December 2014. The third period is the SSM period, which covers the period between January 2015 and December 2017. In this way, we analyze a 7-year period consisting of three sub-periods of unequal length.

With these data at hand, we estimate the following model:

$$\Delta NFCLending_{bct} = \beta SI_{bct} \times Post2012_t + \gamma SI_{bct} \times Post2014_t + \mu_b + \phi_{ct} + \varepsilon_{bct}, \tag{7}$$

Here SI is a dummy variable equal to one if the bank is a Significant Institution, and to zero otherwise. Once again, there are three observations per bank, one for each period. The causal interpretation of the overall effect is based on the randomness of the SSM assignment around an arbitrary bank-size threshold. Identification is further strengthened by the inclusion of bank fixed effects, which allows us to hold control for unobservable time-invariant bank-specific factors. Furthermore, we include country-period dummy interactions, which allows us to net out the impact of country-specific shocks that are common to both Significant and Less Significant Institutions within the same country.

The results in column (1) of Table 9 point to a 6.5% reduction in total lending to domestic NFCs during the Comprehensive Assessment period. This effect is significant at the 1% statistical level. The data thus strongly suggest that the reform in European supervisory architecture was associated with a reduction in lending both in the short run (Table 9) and in the long run (Table 8).

In column (2) of Table 9, we include interactions with bank capital on the right-hand side of equation (7). We calculate bank capital as the average ratio of the banks' equity to total assets before the announcement of the SSM in 2012. The point estimates suggest that the decline in corporate lending during the Comprehensive Assessment period was significantly larger for SIs which had relatively low capital levels before the announcement of the SSM. The coefficient on the triple interaction implies that an SI bank reduced corporate lending by a quarter of a standard deviation more if it was at the 25th, relative to the 75th, percentile of pre-SSM capital levels. This finding supports the notion put forth in Carletti, Dell'Arriccia, and Marquez (2021) that the effect of supervision on bank risk taking crucially depends on the bank's degree of capitalization. The findings on lower lending by Significant Institutions after they shift to SSM supervision is consistent with previous research by Fiordelisi,

Ricci, and Stentella Lopes (2017), Eber and Minoiu (2016), and Altavilla, Boucinha, Peydro, and Smets (2020).

The estimates reported in Tables 8 and 9 thus allow us to conclude that at least in part, the reduction in intangible investment for firms with credit relationships to SSM banks appears to be driven by a reduction in overall lending by such banks to their corporate clients.

6 Conclusion

Theory provides opposing hypotheses on the effect of supervisory architecture on bank lending and thus corporate finance. On the one hand, centralized supervision might be more effective, if bank supervision exhibits scale economies. Centralised supervision might also be better able to reduce the risk of banks arbitraging differences in regulatory stringency across countries. On the other hand, centralized supervisors' ability to extract information from banks may be lower. Centralized supervision can also reduce the monitoring of firms, if it reduces the incentives for local supervisors to collect information. These conflicting theories have corresponding conflicting predictions about the impact of different supervisory organizations on bank lending and risk taking, as well as on the decisions that firms borrowing from affected banks take.

In this paper, we take this theoretical ambiguity to the data, using the introduction of the SSM as an exogenous shock to how some (but not all) euro-area firms' lenders are supervised. We find that relative to firms with credit relationships to banks that remained under the supervision of national authorities, firms borrowing from SSM-supervised banks reduced investment in intangible assets. These same firms increased cash holdings in the short-run, and investment in tangible assets in the long run. These effect are robust to controlling for observable and unobservable firm heterogeneity, to controlling for country trends, to controlling for firm-specific balance sheet shocks, to comparing very similar distributions of treated and control firms, and to controlling for bank connections. Importantly, these trends do not pre-date the announcement and introduction of the SSM, and they are not observed in counterfactual tests in countries that did not join the SSM.

The main effect in the paper is stronger in innovation-intensive industries. We also find that in the

long-run, employment increases at affected firms, but labor productivity declined. This points to a sustained negative effect from the reduction in productivity-enhancing intangible investment. Finally, we also find that part of the effect in the paper is explained by a reduction in overall lending, and especially by long-term lending, by banks affected by the supervisory reform.

Overall, our results suggest that centralized bank supervision is associated with a decline in lending to firms, which is accompanied by a shift away from intangible investment and towards more cash holdings and higher investment in easily collateralizeable physical assets. This is an instructive result, in light of the fact that in the long run, capital investment has a negligible contribution to economic growth, while R&D investment accounts for the bulk of long-term growth (Fernald and Jones, 2014). The combination of the two effects we document thus raises the possibility that centralized bank supervision can slow down the shift from the "old", capital-based, to the "new", knowledge-based, economy.

Several caveats are in order when interpreting our empirical results. First, we use the introduction of centralized supervision as quasi-natural shock to firms whose main lender shifted to SSM-supervision. Obviously, the allocation of firms to treated and control banks is not random, which might introduce a bias into our analysis. However, we use an array of different methods to control for any bias that such non-random assignment might pose. Second, while we confirm our findings are consistent across firm- and bank-level regressions, we can only shed limited light onto the channels through which centralized supervisors affects banks' risk-taking and firm's funding and investment choices. We leave the more thorough exploration of such channels to future research.

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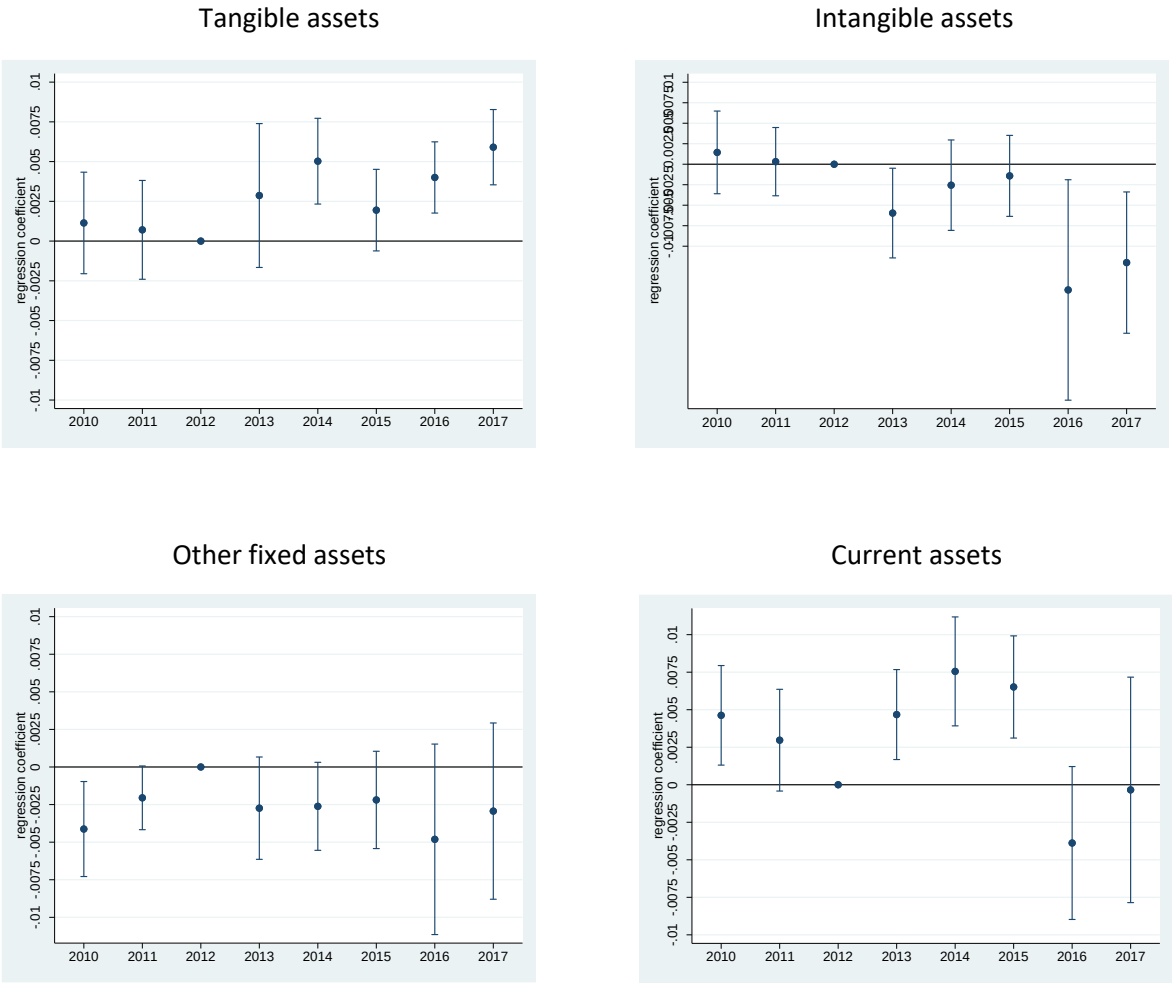
Figure 1. SSM and firm assets over time: SI versus LSI firms



Note: The figure uses annual data for the period 2010 to 2017. The graph plots period-by-period coefficients and 90% confidence intervals that we obtain by replacing in Equation (1) the variables *Post2012* and *Post2014* in the interaction with *SI* with a sequence of year dummies.

Table 1. Summary statistics

Panel A. Firm-specific outcomes, full sample period

	(1)	(2)	(3)	(4)
	Mean	St. dev.	Min.	Max.
Δ Tangible assets	-0.0443	0.2089	-1.00	1.00
Δ Intangible assets	-0.1170	0.2873	-1.00	1.00
Δ Other fixed assets	0.0260	0.2022	-1.00	1.00
Δ Current assets	0.0267	0.1606	-1.00	1.00
Δ Employment	0.0038	0.1425	-1.00	1.00
Δ Labor productivity	0.0118	0.1762	-1.00	1.00
Δ Total debt / Assets	-0.0682	0.6941	-1.00	1.00
Δ Short-term debt / Assets	-0.0405	0.9289	-1.00	1.00
Δ Long-term debt / Assets	-0.1197	0.6646	-1.00	1.00
# firms	188,600			

Panel B. Firm-specific factors, pre-treatment

	(1)	(2)	(3)	(4)
	Full sample	SI = 0	SI = 1	Difference
Log (Assets)	14.2729	14.3168	14.2630	0.0538***
Sales / Assets	1.6509	1.5218	1.6798	-0.1580***
Debt / Assets	0.2327	0.2727	0.2240	0.0486***
Cash / Assets	0.0665	0.0583	0.0684	-0.0101***
Age	20.1915	18.8533	20.4917	-1.6384***
# firms	188,600	34,567	154,033	

Note: The Table summarizes the variables used in the empirical tests. The sample period is 2010—2017 (Panel A) and 2010—2012 (Panel B). Only firms that report a credit association with at least one bank are included. In column (2) of Panel B, summary statistics are reported for firms with a credit relationship with a less significant institution (SI = 0). In column (3) of Panel B, summary statistics are reported for firms with a credit relationship with a significant institution (SI = 1). In column (4) of Panel B, comparison-in-means from a two-sided Mann-Whitney test are reported. 'Δ Total assets' denotes the year-on-year percentage change in the firm's total assets. 'Δ Tangible assets' denotes the year-on-year percentage change in the firm's tangible assets. 'Δ Intangible assets' denotes the year-on-year percentage change in the firm's intangible assets. 'Δ Other fixed assets' denotes the year-on-year percentage change in the firm's other fixed assets total assets. 'Δ Current assets' denotes the year-on-year percentage change in the firm's current assets. 'Δ Employment' denotes the year-on-year percentage change in the firm's employees. 'Log (Assets)' denotes the natural logarithm of the firm's total assets. 'Sales / Assets' denotes the ratio of the firm's total sales to the firm's total assets. 'Debt / Assets' denotes the ratio of the firm's total debt to the firm's total assets. 'Cash / Assets' denotes the ratio of the firm's cash flow to the firm's total assets. 'Age' is the firm's age in years. Data come from Orbis.

Table 2. Bank supervision and firm investment: Main result

	(2)	(3)	(4)	(5)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SI	0.0030	-0.0053***	-0.0001	0.0043***
	(0.0020)	(0.0015)	(0.0010)	(0.0012)
Post 2014 × SI	0.0026*	-0.0049***	0.0003	0.0025***
	(0.0014)	(0.0016)	(0.0013)	(0.0008)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering		Country × Period		
Observations	531,446	201,287	369,289	558,580
R-squared	0.43	0.44	0.36	0.36

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 3. Bank supervision and firm investment: Pre-trends

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2010 × SI	-0.0011	-0.0017	0.0044**	-0.0029
	(0.0031)	(0.0023)	(0.0019)	(0.0023)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering		Country × Period		
Observations	343,856	141,722	227,886	363,354
R-squared	0.59	0.63	0.53	0.51

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2010' is a dummy variable equal to one in 2011 and 2012. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in two observations per firm, one average for the 2009—2010 period, and one average for the 2011—2012 period. In all regressions, only firms with at least one observation before and at least one observation after 2011 are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009—2012. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 4. Bank supervision and firm investment: Placebo

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2012 × SI	-0.0127**	-0.0007	-0.0126	0.0016
	(0.0057)	(0.0211)	(0.0145)	(0.0061)
Post 2014 × SI	-0.0066	-0.0027	0.0081	0.0034
	(0.0058)	(0.0218)	(0.0157)	(0.0073)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering	Country × Period			
Observations	51,900	4,911	4,752	59,328
R-squared	0.40	0.51	0.45	0.34

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank would be a significant institution if the country was under the jurisdiction of the SSM. The sample includes firms domiciled in Denmark, Hungary, and the UK. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010–2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 5. Bank supervision and firm investment: Matched sample

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed Assets	Δ Current assets
Post 2012 × SI	0.0030	-0.0052***	-0.0003	0.0043***
	(0.0020)	(0.0014)	(0.0010)	(0.0011)
Post 2014 × SI	0.0028***	-0.0045***	0.0002	0.0023***
	(0.0014)	(0.0014)	(0.0013)	(0.0007)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering	Country × Period			
Observations	523,364	198,715	365,433	548,438
R-squared	0.43	0.44	0.36	0.36

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period, for each individual variable in columns (1)—(4), are included. The treatment and control groups are chosen after a propensity-score matching procedure, based on pre-2013 observations of 'Log (Assets)', 'Sales / Assets', 'Cash / Assets', and 'Age'. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 6. Bank supervision and firm investment: Industry heterogeneity

Panel A. R&D intensity

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2012 × SI	-0.0013	0.0048	-0.0036	0.0032
	(0.0036)	(0.0071)	(0.0023)	(0.0033)
Post 2012 × SI × R&D	0.0012	-0.0124***	0.0052*	0.0006
	(0.0025)	(0.0047)	(0.0027)	(0.0027)
Post 2014 × SI	0.0034	-0.0114	0.0052**	0.0006
	(0.0033)	(0.0098)	(0.0021)	(0.0023)
Post 2014 × SI × R&D	0.0012	0.0044	-0.0053**	0.0018
	(0.0019)	(0.0066)	(0.0026)	(0.0021)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering		Country × Period		
Observations	91,850	37,014	61,662	94,595
R-squared	0.43	0.42	0.37	0.36

Panel B. Patent intensity

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2012 × SI	-0.0014	0.0041	-0.0028	0.0026
	(0.0038)	(0.0067)	(0.0019)	(0.0030)
Post 2012 × SI × Patents	0.0032	-0.0255***	0.0093*	0.0030
	(0.0057)	(0.0089)	(0.0052)	(0.0053)
Post 2014 × SI	0.0026	-0.0105	0.0052**	-0.0006
	(0.0035)	(0.0095)	(0.0019)	(0.0022)
Post 2014 × SI × Patents	0.0047	0.0072	-0.0116**	0.0070*
	(0.0044)	(0.0127)	(0.0054)	(0.0038)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering		Country × Period		
Observations	91,850	37,014	61,662	94,595
R-squared	0.43	0.42	0.37	0.36

Panel C. High-tech intensity

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2012 × SI	-0.0963	0.1848	-0.1741***	0.0490
	(0.0667)	(0.1245)	(0.0548)	(0.0513)
Post 2012 × SI × High-tech	0.0903	-0.1783*	0.1643***	-0.0426
	(0.0627)	(0.1168)	(0.0521)	(0.0475)
Post 2014 × SI	-0.0554	-0.0781	0.1405**	-0.1132***
	(0.0628)	(0.1636)	(0.0639)	(0.0398)
Post 2014 × SI × High-tech	0.0561	0.0660	-0.1312**	0.1083***
	(0.0583)	(0.1532)	(0.0610)	(0.0374)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering	Country × Period			
Observations	91,850	37,014	61,662	94,595
R-squared	0.43	0.42	0.37	0.36

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period, for each individual variable in columns (1)—(4), are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. 'R&D' is the sum of all R&D expenses divided by total sales reported by public firms in an industry between 1976 and 2006. 'Patents' is the sum of all patents with the USPTO by non-government organizations or individuals in an industry between 1976 and 2006. 'High-tech' is the cross-sectional median in of annual gross growth in R&D expenses in a industry between 1976 and 2006. Data on these three industry benchmarks come from Hsu, Tian, and Xu (2014). Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 7. Bank supervision, employment, and labor productivity

	(1)	(2)
	Δ Employment	Δ Labor productivity
Post 2012 × SI	-0.0013**	0.0002
	(0.0006)	(0.0008)
Post 2014 × SI	0.0018***	-0.0018**
	(0.0005)	(0.0007)
Firm FEs	Yes	Yes
Country × Sector × Period FEs	Yes	Yes
Clustering	Country × Period	
Observations	449,766	446,179
R-squared	0.38	0.27

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's employment (column (1)), and the year-on-year percentage change in the firm's output per worker (column (2)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period, for each individual variable in columns (1)—(4), are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 8. Bank supervision and firm debt: Orbis data

	(1)	(2)
	Δ Short-term debt / Assets	Δ Long-term debt / Assets
Post 2012 × SI	0.0085**	-0.0003
	(0.0040)	(0.0029)
Post 2014 × SI	0.0041	-0.0059*
	(0.0060)	(0.0036)
Firm FEs	Yes	Yes
Country × Sector × Period FEs	Yes	Yes
Clustering	Country × Period	
Observations	135,906	148,710
R-squared	0.33	0.34

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's ratio of debt with maturity of less than one year to total assets (column (1)), and the year-on-year percentage change in the firm's ratio of debt with maturity over one year to total assets (column (2)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 9. Bank supervision and lending to firms: IBSI data

	(1)	(2)
	Δ Loans / Assets	
Post 2012 × SI	-0.0654***	-0.1185***
	(0.0254)	(0.0313)
Post 2014 × SI	-0.0060	-0.0133
	(0.0225)	(0.0318)
Post 2012 × Capital		-0.3466*
		(0.1882)
Post 2014 × Capital		0.1695
		(0.2155)
Post 2012 × SI × Capital		0.6536***
		(0.2352)
Post 2014 × SI × Capital		0.1058
		(0.1850)
Bank FEs	Yes	Yes
Country × Period FEs	Yes	Yes
Observations	520	520
R-squared	0.49	0.49

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the period-on-period log difference in total lending to all domestic non-financial corporations. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the bank is a significant institution. 'Capital' is the bank's average ratio of equity to total assets before the announcement of the SSM. All regressions include fixed effects as specified. The sample period is 2010—2017. Data come from IBSI. All regressions include fixed effects as specified. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 1. Bank supervision and firm investment: Controlling for lagged firm characteristics

	(1)	(2)	(3)	(4)
	Δ Tangible Assets	Δ Intangible assets	Δ Other fixed Assets	Δ Current assets
Post 2012 × SI	0.0027	-0.0056***	0.0001	0.0024**
	(0.0022)	(0.0017)	(0.0011)	(0.0012)
Post 2014 × SI	0.0028**	-0.0029**	0.0011	0.0009
	(0.0015)	(0.0016)	(0.0015)	(0.0009)
Firm controls	Yes	Yes	Yes	Yes
Post 2012 × Firm controls	Yes	Yes	Yes	Yes
Post 2014 × Firm controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering	Country × Period			
Observations	473,910	189,689	339,682	492,689
R-squared	0.43	0.44	0.37	0.40

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. 'Firm controls' include 'Log (Assets)', 'Sales / Assets', 'Debt / Assets', 'Cash / Assets', and 'Age', all 1-period lagged. In all regressions, only firms with at least two observations during each period, for each individual variable in columns (1)—(4), are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 2. Bank supervision and firm investment: Clustering at country level

	(2)	(3)	(4)	(5)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SI	0.0030	-0.0053***	-0.0001	0.0043**
	(0.0028)	(0.0017)	(0.0011)	(0.0017)
Post 2014 × SI	0.0026**	-0.0049**	0.0003	0.0025***
	(0.0012)	(0.0019)	(0.0018)	(0.0006)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering			Country	
Observations	531,446	201,287	369,289	558,580
R-squared	0.43	0.44	0.36	0.36

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 3. Bank supervision and firm investment: Clustering at bank-period level

	(2)	(3)	(4)	(5)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2012 × SI	0.0030*	-0.0053*	-0.0001	0.0043***
	(0.0017)	(0.0033)	(0.0022)	(0.0015)
Post 2014 × SI	0.0026	-0.0049*	0.0003	0.0025*
	(0.0021)	(0.0031)	(0.0021)	(0.0014)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering		Bank × Period		
Observations	531,446	201,287	369,289	558,580
R-squared	0.43	0.44	0.36	0.36

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the bank-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 4. Bank supervision and firm investment: Controlling for bank-level omitted variables

	(1)	(2)	(3)	(4)
	Δ Tangible Assets	Δ Intangible Assets	Δ Other fixed Assets	Δ Current assets
Post 2012 × SI	0.0030*	-0.0053***	-0.0001	0.0043***
	(0.0020)	(0.0015)	(0.0010)	(0.0012)
Post 2014 × SI	0.0025*	-0.0049***	0.0003	0.0025***
	(0.0014)	(0.0016)	(0.0013)	(0.0008)
Firm FEs	Yes	Yes	Yes	Yes
Bank FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering	Country × Year			
Observations	531,386	201,250	369,246	558,515
R-squared	0.43	0.44	0.36	0.36

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period, for each individual variable in columns (1)—(4), are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 5. Bank supervision and firm investment: SUR

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SI	0.0053***	-0.0052***	0.0004	-0.0036**
	(0.0019)	(0.0020)	(0.0017)	(0.0014)
Post 2014 × SI	0.0059***	-0.0043**	0.0019	-0.0062***
	(0.0019)	(0.0021)	(0.0017)	(0.0014)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering	Country × Period			
Observations	150,702	150,702	150,702	150,702
R-squared	0.19	0.29	0.20	0.15

Notes: The Table reports the point estimates from Seemingly Unrelated Regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are aggregated in three observations per firm, one average for the 2010—2012 period, one average for the 2013—2014 period, and one average for the 2015—2017 period. In all regressions, only firms with at least two observations during each period, for each individual variable in columns (1)—(4), are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-period level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 6. Non-collapsed data

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed Assets	Δ Current Assets
Post 2012 × SI	0.0033*	-0.0049**	-0.0007	0.0036**
	(0.0017)	(0.0021)	(0.0015)	(0.0017)
Post 2014 × SI	0.0033***	-0.0058*	-0.0006	0.0023
	(0.0011)	(0.0035)	(0.0019)	(0.0017)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering	Country × Year			
Observations	1,492,464	591,319	905,995	1,302,702
R-squared	0.23	0.36	0.22	0.16

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one in 2015, 2016, and 2017. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. Data are annual. In all regressions, only firms with at least two observations during each period, for each individual variable in columns (1)—(4), are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2017. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.