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Out with the new, in with the old?
Supranational bank supervision and
the composition of firm investment

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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 subject to national supervision, firms borrowing from banks subject to supranational supervision reduce their share of intangible assets. This effect does not pre-date the supervisory reform and it does not obtain in non-SSM jurisdictions. The reallocation of investment away from intangible assets is stronger for small and young firms and appears to be driven by a short-term reduction in lending and a persistent increase in collateral standards.

JEL classification: D25, F30, G21, G28.

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Non-technical summary

Does financial sector regulation and supervision aiming at improving financial stability help or hinder economic growth? On the one hand, systemic banking distress results not only in negative GDP growth and deep recessions, but in a permanent loss in GDP. More effective supervision of banks can reduce the likelihood of idiosyncratic and systemic banking distress and thus reduce aggregate economic losses that come with such distress. On the other hand, countries with more developed financial systems but occasional financial crises tend to grow faster than countries with stable but shallow financial conditions. And while sectors highly dependent on external finance tend to experience a greater contraction during a banking crisis in more developed financial systems, in the long run these sectors benefit more from financial development.

We use the introduction of the Single Supervisory Mechanism (SSM) in the euro area in 2014 as a natural experiment to test these hypotheses. On 29 June 2012, the heads of state and government of all euro-area countries issued a statement announcing that the Commission would present proposals for the creation of a 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 completed 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 the banks located in the euro area, whether directly by the ECB's own supervisory arm for significant (larger) banks, or indirectly by the national prudential supervisors but under the general guidance of the ECB for 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.

Matching firm-level balance sheet data to firms' main lender across 121,394 unique firms and 1,839 banks belonging to 292 banking groups in 12 euro area countries over the period 2009 to 2018, we find 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 from intangible to tangible assets. This effect is observed both during the Comprehensive Assessment period (2013–2014) when banks' balance sheets were closely inspected in preparation for joining the SSM, and after the implementation of the SSM (2015–2018). We document a similar patterns when

we use supervisory data on bank lending and EU KLEMS data on research and development (R&D), with R&D investment declining significantly in country-sectors relatively more exposed to lending by SSM-supervised banks, especially after the introduction of the SSM. The relative decline in intangible assets is particularly pronounced for small and young firms and in intangibles-intensive sectors.

When we investigate the mechanisms at play, we find that corporate lending by banks that came under SSM supervision declined during the transition period, compared to corporate lending by banks not subject to SSM supervision. While this reduction could be due to either demand or supply factors, we then document that firms borrowing from SSM-supervised banks experience an increase in collateral requirements when applying for a bank loan. Our findings thus suggest that the reallocation from intangible to tangible assets after the introduction of the SSM is explained by a combination of a short-run reduction in overall lending and a both short- and long-run tightening in collateral standards by banks affected by the supervisory reform.

Our findings are consistent with hypotheses that posit a dampening supply-side effect of centralized (and thus more stringent) supervision on banks' lending, and from there a shift of firms' investment towards assets that are more easily collateralizable. The combination of the effects we document thus raises the possibility that while strongly enhancing financial stability, centralized bank supervision can slow down the shift from the "old", capital-based, to the "new", knowledge-based, economy.

1 Introduction

Does financial sector regulation and supervision aiming at improving financial stability help or hinder economic growth? When bank supervision fails, systemic banking distress results not only in negative GDP growth and deep recessions, but in a permanent loss in GDP (Jorda, Schularick and Taylor, 2013; Laeven and Valencia, 2010). More effective supervision of banks can reduce the likelihood of idiosyncratic and systemic banking distress and thus reduce aggregate economic losses that come with such distress. On the other hand, Ranciere, Tornell, and Westermann (2008) show that countries with more developed financial systems but occasional financial crises have, on average, grown faster than countries with stable but shallow financial conditions, arguing that financial liberalization increases investment but also systemic risk, adding to a large literature that shows a positive relationship between financial development and economic growth. Similarly, while Kroszner, Klingebiel and Laeven (2007) find that sectors highly dependent on external finance tend to experience a greater contraction during a banking crisis in more developed financial systems, they also find that in the long run these sectors benefit more from financial development. This suggests that bank regulation and supervision might be a secondary factor in explaining economic growth.

We contribute to this debate by studying the effect of an important change in bank supervisory practices (the introduction of supranational bank supervision in the euro area) on one well-defined growth mechanism (intangible corporate investment). After the Global Financial and Eurodebt crises of the late 2000s and early 2010s, respectively, regulators enacted a number of reforms aimed at improving the resilience of European banks. One important piece of this drive was the introduction of the Single Supervisory Mechanism (SSM) in Frankfurt, when 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 supranational supervision resulted in stability-enhancing actions by the affected banks (Fiordelisi, Ricci, and Stentella Lopes, 2017; Eber and Minoiu, 2017; Altavilla, Boucinha, Peydro, and Smets, 2020), arguably because supranational supervisors are more immune to pressure from national politicians and better able to arbitrage differences in regulatory stringency across countries. We use the announcement of the SSM in 2012 and its introduction in 2014 as a laboratory to study the impact of a safer financial system on the

performance of the real economy. Our principal finding is that relative to firms borrowing from banks remaining under national supervision, firms borrowing from SSM-supervised banks reduce their share of intangible assets. This effect is stronger for small and young firms and in intangibles-intensive sectors. Our findings provide some support for the notion that by increasing the stability of the banking system, supranational bank supervision can affect negatively investment in the type of capital that is central to the modern knowledge-based economy.

To assess the impact of this shift in supervisory architecture across national borders, we match firm-level balance sheet data to firms' main lender across 121,394 unique firms and 1,839 banks belonging to 292 banking groups in 12 euro area countries over the period 2009 to 2018. We use Orbis, a micro database maintained by Bureau Van Dijk which contains both public and private companies that span the entire firm-size distribution. 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 tangible and intangible assets. The database also includes information on each firm's main creditor(s), which we use to match firms and banks. For each firm's main 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). 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.¹ Furthermore, we perform all analyses on a sample of firms where we make sure that "treated" and "control" firms are similar in terms of observable characteristics, including those of the banks they borrow from.

¹A similar exercise would not be possible to the same extent for the US. It is true that the Y14 Corporate Loan Schedule has recently become available, and it includes credit exposures exceeding 1 million USD for banks with more than 100 billion USD in assets. While these loans account for around 75 percent of all commercial and industrial lending volume, such an analysis would miss the equivalent to less significant institutions and smaller firm borrowers.

More stringent supervision can have an effect on risk management practices and governance within the bank, reinforcing incentives towards a more conservative risk appetite and reduced risk-taking. As argued by Kok, Mueller, Ongena, and Pancano (2023), requests for more frequent information may also lead banks to invest more into information systems that enable them to manage their business more prudently. Empirical evidence has shown that more stringent supervision, including stress tests and loan-level scrutiny can lead banks to reduce lending and risk-taking (Bassett, Lee, and Spiller, 2015; Ivanov and Wang, 2023; Kok, Mueller, Ongena, and Pancano, 2023; Passalacqua, Angelini, Lotti, and Soggia, 2020), while it it also might imply a stronger focus on collateralized lending (Stiglitz and Weiss, 1981; Boot and Thakor, 1994; Holmstrom and Tirole, 1997).

We use the change in supervisory structure in the euro area as exogenous shock to supervisory stringency. While Colliard (2020) and Carletti, Dell’Ariccia, and Marquez (2021) point to potential information losses of centralizing bank supervision on the supranational level, such centralized supervision might benefit from scale economies (Eisenbach, Lucca, and Townsend, 2022), reduce the risk of banks arbitraging differences in regulatory stringency across countries (Dell’Ariccia and Marquez, 2006), and can increase supervisory independence (Rochet, 2008). Empirical evidence has shown that the move to supranational supervision within the euro area has reduced lending in the affected banks and increased their resilience (Fiordelisi, Ricci, and Stentella Lopes, 2017; Eber and Minoiu, 2017; Altavilla, Boucinha, Peydro, and Smets, 2020). We explore the effect of the change in supervisory structure on firms’ asset composition.

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 from intangible to tangible assets. This effect is observed both during the Comprehensive Assessment period (2013–2014) when banks’ balance sheets were closely inspected in preparation for joining the SSM, and after the implementation of the SSM (2015–2016). Numerically, the introduction of the SSM is associated with at least a 2.7% decline in the share of intangible assets, generating one-tenth of a percent in foregone GDP over the course of five years under plausible assumptions about the contribution of intangible investment to long-term growth (Fernald and Jones, 2014). The relative reduction in intangible investment is remarkably robust across specifications

that account for non-similarities between “control” and “treated” firms, for time-varying firm-specific shocks, as well as for model misspecification. They are also robust to controlling for unobservable firm heterogeneity, for country-sector-specific trends, and for bank fixed effects.

Crucially, we document a similar patterns when we use supervisory data on bank lending and EU KLEMS data on R&D: R&D investment declines significantly in country-sectors relatively more exposed to lending by SSM-supervised banks, especially post-2014, after the introduction of the SSM. Given the long lag between R&D investment and patented innovation (Kordal, Cahoy, Mankabo, and Sherer, 2016), our results suggest that the reduction in intangible investment we document can be associated with a long-term decline in innovation-promoting investment, even though the timing of these effects does not completely match.

Moreover, we find that the relative decline in intangible assets is particularly pronounced for small and young firms and in intangibles-intensive sectors. Such firms and sectors 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. This can have negative repercussions for economic growth, given the increasing reliance of advanced economies on intangible assets and the importance of innovation for aggregate productivity (Corrado and Hulten, 2010; Haskel and Westlake, 2017; Ottonello and Winberry, 2024) 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, 2023). On the other hand, a slower shift towards intangible assets might also slow the trend towards an ever less effective monetary policy that has been document by Dottling and Ratnovski (2023), 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 in the case of tangible and intangible assets, 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, Croatia, Hungary, Poland, and the United Kingdom—all five 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 supranational supervision and firms borrowing from banks that would have stayed under national supervision, we find that after the implementation of the SSM, the decline in the share of intangible assets is observed only for euro area firms. These results suggest that our findings are not driven by other global or regional trends affecting banks of different sizes and systemic importance and their borrowers differently. They also confirm that the decline in the share of intangible assets is not due to the post-crisis tightening of bank regulation, which happened across all EU countries, while the implementation of SSM only affected banks in euro area countries.²

Finally, we investigate the mechanisms at play. We first show that corporate lending by banks that came under SSM supervision declined during the transition period, compared to corporate lending by banks not subject to SSM supervision. While this reduction could be due to either demand or supply factors, we then document that firms borrowing from SSM-supervised banks experience an increase in collateral requirements when applying for a bank loan. Our findings thus suggest that the reallocation from intangible to tangible assets after the introduction of the SSM is explained by a combination of a short-run reduction in overall lending and a both short- and long-run tightening in collateral standards by banks affected by the supervisory reform. They also suggest that the negative effect of the supervisory reform in Europe on intangible investment was more than a short-term feature of the initial stress tests.

In summary, our findings are consistent with hypotheses that posit a dampening supply-side effect of centralized (and thus more stringent) supervision on banks' lending, and thus a shift of firms' investment towards assets that are more easily collateralizable.³ They are also consistent with theories focusing on the growth-dampening effects of bank supervision.

²This also confirms that our findings are not due to confounding factors such as EU-wide stress tests or higher capital requirements, such as are documented by Gropp, Mosk, Ongena, and Wix (2019).

³See Rampini and Viswanatan (2010) and Falato, Kadyrzhanova, Sim, and Steri (2022) for evidence that tangible assets are easier to use as collateral and are more easily diverted, and Beck, Döttling, Lambert, and van Dijk (2023) for evidence that banks' liquidity creation helps foster tangible but not intangible investment.

Our analysis contributes to the literature that assesses the effect of supervisory stringency on bank behavior. Hirtle, Kovner, and Plosser (2020) find that banks receiving 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 (Office of Thrift Supervision, 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. Ivanov and Wang (2024) 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. Bonfim, Cerqueiro, Degryse, and Ongena (2023) find for Portuguese banks 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. Delis and Staikouras (2011) show a negative relationship between the number of on-site inspections and bank risk in an international sample.⁴

Our paper contributes to this literature in three distinct ways. First, and most importantly, we are the first to analyze the transmission of supervisory reform to firms' investment decisions and thus economic growth. Second, we focus on a systematic change in supervisory architecture, moving banks that make up around 80% of total banking sector assets in the euro area into a new supervisory framework, with a more prominent role for supranational 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 and thus put to rest concerns about external validity. Third, we provide a comprehensive analysis of the link between supervision and bank lending and risk taking in Europe, adding to a literature dominated by US studies.

⁴A related literature has shown how differences in supervisory stringency across authorities within a country have an effect on banks' behavior, mostly exploiting the US case where similar banks in close proximity, or even the same banks, can be supervised by different authorities, allowing for a discontinuity-type analysis. See Agarwal, Luca, Seru, and Trebbi (2014) and Gopalan, Kalda, and Manela (2021).

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 insurance 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.⁵ With this, the 2014 Comprehensive Assessment, which included an asset quality review and stress test, was a financial health check of 130 banking groups (including both parent and subsidiaries) 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.

How are banks slotted into the two groups (SIs and LSIs)? The criteria for a bank being classified as an SI are the following: - size (the total value of its assets exceeds €30 billion); - economic importance (for the specific country or the EU economy as a whole); - cross-border activities (the total value of its assets exceeds €5 billion and the ratio of its cross-border assets/liabilities in more than one other participating Member State to its total assets/liabilities is above 20%); - direct public financial assistance (it has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility).⁶

As of end-2023, the ECB directly supervises 113 significant banking groups in the participating

⁵See <https://www.ecb.europa.eu/pub/pdf/other/notecomprehensiveassessment201310en.pdf>.

⁶See <https://www.bankingsupervision.europa.eu/banking/list/criteria/html/index.en.html>

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 and matching

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, as well as the matching procedure which we use in order to choose comparable sub-samples of “treated” and “control” firms.

3.1 Firm-level data and matching: Orbis

3.1.1 Orbis data

Our firm-level data come from the Orbis data set provided by Bureau van Dijk (BvD). Orbis contains financial and ownership data for millions of firms world-wide.⁷ For our analysis, we focus on EU companies with financial data in the period 2009–2018, and we work with unconsolidated accounts. We follow the downloading methodology and cleaning procedure described in Kalemli-Özcan, Sorensen, Villegas-Sanchez, Volosovych, and Yesiltas (2024) 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 by dropping those for which Orbis coverage relative to Eurostat is below 10%, namely the Czech Republic (8% coverage), Malta (4% coverage), and Cyprus (1% coverage).

In terms of firm-specific information, we make use of the following variables: tangible fixed assets, intangible fixed assets (the two add up to total fixed assets), employment, long-term debt, short-term debt, cash flow, sales, age, and net worth. Our consistency checks make sure that balance-sheet identities hold within a small margin and entries are meaningful from an accounting point of view. We

⁷For details on Orbis, see Kalemli-Özcan, Sorensen, Villegas-Sanchez, Volosovych, and Yesiltas (2024).

drop firm-year observations in which total fixed assets, tangible fixed assets, intangible fixed assets, sales, short-term debt, long-term debt, and other current liabilities have negative values. Furthermore, we drop firm-year observations for which some basic accounting identities are violated by more than 10 percent. These identities ensure that (i) total assets 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 restrict our sample to firms which have at least one observation during the pre-Banking Union period (2009–2012), the Comprehensive Assessment period (2013–2014) and the SSM period (2015–2018), producing a balanced panel. We drop observations where period-on-period log differences are higher than 1 or lower than -1.

One of our main dependent variables of interest are intangible fixed assets, defined as “all balance sheet intangible assets such as formation expenses, research expenses, goodwill, development expenses, and all other expenses with a long-term effect.” (Deng and Liu, 2024). It is important that this is an accounting based measure, as indicated by the firm. In addition, intangible assets might be subject to different amortization rules than tangible assets, which introduces a measurement bias when considering relative changes in these two variables. As our firm-level measure of intangible investment might also include goodwill, we use R&D expenditures as alternative (flow) measure of investment into intangible assets.

In addition, the Orbis database provides, for each company, the name of the main bank(s) the company conducts business with. For practical purposes, we focus on the firm’s main bank. This information 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.⁸

The bank relationship variable provided is a self-reported text variable and thus can contain typos. We compare the list of creditors in Orbis to the list of Significant Institutions provided by the SSM. In the process, we manually check each entry 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

⁸We note that the firm-bank relationship in Orbis is based on a snapshot taken in 2013 and thus sticky over the sample period.

properly. This variable is not available for all countries in the dataset.

3.1.2 Final sample construction

The firms in our sample may not be comparable on two margins. The first is the size of their creditor. SIs—or banks supervised by the SSM—are typically the country’s systemically important institutions. As a result, they are significantly larger than the LSIs in our sample. This raises the possibility that we are comparing dissimilar firms because their creditors are different not only in the dimension of who supervises them, but also in terms of access to liquidity, internal capital markets, etc. If so, then observable differences across the two types of firms may have less to do with supervision and more with intrinsic differences across creditors. To make sure that we are comparing firms borrowing from relatively similar banks, we exclude firms borrowing from the 2 largest SIs and firms borrowing from LSIs other than the 5 largest, in each country.⁹

Second, firms borrowing from SIs and LSIs may themselves be different. In particular, firms borrowing from banks that switched from being supervised by national supervisors to being supervised directly by the SSM can be statistically different in important ways, such as size, age, or initial propensity to invest in intangible assets. Simply controlling for these factors 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 the firm-level variables based on the following variables: $\log(\text{total assets})$, debt-asset ratio, cash-asset ratio, age, net worth, $\log(\text{sales})$, $\log(\text{employment})$ and the initial intangible asset share (Table 1). We then use nearest neighbor propensity score matching to match observations across groups, using a probit model to estimate the probability of a firm being attached to a SI, as opposed to being attached to a LSI.

⁹In Appendix Figure 1, we compare firm size (i.e., total fixed assets) across the two samples, the firms that are dropped and those that remain after applying the above sample selection criterion. The two distributions turn out to be statistically similar.

Figure 1 presents the standardized percentage bias for the covariates used in the propensity score model before and after matching. Prior to matching, several variables exhibit substantial imbalance between the treatment and control groups, particularly Sales, Initial intangible share, Assets, and Number of employees, with standardized biases exceeding 10%. After matching, the standardized bias for all covariates is substantially reduced and clustered around zero, indicating a marked improvement in covariate balance between the groups. Most variables fall well below the commonly used 10% threshold, suggesting that the propensity score matching procedure effectively balances observable characteristics.

These matching and selection procedures thus ensure that we are comparing “treated” and “control” firms that are similar on observable characteristics, as well as attached to banks of a similar size. After applying the two procedures, we are left with a sub-sample of 121,394 firms in 12 euro area countries (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Luxembourg, Netherlands, Portugal, Slovenia, and Spain)¹⁰ borrowing altogether from 1,839 banks belonging to 139 banking groups. Of these, 1,157 belong to 79 SI groups, and 682 belong to 60 LSI groups. This is a reduction of almost 40% relative to the starting sample of 199,065 firms borrowing from 3,361 banks. The resulting sample is slightly more balanced in terms of bank-firm relationships: 77.8% of firms have a relationship with a Significant Institution, as opposed to 80.6% in the unmatched sample.

In Table 2, we report summary statistics for all firm outcomes considered in the paper, for the matched sample and for the full sample period (2009–2018). On average, intangible fixed assets make up 9.2 percent of total fixed assets, with a range of between 0% and 100%. On their own tangible assets are zero only for 0.5% of firm-year observations, while intangible assets are zero in 44.4% of all cases.

One potential source of bias is that even if treatment is randomly assigned, spillover effects between treated and control banks/firms are possible. For example, firms may be likely to increase their reliance on non-treated banks, while simultaneously reducing reliance on treated banks after the roll-out of the SSM as both SSM and non-SSM banks operate in the same corporate lending markets. Berg, Reisinger, and Streitz (2021) show that such spillover effects could bias the treatment effects estimates, especially

¹⁰The main reason for the significant reduction in the number of countries is the lack of a reported firm-bank link.

in models heavily saturated with fixed effects. However, we believe that if present, this potential bias is small and goes against us. For one, firm-bank relationships tend to be stable; for example, Dwenger, Fossen, and Simmler (2015) show that in Germany, less than 3% of firms switch across banks in an individual year, and case studies from the UK suggest that around 0.5% of SMEs switch banks over 10 years.¹¹ Second, if firms are moving from treated to non-treated banks, we would see less impact of the reform. In the extreme, we would see no effect because any firm that sees an increase in credit constraints or is asked for more tangible collateral would choose to move to a non-treated bank. Of course, it may still be the case that the initial allocation of firms to treated and control banks is not random, which might introduce bias into our analysis. While we use an array of different methods to control for the bias that such non-random assignment might pose, we cannot fully rule out the possibility that firms with lower unobservable growth opportunities sorted into credit relationship with banks that later became treated.

3.2 Firm-level data: SAFE

We also use the Survey on the Access to Finance of Enterprises (SAFE), a firm-level dataset which allows to study the evolution of various loan terms over time. The SAFE is a regular survey conducted by the ECB to assess financing conditions for firms, particularly small and medium-sized enterprises (SMEs), across the euro area. The survey collects information directly from companies about their experiences with external financing, including bank loans, credit lines, trade credit, and other sources of funding. It also captures firms' perceptions of changes in the availability and cost of finance, their financing needs, and obstacles they encounter when seeking funding. By focusing on firms' own assessments, SAFE provides insights that complement bank-based statistics and financial market data.

The SAFE is typically conducted twice a year and covers thousands of firms across euro-area countries, making it possible to analyze differences across countries, sectors, and firm sizes. The results help policymakers understand how monetary policy and financial conditions affect businesses,

¹¹See <https://www.allica.bank/press-releases/number-of-smes-switching-banks-using-the-industry-7-day-switching-scheme-at-the-lowest-level-for-10-years-new-research-shows>.

especially SMEs that rely heavily on bank lending. The survey’s findings are widely used in research and policy analysis aimed at documenting the evolution of financing condition for euro-area SMEs (e.g., Ferrando, Popov, and Udell, 2019; 2022).

The SAFE includes several outcome variables that capture firms’ financing experiences and results when seeking external funding. These variables measure whether firms applied for specific financing instruments (such as bank loans, credit lines, trade credit, leasing, or equity) and the outcome of those applications, including whether financing was obtained in full, partially granted, rejected, or not pursued due to expected rejection (discouraged borrowers). Crucially for our purposes, the survey also records changes in loan conditions, including collateral requirements.

We download the data for waves 1–7 (corresponding to the period 2009–2012), waves 8–11 (corresponding to 2013–2014), and waves 12–21 (corresponding to 2015–2019). We next merge the SAFE with Bankscope, a bank-level dataset that contains information on banks’ exposures to sovereign debt. To do so, we make use of a variable called “BANKER”, made available through a merge with Bureau van Dijk’s Amadeus dataset and originally acquired from the Kompass dataset. This variable displays the name of the main banks with which the firm has a credit relationship. Following Kalemli-Ozcan, Laeven, and Moreno (2022), we use OpenRefine and Reconcile-CSV to match bank names to the BvD variable “BANKER”. If a firm reports more than one bank, we use the bank reported as the firm’s main bank (see Giannetti and Ongena, 2012; Kalemli-Ozcan, Laeven, and Moreno, 2022). In all, we recover information on 659 banks in the countries in our dataset. Finally, we use the list of SIs and LSIs to classify these banks according to SSM status.

With these data in hand, we construct the variable $Collateral_{fbcst}$ as a dummy variable equal to one if the firm’s main creditor increased the collateral requirements on loans in the past 6 months, and to zero if collateral requirements decreased or stayed the same. Table 2 reports that on average around a quarter of the firms in the sample experienced an increase in collateral requirements.

3.3 Bank-level data: IBSI

We make use of two datasets which contain detailed bank-level balance sheet information. The first one is 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 allow us to distinguish between lending to domestic customers and customers from other euro area countries.

We focus on the same 12 euro area countries and the same set of banks that we arrived at in the Orbis database after the bank selection and matching procedure. As 5 of these are absent in IBSI, we end up with 126 banking groups from 7 euro area countries (Austria, France, Germany, Greece, Luxembourg, Netherlands, and Spain), down from 186 banking groups from the same 7 countries in the unmatched sample.

3.4 Bank-level data: SSM

The second bank-level dataset that we use is gathered and harmonized by the SSM itself. More specifically, we use data coming from the financial reporting (FINREP) framework. The FINREP framework, provided by the European Banking Authority, ensures that homogeneous financial (accounting) information across all European credit institutions is reported to the regulator. In particular, we use template F 06.00 (“Breakdown of loans and advances to non-financial corporations by NACE codes”) which contains information on total loans granted by each credit institution to each Level 1 NACE code sector (18 sectors overall).

From FINREP, we extract data on total loans by an individual bank to firms in a sector in a country in an individual month. Next, we aggregate the information across firms and months, as well as across two classes of banks: SIs and LSIs. The final dataset contains data on the share of total

lending by SIs, out of total lending by both SIs and LSIs, to an individual sector in an individual country in a given year. We generate these data for the 12 countries in our final Orbis dataset for the sample period 2009–2018. Thus, our data allows us to proxy for overall exposure to SI lending by a country-sector in a given year.

3.5 R&D data: EU KLEMS

We complement the supervisory data just described with data from the 2019 release of the EU KLEMS database run by the Vienna Institute for International and Economic Studies. The EU KLEMS Release 2019 provides a database on measures of economic growth, productivity, employment, capital formation, and technological change at the industry level for all European Union member states. Productivity measures have been developed using growth accounting techniques. In addition, the EU KLEMS Release 2019 provides supplementary indicators on intangible assets, including expenses on Research&Development (R&D).¹²

From EU KLEMS we extract data on total R&D investment in an individual sector in an individual country in a given year. For consistency, we aggregate the data for the same 18 Level-1 sectors as in FINREP. We then calculate the change, year-on-year, in this variable. Once again, we generate these data for the 12 countries in our final Orbis dataset, for the three periods under consideration (2009–2012, 2013–2014, and 2015–2018). Thus, our data allows us to proxy for overall changes in total R&D investment in a country-sector.

4 Empirical strategy: Event study

Our goal is to study differences in investment behavior across firms over time, distinguishing between firms with credit relationships with banks directly and indirectly affected by the introduction of the Single Supervisory Mechanism (SSM). We also want to make sure that any changes in firm investment behavior that we attribute to the switch to supranational supervision do not precede the supervisory

¹²See Stehrer, Bykova, Jager, Reiter, and Schwarzhappel (2019) for further details on the methodology for the database construction.

reform. To that end, we estimate the following panel regression model with multi-dimensional fixed effects:

$$K_{fbct} = \sum_{n=2009}^{2018} \beta_n \times Year_n \times SI_{fbcst} + \mu_f + \phi_{ct} + \psi_{st} + \varepsilon_{fbct} \quad (1)$$

and

$$Intangible\ share_{fbct} = \sum_{n=2009}^{2018} \beta_n \times Year_n \times SI_{fbcst} + \mu_f + \phi_{ct} + \psi_{st} + \varepsilon_{fbct} \quad (2)$$

In Equation (1), K_{fbct} is either the natural logarithm of tangible fixed assets or the level of intangible fixed assets by firm f , borrowing from bank b , located in country c , operating in sector s in year t .¹³ In Equation (2), $Intangible\ share_{fbct}$ is the share of intangible fixed assets, out of total fixed assets, for firm f , borrowing from bank b , located in country c , operating in sector s in year t . The latter approach allows us to distinguish between two types of fixed assets: *tangible fixed assets* which encompass assets such as buildings, machinery and equipment, and *intangible fixed assets* which encompass assets such as R&D, on-the-job training, and goodwill. The difference between the two types of assets is that tangible assets are preferred by banks as collateral in loan contracts, as unlike intangible assets, they are redeployable.

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 equal to one for each year during the period 2009–2018, with $Year_{2012}$ being the reference category. We choose 2012 as the last year of the pre-period and thus the reference year because the list of significant versus less significant institutions was announced in March 2013, which is when the Comprehensive Assessment started for those. The

¹³This choice is driven by the fact that, as shown in Table 2, tangible assets are strictly positive for all firms, making it possible to estimate OLS with logs, while intangible assets are zero in 45% of the cases, calling for a Poisson pseudo-maximum likelihood regression in levels.

pre-Banking Union period is thus 2009–2012.

We include firm-fixed effects μ_f to control for unobservable firm-specific time-invariant factors explaining variation in investment behavior. The terms ϕ_{ct} and ψ_{st} denote interactions of country-year and sector-year dummies, which absorbs any time-varying shocks to aggregate country-wide shocks and to technological sector-wide shocks. Identification is thereby achieved by comparing the differential within-firm changes over time between treated and control firms after conditioning on the included fixed effects. Finally, ε_{fbctst} is the idiosyncratic error term.

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 year dummies on their own because their direct effect on investment is absorbed by the country-year and sector-year fixed effects.

Finally, in all regressions, we cluster the standard errors by country-SI. This accounts for the fact that the SSM shock applies to bank groups within a country. In robustness tests, we show that the main results in the paper are robust to clustering the standard errors at different levels, such as by bank, country, or country-SI-period.

The coefficients of interest are β_n . Without loss of generality, a negative coefficient β_{2015} would imply that all else equal and compared with 2012, total fixed investment or the share of intangible fixed assets declined in 2015 for firms whose bank is now subject to SSM supervision, relative to firms whose lender was not subject to change in supervision. The point estimates of the β coefficients thus measure the numerical change in investment from switching the firm from the control group to the treatment group.

Because intangible fixed assets, and as a result the variable *Intangible share*_{fbctst}, have a lot of zeros (about 45% of the observations), we estimate Equation (1) for intangible assets and Equation (2) using Poisson pseudo-maximum likelihood (PPML). The PPML regression is appropriate to estimate semi-elasticities in the presence of many zeros and high-dimensional fixed effects, with the results being robust to linear specifications (see Chen and Roth, 2024).

Figure 2 plots the series of coefficients and corresponding 90% confidence intervals from estimating

Equation (1)—separately for tangible and for intangible assets—and of Equation (2). The timing evidence supports a causal interpretation of our results. The plot shows little evidence of significant pre-trends for the two variables of interest, meaning that firms borrowing from SIs were adjusting their intangible fixed assets share at the same rate as firms borrowing from LSIs. After 2012, tangible assets weakly increase, with the effect being significant in 2016 and marginally insignificant in 2017 (Panel A), while intangible assets exhibit a moderate (insignificant) decline (Panel B). At the same time, after 2012 the intangible fixed assets share declines sharply and significantly, for firms borrowing from SIs, compared to firms borrowing from LSIs (Panel C). The decline is largest in 2015 and 2016 and persists all the way until 2018 when the share of intangible assets is no longer statistically different than that in 2012.

5 Empirical strategy: Difference-in-differences

The event study just reported helped us establish that the supervisory reform precipitated a reallocation from intangible to tangible assets, but not a significant change in total assets. However, the interpretation of some of the coefficients relies on the 90% confidence intervals and the analysis does not control for other factors. We therefore now employ a difference-in-differences regression to estimate and quantify the evolution of the share of intangible investment from the pre-Banking Union period to the transition period to the post-SSM period. To that end, we estimate the following panel regression model with multi-dimensional fixed effects:

$$\begin{aligned} \text{Intangible share}_{fbct} &= \beta_1 SI_{fbcst} \times Post\ 2012_t + \beta_2 SI_{fbcst} \times Post\ 2014_t \\ &+ \mu_f + \phi_{ct} + \psi_{st} + \varepsilon_{fbct} \end{aligned} \quad (3)$$

where $Post\ 2012_t$ is a dummy variable equal to one in 2013 and 2014, and $Post\ 2014_t$ is a dummy variable equal to one in 2015–2018.¹⁴

¹⁴In later robustness tests, we also add a vector of firm controls X_{bfct} . These include the logarithm of total assets, the ratio of cash flow to total assets, net worth (defined as the difference between total assets and total liabilities, divided by total assets), the ratio of debt to total assets, the ratio of cash flow to assets, and age. The inclusion of these variables allows us to capture the independent impact of various firm-specific developments, such as shocks to overall

In Table 3, we present the estimates from Equation (3). We do so using OLS (Panel A) and PPML (Panel B), and we do so for all firms (column (1)), for those with zero intangible assets pre-2012 (column (2)), and for the three terciles of firms with positive intangible assets pre-2012 (columns (3)-(5)). We thus test for both extensive (column (2)) and intensive (columns (3)-(5)) margins. In the full sample of firms, we confirm the main finding from the event study, namely that the share of intangible fixed assets declined during both the transition and the post-SSM period, and this decline is uniformly significant at the 1-percent statistical level (Panels A and B, column (1)).

When distinguishing between firms in different segments of the distribution of intangible assets pre-2012, we find that all firms are compliers with the policy shift. We first document a significant relative decline in the intangible asset share for affected firms during both the transition and the SSM period among those firms with zero intangible assets pre-2012 (column (2)). Given that we are estimating a differences-in-differences regression, the interpretation of the coefficient is that, e.g., during the SSM period, firms borrowing from LSIs increased their intangible asset share by 7.6% more than firms borrowing from SIs (Panel B). Turning to the rest of the distribution, and focusing on the PPML regressions, we find a significant relative decline in intangible investment by treated firms during both periods for those in the first tercile of firms with strictly positive intangible assets pre-2012 (column (3)), during the transition period for those in the second tercile (column (4)), and during the SSM period for those in the third tercile (column (5)). The explanatory power of the tests is quite high, with the variation in attachment to particular sets of banks, together with firm fixed effects and country-year and sector-year fixed effects, explaining up to 89% of the variation in investment over time.

While statistically significant, the economic effect is fairly small. In the full sample of firms (column (1)), the decline in the intangible asset share is between 1.4% and 1.8% of the sample mean in Panel A, and between 2.2% and 2.7% in Panel B. However, when we run the regression with asset-weighted regressions, the economic effect is significantly larger. Specifically, column (2) of Appendix Table 5 debt, profits, cash flow, or assets. We also interact the firm controls with the dummies *Post2012* and *Post2014*. In this fashion, we 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, on firm investment via balance sheet factors.

report estimates from this regression, with the coefficients numerically much larger: more than four times larger for the transition period and around 50% larger for the SSM period.

Turning to the interpretation of the PPML regressions, for the sample of firms with strictly positive intangible assets pre-2012 and given the sub-sample average in Panel C, the point estimates in Panel B imply that as a result of the SSM reform, the share of intangible assets declined from 0.24% to 0.19% for firms in the first tercile during the transition period, from 3.03% to 2.85% for firms in the second tercile during the transition period, and from 42.64% to 42.25% for firms in the third tercile during the SSM period. The evidence thus suggests that following the implementation of the SSM, the average share of intangible assets by treated firms with strictly positive intangible assets in 2012 declined from 15.3% to 15.1%.

The evidence presented in Figure 2 and in Table 3 thus suggests that after the announcement of the SSM, and relative to firms borrowing from Less Significant Institutions, firms borrowing from SSM-supervised banks did not increase investment, but rather reallocated investment away from intangible fixed assets towards tangible fixed assets. The evidence is thus consistent with the idea that the centralization of supervision into a supranational authority is associated with a move away from long-term intangible investment, such as R&D, and towards investment in tangible collateralizable assets, such as property, plant and equipment. 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, Ottonello and Winberry, 2024). The evidence therefore suggests that centralized (and thus more stringent) supervision may have pushed banks to reduce their support for the “new”, knowledge-based economy and increase their support for the “old”, 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 and supervisory 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.

At the same time, the effect remains small in the aggregate. The euro area economy has grown at around 1.5% per year since 1999. Assuming that, as in Fernald and Jones (2014), investment in intangible assets such as R&D accounts for around 60% of that growth, investment in intangible assets

is responsible for a 0.9% increase in GDP year-on-year. A 2.7% decline in the intangible asset share (as per Table 3 and Figure 2, Panel C) reduces this contribution to 0.875%. Given that “affected” firms are 80% of the population, this generates one-tenth of a percent in foregone GDP over the course of five years. It is important to stress that, on the one hand, these calculations depend on the assumption of permanent effects, but on the other hand, our estimates might constitute a lower bound, as discussed above.

5.1 Placebo test

An important potential bias is that after 2012, intangible assets may have declined in relative terms for all firms borrowing from SSM-eligible (i.e., larger) banks, regardless of whether the SSM actually took over the supervision of these banks. This evolution may have been driven by other regulatory reforms: for example, around the same period, the larger, more systemic banks in the euro area also became subject to additional O-SII capital buffers (e.g., Cappelletti, Ponte Marques, Varraso, Budrys, and Peeters, 2024).

To address this concern, we add to the analysis a sample of 22,011 firms from Croatia, Denmark, Hungary, Poland, and the United Kingdom borrowing from a total of 194 banks. None of these countries was a euro-area member state during the sample period, 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. Consequently—and after excluding firms borrowing from the 2 largest SIs and firms borrowing from LSIs other than the 5 largest—64 of the 194 are classified as SIs and 130 as LSIs. 65 percent of the firms in this new sample are borrowing from one of the pseudo-SSM banks.

With these data in hand, we now run the following specification:

$$\begin{aligned}
 \text{Intangible share}_{fbcs,t} &= \beta_1 SI_{fbcs} \times \text{Post 2012}_t + \beta_2 SI_{fbcs} \times \text{Post 2014}_t \\
 &+ \beta_3 SI_{fbcs} \times \text{Post 2012}_t \times EA + \beta_4 SI_{fbcs} \times \text{Post 2014}_t \times EA \\
 &+ \mu_f + \phi_{ct} + \psi_{st} + \varepsilon_{fbcs,t}
 \end{aligned} \tag{4}$$

Here, EA is a dummy equal to one if the firm is in the euro area, and to 0 if it is in a non-euro-area European country.

The estimates from Equation (4) are reported in Table 4. We find that the evolution of investment that we documented in Figure 2 and in Table 3, column (1)—namely, a reduction in the share of intangible assets for firms borrowing from significant institutions—is a euro-area phenomenon and not a global one. Specifically, while the intangible asset share increases significantly for SSM-eligible banks, it declines for SSM-supervised institutions in the euro area after 2012 and 2014, with the sum of the coefficients on the double and triple interaction terms being negative and significant.¹⁵

5.2 Sector-level R&D expenses

In the analysis presented so far, we have used information on the intangibles accounting entry of firms' balance sheets. A possible concern relates to the fact that this entry contains elements that are not part of an active decision on the firm to invest in productive assets (e.g., goodwill). From our available data sources, it is not possible to obtain information on the different components of intangible assets at the firm level. In particular, there is no information on firm-level R&D investment in Orbis. To address this issue, we turn to the 2019 release of the EU KLEMS database run by the Vienna Institute for International and Economic Studies. The EU KLEMS Release 2019 provides measures of economic growth, productivity, employment, capital formation, and technological change at the industry level for all member states of the European Union.

More importantly for our purpose, the database contains a measure of the annual expenditure on R&D at the sector level, for each country in our analysis. We merge these data with information coming from the SSM on banks' lending to different industrial sectors. From there, we calculate a proxy for the share of total lending coming from Significant Institutions, for each sector in each

¹⁵This analysis assumes that bank health was equivalent in SSM and non-SSM regions. In Figure 3, we plot data from the Financial Soundness Indicators database on the regulatory Tier 1 capital-to-risk-weighted assets ratio between the SSM countries and the non-SSM countries at the time of the announcement of the Banking Union (2012). It becomes readily apparent that the regulatory capital ratios of the banking sectors in both groups are not only similar, but also significantly above the ones recommended by Basel III, indicating healthy banking systems throughout. This strongly suggests that the results are not driven by a generic bank-health effect.

country, fixing this value in 2012.¹⁶

With these data in hand, we run the following regression:

$$R\&D_{cst} = \beta_1 Share SI_{cs} \times Post\ 2012_t + \beta_2 Share SI_{cs} \times Post\ 2014_t + \mu_{cs} + \phi_{st} + \varepsilon_{cs}, \quad (5)$$

We estimate the model using Poisson Maximum Likelihood regression, which is more appropriate than OLS in the presence of many zeros (in this case, around 20% of the observations). $R\&D_{cst}$ are R&D expenses by sector s in country c in year t . $Share SI_{cs}$ is the share of total lending in each sector s and country c coming from Significant Institutions in 2014 (the first year in which the SSM records this information). The regression also includes country-sector fixed effects μ_{cs} , which control for time-invariant technological heterogeneity across sectors in the same country, and sector-year fixed effects ϕ_{st} , which net out the effect of sector-specific technological shocks common across countries. The standard errors are clustered by country. Our hypothesis is that a larger reliance on credit from SIs at the start of the SSM would result in a decrease in R&D expenses. This prior is in line with the main results on investment in intangibles presented in the sections above.

The results in Table 5 confirm that sectors with a relatively large share of lending coming from SIs saw a substantial decline in total R&D expenses after 2014. The effect is statistically significant at the 5% level. The size of the effect is also non-negligible. Numerically, after the inception of the SSM, R&D expenses in a country-sector with a share of SI lending at the 75th percentile of the distribution decline by 3.5% more than in a country-sector with a share of SI lending at the 25th percentile of the distribution. R&D expenses declined between 2012 and 2014 as well, in country-sectors relatively more exposed to lending by SIs, but this effect is not significant in the statistical sense.

A similar picture emerges when we estimate the event-study type regression:

$$R\&D_{cst} = \sum_{n=2009}^{2018} \beta_n \times Year_n \times Share SI_{cs} + \mu_{cs} + \phi_{st} + \varepsilon_{cs}, \quad (6)$$

¹⁶Both EU KLEMS and SSM data report sector information using NACE codes. EU KLEMS data combines together sectors “M: Professional, scientific and technical activities” and “N: Administrative and support service activities”, so we combine those 2 sectors in the SSM data. We are thus left with 17 sectors.

The evidence, presented visually in Figure 4, strongly suggests that after 2012, R&D investment declined relatively more for country-sectors with relatively higher prior exposure to SIs. While this effect is not significant during the Comprehensive Assessment period, it becomes statistically significant in 2015 and gets even stronger in the economic sense thereafter.

These results provide additional support to the main findings based on Orbis data, even though the timing of the firm-level results for the intangible asset share (both Comprehensive Assessment and implementation periods) and sector-level for R&D (only implementation period) do not match completely; further, the measurement of these two variables relate to different concepts as discussed above.¹⁷ Taken together, our results thus suggest that after the transition from national to supra-national bank supervision, firms borrowing from SSM-supervised banks reduced their investment in intangible assets relative to those supervised by non-SSM banks, and this is mirrored by a decline in aggregate country-sector-level R&D investment. These findings are consistent with the hypothesis that more stringent bank supervision might have unintended consequences for long-term growth.

5.3 Robustness tests

We subject our estimates to a number of robustness tests, reported in the Appendix, aimed at making sure that the results reported in Table 3 are not an artefact of using a particular empirical set-up.

Appendix Table 1 reports a version of the tests in Table 3, columns (2)-(5), implemented in a single regression. While for low-intangibles firms, the effect is concentrated during the Comprehensive Assessment period, for the high-intangibles firms the effect is strongest after 2014.

In Appendix Table 2, we juxtapose the changes in tangible fixed assets, and in intangible fixed assets, employing the empirical set-up from Equation (3). The evidence strongly suggests that after 2012, tangible fixed assets increased,¹⁸ with this increase being statistically significant during the

¹⁷Specifically, it is important to acknowledge that there is no one-to-one mapping between intangibles and R&D. For example, Peters and Taylor (2017) compute intangible investment by summing R&D costs and 30 percent of "Selling, General, and Administrative Expenses" in Compustat, resulting in R&D being around one-third of total intangible capital.

¹⁸This is the case both when estimating a log specification using OLS (column (1)) and when estimating a PPML regression in levels after excluding extreme outliers (results omitted for brevity).

SSM period at around 1%. At the same time, intangible fixed assets declined, being around 0.7% lower during the Comprehensive Assessment period. The decline in the share of intangible assets thus appears to be driven by dual forces: an absolute decline in intangible investment combined with a reallocation of investment from intangible to tangible assets.

Next, we note that in the main regressions, we are not controlling for other firm characteristics, both because we have already matched firms on those factors (using their pre-2012 values) and because over time they are affected by supervisory changes, making them potentially bad controls. In Appendix Table 3, we nevertheless report estimates from two robust models, one with time varying firm controls and their interactions with the time dummies (column (1)) and one with firm controls fixed in 2012 and their interactions with the time dummies (column (2)).¹⁹ In both cases, the main results of the paper continue to obtain.

Next, we note that our clustering scheme may be insufficiently conservative. It is possible that the standard errors are correlated across firms within countries or within country-bank classes, rather than within country-bank class-period, because of long-term factors. Alternatively, it is possible that the right clustering of the standard errors is by bank, because this is the unit of the shock induced by the supervisory reform. In Appendix Table 4, we report the estimates from Equation (3) where the standard errors are clustered by country, country-SI-year, and bank-period, respectively. In all three cases, the main effect—a decline in the share of intangible fixed assets—continues to obtain, and the point estimate is significant at least at the 10-percent statistical level in all cases.

Another way in which the model estimated in Table 3, column (1)) can be misspecified is that in Equation (3) we do not control for other, non-SSM related shocks that may be affecting the level and composition of banks' credit supply, and for firm size. In Appendix Table 5, we first re-estimate Equation (3) after including bank fixed effects, in addition to firm fixed effects and interactions of country, sector, and period dummies (column (1)). The point estimates of the coefficients of interest in Equation (3) continue to confirm the main results of the paper, namely, a reallocation of investment away from intangible and towards tangible fixed assets. In column (2), we run the main regression

¹⁹These controls include the logarithm of total assets, the ratio of cash flow to total assets, net worth (defined as the difference between total assets and total liabilities, divided by total assets), the ratio of debt to total assets, the ratio of cash flow to assets, and age.

with asset-weighted regressions. We find that when weighting for firm size, the economic effect is significantly larger: more than four times larger during the transition period and around 50% larger during the SSM period.

In Appendix Table 6, instead of the variable *SI*, we employ, in the case of firms borrowing from SIs, a variable equal to the difference between 15 and the country-specific Supervisory Power Index of the country before the SSM reform (see Loipersberger, 2015). In this way, we measure the intensity of improvement in supervision resulting from the move to supranational supervision. The results are similar to those in Table 3, and the point estimates during both periods are significant at least at the 5-percent statistical level.

In Appendix Table 7, we address identification threats stemming from aggregate shocks, such as the European financial and sovereign debt crisis. In principle, by including country-time fixed effects in the main specification, we already account for aggregate crisis effects common to all banks in a country, but the possibility remain that these effects are bank-specific. To account for these, we determine which of the banks in our sample received public assistance during the Global Financial Crisis (i.e., were more affected by the crisis itself).²⁰ If these banks were also predominantly SIs, then the reduced propensity of the firms borrowing from them to invest in intangible assets after the introduction of the SSM can be due to a lingering crisis effects as opposed to an effect of the supervisory policy in question. To disentangle the two, we first drop the firms borrowing from these banks (column (1)), and then we explicitly control for the effect of these creditors' crisis exposure over time (column (2)). In both cases, the main results still obtain, with neither the magnitude nor the statistical significance of the supervisory-policy effect declining. This suggests that crisis effects are unlikely to explain our main results.

Next, we re-run Equation (3) on the sample of matched firms borrowing from all banks, i.e., without excluding firms borrowing from the 2 largest SIs and firms borrowing from LSIs other than the 5 largest, in each country. While Appendix Figure 1 shows that the two distributions of firms are statistically similar, looking at the population of firms helps with the external validity of our results. The evidence reported in Appendix Table 8 suggests that the decline in the share of intangible assets

²⁰We collect data on individual banks from Igan, Moussawi, Tieman, Zdzenicka, Dell'Ariccia, and Mauro (2022).

in the wake of the move to supranational supervision still obtains in the larger firm sample.

Next, we address the possibility that within a firm, investment decisions may be correlated over time. Our original data is at the annual frequency. By estimating a model where changes in investment are observed within a firm for as much as six 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 re-estimate Equation (3) 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 2011–2012), one Comprehensive Assessment observation (i.e., over the period 2013–2014), and one post-SSM observation (i.e., over the period 2015–2016). We only use firms for which we have at least one underlying observation in each of the three periods. The estimates from this variant of Equation (3) are reported in Appendix Table 9, and a statistically significant decline in the share of intangible fixed assets during the SSM period continues to be apparent.

Finally, we address the concern that the introduction of the SSM can be viewed as simultaneously tightening bank supervision and changing the regulatory structure. In Appendix Table 10, we separate banks according to their capital shortfall recorded in the Asset Quality Review performed before the start of the SSM. It does not appear to be the case that more and less well capitalized banks were affected differently by the Comprehensive Assessment or by the introduction of the SSM. We interpret this to suggest that it is the channel of changing the supervisory structure, as opposed to the channel of tightening bank regulation, that explains our results.

5.4 Firm and sector heterogeneity

5.4.1 Firm heterogeneity

Is the effect we document in the paper identical across firms attached to SIs, or is it driven by those of them that are credit constrained? The most natural way to address this question is to account for size and age. Both small firms (Berger and Udell, 1998) and young firms (Haltiwanger, Jarmin, and

Miranda, 2013) have been shown to be more sensitive to changes in credit access, suggesting that size and age are fundamental factors that for higher sensitivity to fluctuations in market conditions.

To test for this possibility, we modify Equation (3) as follows:

$$\begin{aligned} \text{Intangible share}_{fbcs} = & \beta_1 SI_{fbcs} \times \text{Post 2012}_t + \beta_2 SI_{fbcs} \times \text{Post 2014}_t \\ & + \beta_3 SI_{fbcs} \times \text{Post 2012}_t \times CC_f + \beta_4 SI_{fbcs} \times \text{Post 2014}_t \times CC_f \\ & + \mu_f + \phi_{ct} + \psi_{st} + \varepsilon_{fbcs} \end{aligned} \quad (7)$$

where CC_f stands for *Credit Constrained* and is, in turn, a dummy variable equal to one if the firm has fewer than 50 employees (*Small*) and a dummy variable equal to one if the firm is younger than ten years old (*Young*). The coefficient β_3 (β_4) now measures the change in investment during the Comprehensive Assessment period (SSM period), for small versus large and for young versus old firms borrowing from affected versus non-affected banks.

The estimates of Equation (7) are reported in columns (1) and (2) of Table 6. We do find systematic support in the data for the mechanism related to credit constraints. Both small (column (1)) and young (column (2)) firms borrowing from SIs appear to be significantly more likely to reduce their investment in intangible assets during the SSM period. The evidence thus provides support to the notion that the reduction in intangible assets is stronger for credit constrained firms.²¹

5.4.2 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,

²¹While our finding of a larger economic effect in an asset-weighted regression in Column (2) of Appendix Table 5 seems to contradict the finding of a stronger effect for small firms, this can be explained by an increasing economic effect in size among non-small firm, so that a stronger economic effect on the top-end of the size distribution dominates the stronger economic effect for small firms compared to the average effect for non-small firms.

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 (3) in the following way. First, we create a sector-level variable $Innovation_s$ which denotes the sector’s technological intangible intensity, measured as the average intangible assets share in the firm’s sector of operation. Then we interact this sectoral benchmark with the interaction of the SI dummy and the $Post$ dummies, as follows:

$$\begin{aligned} Intangible\ share_{fbct} &= \beta_1 SI_{fbcst} \times Post\ 2012_t + \beta_2 SI_{fbcst} \times Post\ 2014_t \\ &+ \beta_3 SI_{fbcst} \times Post\ 2012_t \times Innovation_s \\ &+ \beta_4 SI_{fbcst} \times Post\ 2014_t \times Innovation_s \\ &+ \mu_f + \phi_{ct} + \psi_{st} + \varepsilon_{fbct} \end{aligned} \quad (8)$$

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 $SI_{fbcst} \times Innovation_s$ because they are subsumed in the country x industry x period fixed effects. The coefficient β_3 (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.

The estimates of Equation (8) are reported in column (3) of Table 6, and they show a strong reduction in the share of intangible assets during the SSM period, more so in sectors that are innovation-intensive. The decline is statistically significant at the 5% statistical level.

Our evidence thus suggests that the reallocation away from more towards less TFP-enhancing investment we documented in Table 3, column (1), 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. Our evidence suggests that stability-enhancing supervision may have adverse consequences for some of the channels of long-term growth (Fernald and Jones, 2014).

6 Mechanisms

Our evidence so far raises the natural question of the channel through which changes in the quality of supervision affect firm investment. We hypothesize two potential—not mutually exclusive—channels whereby the documented effects materialize. The first one is a reduction in bank lending precipitated by the supervisory reform, which forces firms to adjust their investments. However, such a reduction could be driven by supply or demand shocks. We therefore complement this analysis with a second mechanism, the tightening of collateral standards by banks, forcing firms to increase (in relative terms) their stock of collateralizable assets. We now explore these two hypotheses in turn.

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 be consistent with both the increase in tangible investment and the relative decline in intangible investment that we document.

6.1 Supervisory reform and bank lending

We first 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 3.3, 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 the same euro area countries and the same set of banks that we arrived at in the Orbis database after the bank selection and matching procedure. This leaves us with 126 banking groups from 7 euro area countries (Austria, France, Germany, Greece, Luxembourg, Netherlands, and Spain). 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 2009 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 2018. In this way, we analyze a 10-year period consisting of three sub-periods.

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

$$\Delta \log NFC Lending_{bct} = \beta SI_{bct} \times Post2012_t + \gamma SI_{bct} \times Post2014_t + \mu_b + \phi_{ct} + \varepsilon_{bct}, \quad (9)$$

Here SI is a dummy variable equal to one if the bank is a Significant Institution, and to zero otherwise. The data are annual, aggregated from the original monthly frequency. Identification is 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-year 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 7 point to a significant reduction in total lending by SIs to domestic NFCs during both the Comprehensive Assessment and the SSM period, compared to LSIs. In the former case, the effect is significant at the 1% statistical level. The coefficient of -0.0839 corresponds to one-half of a sample standard deviation, pointing to a meaningful economic effect.

The data thus strongly suggest that the reform in European supervisory architecture was associated with a reduction in lending both in the short run.

In column (2) of Table 7, we include interactions with bank capital on the right-hand side of Equation (9). 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 (SSM) period was significantly larger (smaller) for SIs which had relatively low capital levels before the announcement of the SSM.²² The coefficient on the triple interaction implies that during the Comprehensive Assessment period, an SI 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 the announcement of the SSM 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 Table 7 thus allow us to tentatively conclude that at least in part, the relative 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. On the bank side, the reduction primarily takes place during the transition period. This fails to explain the relatively larger reduction in the intangible assets share during the SSM period, compared to the CA period.

6.2 Supervisory reform and collateral requirements

To test for the second mechanism—a tightening in collateral requirements precipitated by the switch to the SSM—we turn to the European Central Bank's Survey on the Access to Finance of Enterprises (SAFE), a regular survey conducted by the ECB to assess financing conditions for firms, particularly small and medium-sized enterprises (SMEs), across the euro area. The data allow to match the firms

²²The first result in particular is reminiscent of prior evidence in the literature of a decline in lending during that period driven by the low capitalization of banks exposed to sovereign debt shocks (e.g., Popov and van Horen, 2015; Bofondi, Carpinelli, and Sette, 2018; and Bottero, Lenzu, and Mezzanotti, 2020).

to their creditor, and as a result to identify similar firms borrowing from similar SIs and LSIs (see Section 3.2 for more detail).

With these data at hand, we run the following regression:

$$\begin{aligned} Collateral_{fbcs} = & \beta_1 SI_{fbcs} \times Post\ 2012_t + \beta_2 SI_{fbcs} \times Post\ 2014_t \\ & + \mu_f + \phi_{ct} + \psi_{st} + \varepsilon_{fbcs} \end{aligned} \quad (10)$$

where $Collateral_{fbcs}$ is a dummy variable equal to one if the firm's main creditor increased the collateral requirements on loans in the past 6 months, and to zero if collateral requirements decreased or stayed the same. The rest of the variables are defined as in Equation (3), except that time is defined at the wave (6-month) as opposed to the 1-year level.

The estimates from this regression are reported in Table 8. The evidence strongly suggests that after 2012, firms borrowing from SIs were between 2.9 and 4.6 percentage point more likely to experience an increase in collateral requirements than similar firms borrowing from LSIs. Importantly, the effect is observed both during the Comprehensive Assessment period (short-run) and during the SSM period (long-run). This is fully consistent with the notion that intangible capital is more difficult to collateralize, and as a result, investment in it is hampered by the switch to the SSM via tightening in collateral standards.

Putting the evidence from Tables 7 and 8 together, we tentatively conclude that the reallocation from intangible to tangible assets following the introduction of the SSM is driven by a combination of a decline in lending and an increase in collateral requirements during 2013-2014, and a further tightening in collateral requirements during 2015-2018. The latter effect in particular explains why the observed reallocation persists beyond the very short run. Observing an increase in collateral requirement at the same time as a reduction in lending also makes it more likely that the credit reduction is supply- and not the demand-driven.²³

²³Darmouni and Papoutsis (2022) document increased bond financing of European non-financial corporations potentially mitigating the effect of changing credit conditions. In Appendix Table 11, we once again use the SAFE and replicate Equation (10), with the outcome variable being the probability of having accessed non-bank sources of financing in the past 6 months. Consistent with their work, we find a strong (weak) increase in the use of bonds (equity) by firms affected by the introduction of the SSM, suggesting that the supervisory reform may have contributed to the

7 Conclusion

Theory provides opposing hypotheses regarding the effect of supervisory stringency on bank lending, corporate finance and economic growth. On the one hand, by reducing the risk of systemic fragility, more stringent supervision can result in more stable investment and thus higher growth. On the other hand, if stringent supervision results in insufficient risk-taking, this can result in lower innovation and ultimately growth. 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 stringently 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 banks supervised by a supranational authority reduce investment in intangible fixed assets in relative terms. At the same time, overall investment does not change in one way or another. These effects 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 for small and young firms and in intangibles-intensive industries. We also find that the decline in intangible investment at the firm level is mirrored by a decline in R&D investment at the country-sector level. This points to a potential negative long-run effect from the reduction in productivity-enhancing investment. Finally, we also find that the reallocation from intangible to tangible assets is explained by a combination of a short-run reduction in overall lending and a both short- and long-run tightening in collateral standards by banks affected by the supervisory reform.

Overall, our results suggest that the important stability and resilience gains following the establishment of the SSM are likely to be realized in the long run, as the euro-area financial system moves away from bank funding in Europe.

lishment of the SSM came with allocative costs by reducing intangible assets and R&D investment by firms. This raises the possibility that more stringent and more centralized bank supervision can affect negatively investment in the type of capital that is central to modern economies. One can argue that our results measure a transitory effect and part of the reallocation may reflect the removal of an implicit subsidy (if national supervisors were forbearing and banks were underpricing risk on uncollateralized lending), but on the other hand, our estimate is certainly a lower bound given indirect effects on LSIs and possible spillover effects to control group firms. In addition, the incidence of our effects falls on small, young, intangibles-intensive firms. Overall, it seems difficult to come to a clear cost-benefit calculation, but our results point to an important trade-off associated with the move towards supranational bank supervision: there are positive effects for financial stability, as also shown by previous studies, but there is also reduced bank financing for the knowledge economy.

Our findings also point to the important debate on the role of banks in the transition to the knowledge economy. Beck, Dottling, Lambert, and van Dijk (2023) show that liquidity creation by banks has a positive relationship with economic growth, but less so in economies that rely more on intangible rather than tangible assets. Combining these findings points to the need for a stronger role of non-bank financing providers in European economies to foster their transition to a knowledge economy relying on intangible rather than tangible assets.

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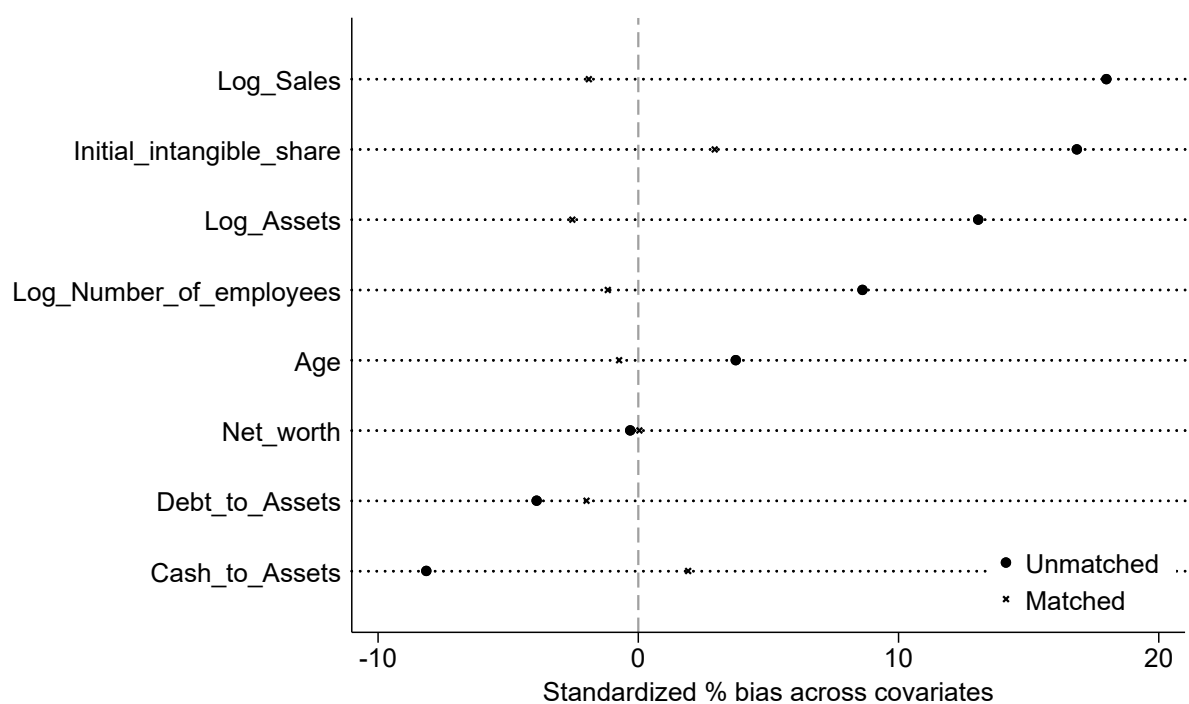
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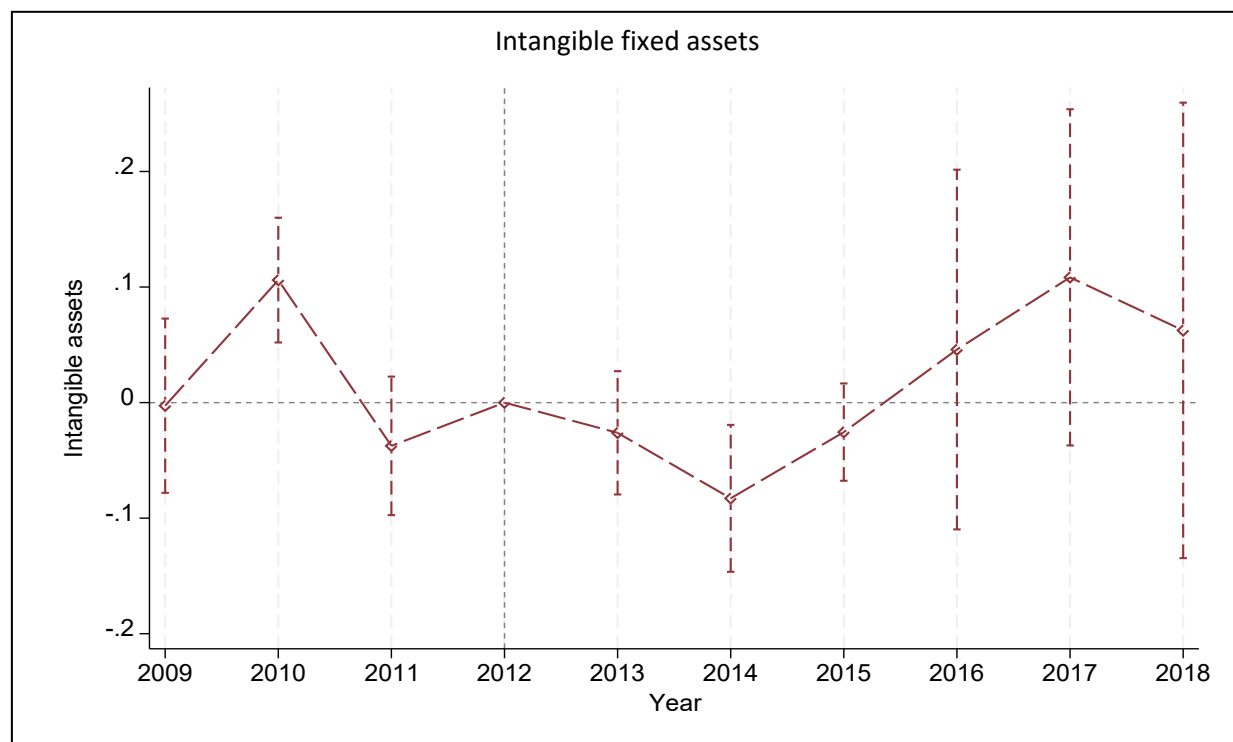
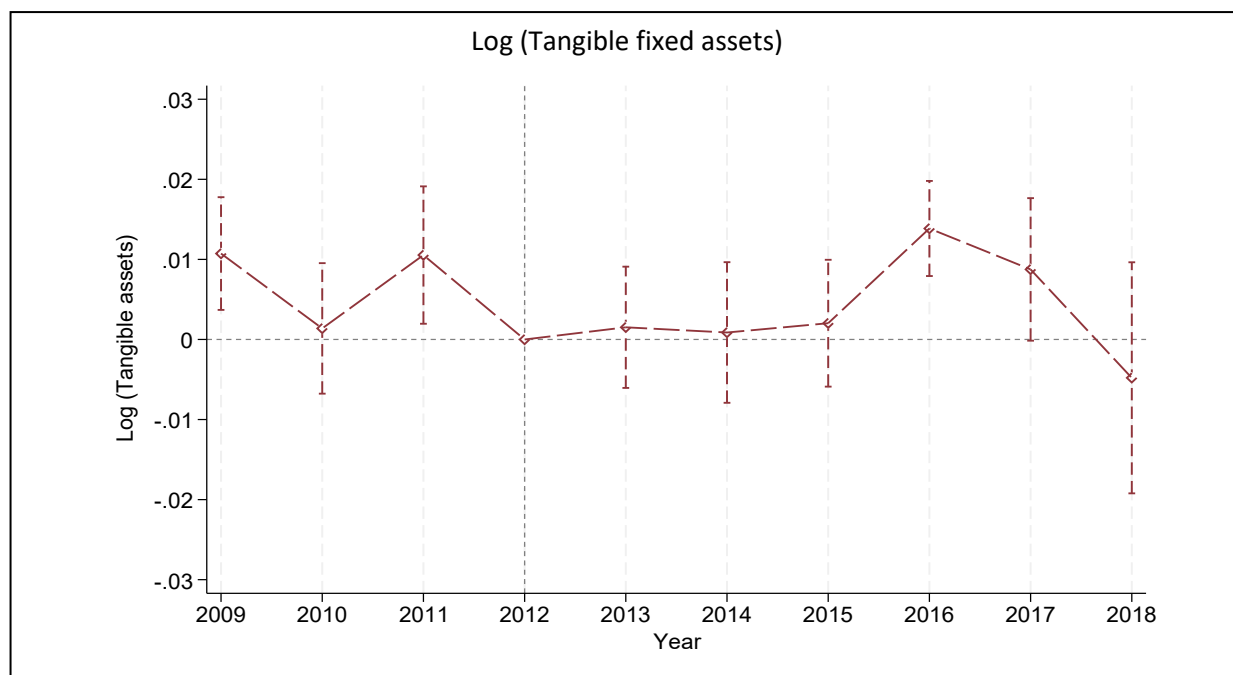
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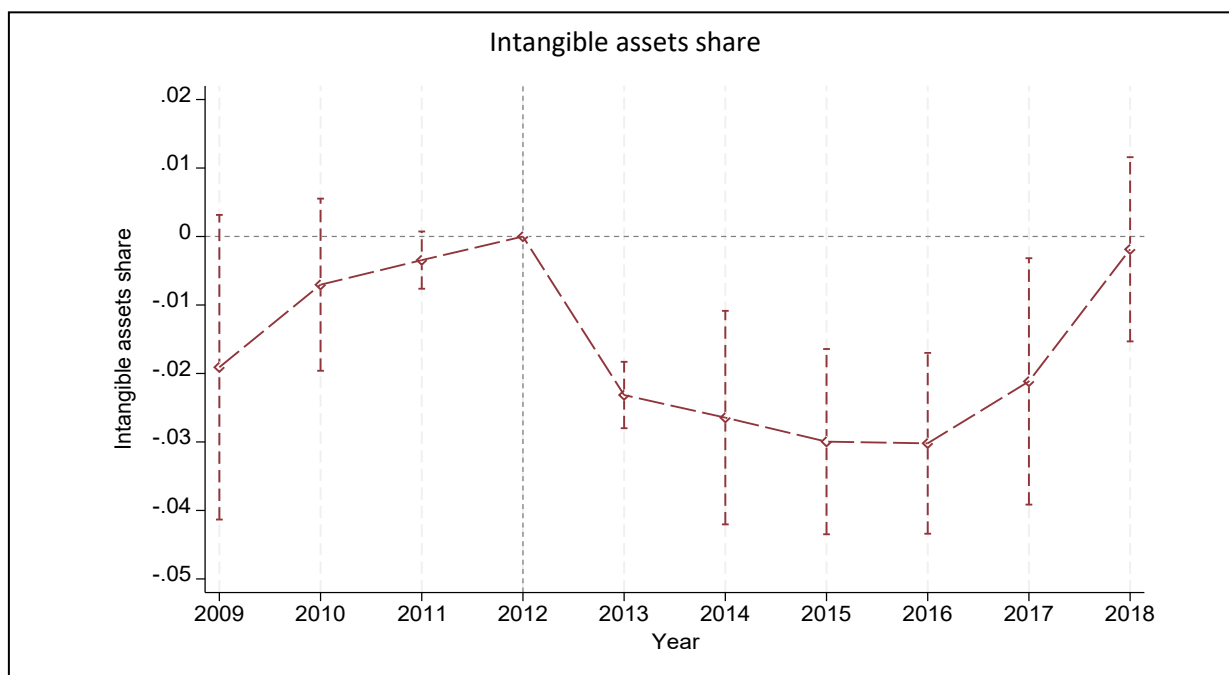
Figure 1. Matched vs. unmatched sample



Note: The figure compares the standardized bias across the firm covariates used in the propensity matching procedure, for the matched vs the unmatched sample.

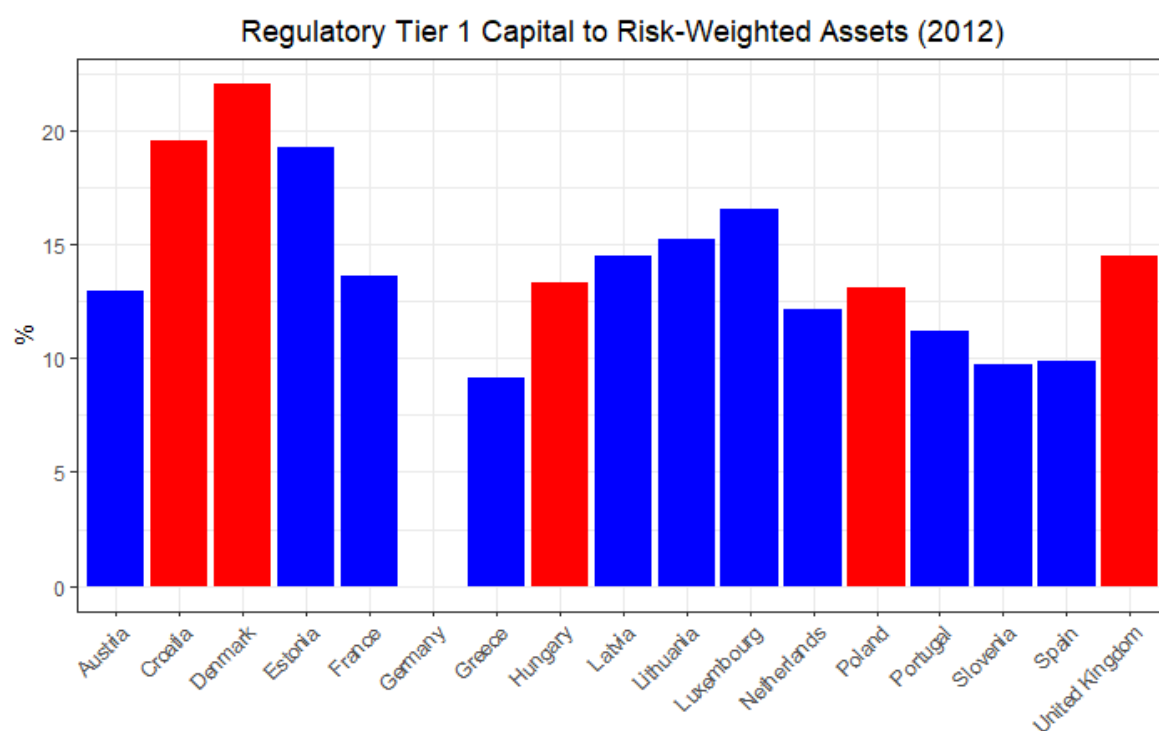
Figure 2. Bank supervision and firm assets over time: SI versus LSI firms





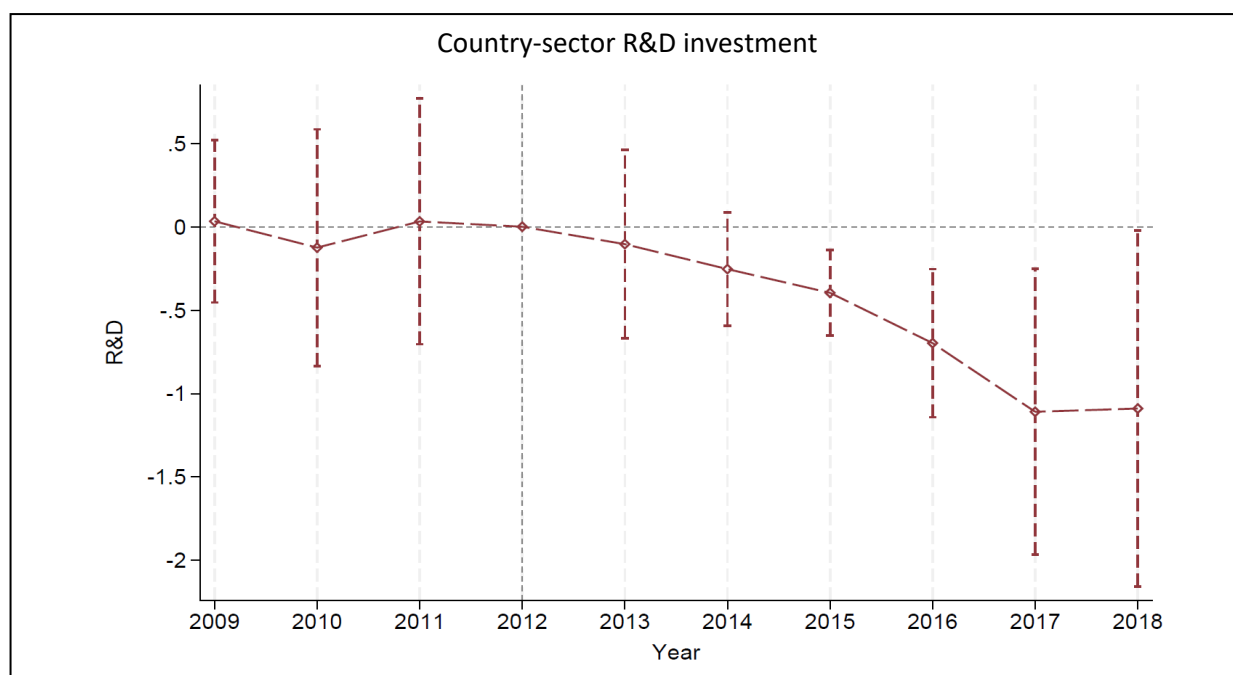
Note: The figure uses annual data for the period 2009 to 2018. The graph plots year-by-year coefficients and 90% confidence intervals that we obtain by replacing in Equation (1) the variables *Post2012* and *Post2014* in the interaction with *SI* with a sequence of year dummies. The first panel is estimated using OLS, the second and the third panel are estimated using Poisson pseudo-maximum likelihood.

Figure 3. Tier 1 regulatory capital, by country



Note: Average country-specific Tier-1 capital in the banking system, for 2012. Data: Financial Soundness Indicators database, of the IMF.

Figure 4. Bank supervision and R&D investment: High vs low sectoral SI dependence



Note: The figure uses annual data for the period 2009 to 2018. The graph plots year-by-year coefficients and 90% confidence intervals that we obtain by replacing in Equation (5) the variables *Post2012* and *Post2014* in the interaction with *Share SI* with a sequence of year dummies. The regression is estimated using Poisson pseudo-maximum likelihood.

Table 1. Summary statistics, firm covariates: Matched sample, euro-area

	(1)	(2)	(3)	(4)	(5)
	Mean	Median	St. dev.	Min.	Max.
Log (Total assets)	14.4738	14.2682	1.6306	7.2985	24.8205
Debt / Assets	0.2380	0.1848	0.2415	-10.0631	15.1912
Cash / Assets	0.0618	0.0526	0.0964	-0.9993	0.9995
Age	22.032	20	14.5124	0	732
Net worth	0.6849	0.8019	1.7314	-0.9991	0.9996
Log (Sales)	14.6297	14.4453	1.7391	-0.0281	24.8728
Log (Employment)	2.7385	2.5820	1.4312	-0.0569	12.5190
Initial intangible share	0.0903	0.0008	0.2123	0	1

Note: The Table summarizes the variables used in the Propensity Score Matching procedure. Statistics are reported for the matched sample. 'Log (Total assets)' denotes the natural logarithm of the firm's total fixed 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. 'Net worth' denotes the ratio of total assets minus total liabilities to total assets. 'Log (Sales)' denotes the natural logarithm of the firm's total sales. 'Log (Employment)' denotes the natural logarithm of the firm's total number of employees. 'Initial intangible share' denotes the firm's share of intangible investment before 2012. Data come from Orbis.

Table 2. Summary statistics, firm outcomes: Matched sample, euro-area

	(1)	(2)	(3)	(4)	(5)
	Mean	Median	St. dev.	Min.	Max.
Tangible fixed assets (mln.)	5.6345	0.2983	484.3529	0	446,774.1
Intangible fixed assets (mln.)	0.9420	0.0004	39.0432	0	13,558.4
Intangible assets share	0.0917	0.0008	0.2144	0	1
Collateral requirements	0.2424	0	0.4285	0	1

Note: The Table summarizes the variables used in the empirical tests. Only firms that report a credit association with at least one bank are included. The sample includes only firms from euro-area countries. Statistics are reported for the Propensity Score Matched sample from Table 1, for the sub-sample of firms in the euro area. 'Tangible fixed assets' denotes the firm's total tangible fixed assets, in € mln. 'Intangible fixed assets' denotes the firm's total intangible fixed assets, in € mln. 'Intangible assets share' denotes the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. Data come from Orbis. 'Collateral requirements' is a dummy equal to one if the firm's main creditor increased the collateral requirements on loans in the past 6 months, and to zero if collateral requirements decreased or stayed the same. Data come from the Survey on the Access to Finance of Enterprises (SAFE).

Table 3. Bank supervision and the composition of firm investment: Headline result

Panel A. OLS

	(1)	(2)	(3)	(4)	(5)
	Intangible assets share				
	All firms	Intangible share pre-2012 = 0	Intangible share pre-2012 > 0		
			Tercile I	Tercile II	Tercile III
Post 2012 × SI	-0.00127*** (0.00044)	-0.00116*** (0.00022)	-0.00178*** (0.00030)	-0.00182* (0.00109)	0.00039 (0.00340)
Post 2014 × SI	-0.00162*** (0.00051)	-0.00165*** (0.00020)	-0.00041 (0.00056)	-0.00011 (0.00168)	-0.00391* (0.00228)
Firm FEs	Yes	Yes	Yes	Yes	Yes
Country × Year FEs	Yes	Yes	Yes	Yes	Yes
Sector × Year FEs	Yes	Yes	Yes	Yes	Yes
Clustering			Country × SI		
Observations	871,761	389,107	159,338	158,719	161,914
R-squared	0.89	0.61	0.62	0.65	0.86

Panel B. Poisson pseudo-maximum likelihood

	(1)	(2)	(3)	(4)	(5)
	Intangible assets share				
	All firms	Intangible share pre-2012 = 0	Intangible share pre-2012 > 0		
			Tercile I	Tercile II	Tercile III
Post 2012 × SI	-0.02205*** (0.00511)	-0.06067** (0.02812)	-0.17722*** (0.03213)	-0.04622** (0.01996)	0.00189 (0.00861)
Post 2014 × SI	-0.02664*** (0.00770)	-0.07583*** (0.02828)	-0.06095** (0.02425)	-0.01696 (0.03004)	-0.00905* (0.00575)
Firm FEs	Yes	Yes	Yes	Yes	Yes
Country × Year FEs	Yes	Yes	Yes	Yes	Yes
Sector × Year FEs	Yes	Yes	Yes	Yes	Yes
Clustering			Country × SI		
Observations	602,549	121,687	152,476	154,409	160,027
Pseudo R-squared	0.39	0.41	0.38	0.22	0.16

Panel C. Mean intangible share

	(1)	(2)	(3)	(4)	(5)
	All firms	Intangible share pre-2012 = 0	Intangible share pre-2012 > 0		
			Tercile I	Tercile II	Tercile III
Intangible share pre-2012	0.0860	0	0.0024	0.0303	0.4264

Notes: The Table reports the point estimates from OLS regressions (Panel A) and Poisson pseudo-maximum likelihood (Panel B). The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. ‘Post 2012’ is a dummy variable equal to one in 2013 and 2014. ‘Post 2014’ is a dummy variable equal to one between 2015 and 2018. ‘SI’ is a dummy variable equal to one if the firm’s main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. The regressions include all firms (column (1)), firms with no intangible fixed assets pre-2012 (column (2)), and firms in the first, second, and third tercile of the distribution in terms of ‘Intangible share pre-2012’, as long as strictly positive (columns (3), (4), and (5), respectively). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009—2018. All regressions are based on the sample from Table 1, where treated and control observations are matched on ‘Log (Assets)’, ‘Net worth’, ‘Debt / Assets’, ‘Cash / Assets’, ‘Log (Sales)’, ‘Log (Employment)’, ‘Intangible share’, and ‘Age’. Standard errors clustered by country-SI 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 the composition of firm investment: Including non-EA countries

	(1)
	Intangible assets share
Post 2012 × SI	0.00301*** (0.00074)
Post 2014 × SI	0.00174*** (0.00024)
Post 2012 × SI × Euro	-0.00430*** (0.00090)
Post 2014 × SI × Euro	-0.00336*** (0.00054)
Firm FEs	Yes
Country × Year FEs	Yes
Sector × Year FEs	Yes
Clustering	Country × SI
Observations	1,031,279
R-squared	0.87

Notes: The Table reports the point estimates from an OLS regression. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. 'Euro' is a dummy variable equal to one if the firm is domiciled in a Euro-area country. In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. The regression includes fixed effects as specified. The sample period is 2009–2018. The regression is based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI 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 R&D investment: SSM and KLEMS data

	(1)
	R&D
Post 2012 × Share SI	-0.1658 (0.5054)
Post 2014 × Share SI	-0.8289** (0.4389)
Country × Sector FEs	Yes
Sector × Year FEs	Yes
Clustering	Country
Observations	1,735
R-squared	0.99

Notes: The Table reports the point estimates from a Poisson pseudo-maximum likelihood regression. The dependent variable is total expenses in Research & Development in each year, in a country-sector. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'Share SI' is the share of total lending coming from Significant Institutions for each sector/country in 2014. Data for R&D expenses are from the KLEMS database. Data for the share of SI lending come from the Single Supervisory Mechanism. The regression includes fixed effects as specified. The sample period is 2009–2018. Standard errors clustered by country 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 the composition of firm investment: Firm and industry heterogeneity

	(1)	(2)	(3)
	Intangible assets share		
Post 2012 × SI	-0.00096 (0.00074)	-0.00129*** (0.00042)	0.00050 (0.00174)
Post 2014 × SI	-0.00056 (0.00086)	-0.00159*** (0.00050)	0.00346* (0.00179)
Post 2012 × SI × Small	-0.00076 (0.00110)		
Post 2014 × SI × Small	-0.00248** (0.00115)		
Post 2012 × SI × Young		0.00015 (0.00191)	
Post 2014 × SI × Young		-0.00272* (0.00137)	
Post 2012 × SI × Innovation			-0.02010 (0.01771)
Post 2014 × SI × Innovation			-0.05721** (0.02023)
Firm FEs	Yes	Yes	Yes
Country × Year FEs	Yes	Yes	Yes
Sector × Year FEs	Yes	Yes	Yes
Clustering		Country × SI	
Observations	871,761	871,761	871,761
R-squared	0.89	0.89	0.89

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. In 'Small' is a dummy variable equal to one if the firm has fewer than 50 employees. 'Young' is a dummy variable equal to one if the firm is less than 8-years old. 'Innovation' is the average intangible assets share in an industry between 2009 and 2018. All regressions are based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. In all regressions, only firms with at least one observation during each period are included. All regressions include the remaining components of the interaction terms. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009–2018. All regressions are based on the propensity-score-matched sample from Table 1, Panel B. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 7. Bank supervision and lending to firms: IBSI data

	(1)	(2)
	Δ Loans / Assets	
Post 2012 $\times$ SI	-0.0839*** (0.0258)	-0.1269*** (0.0348)
Post 2014 $\times$ SI	-0.0187 (0.0291)	-0.0193 (0.0823)
Post 2012 $\times$ Capital		-0.3707** (0.1702)
Post 2014 $\times$ Capital		0.2711 (0.9643)
Post 2012 $\times$ SI $\times$ Capital		0.5566*** (0.1891)
Post 2014 $\times$ SI $\times$ Capital		-0.0218 (0.9240)
Bank FEs	Yes	Yes
Country $\times$ Year FEs	Yes	Yes
Clustering	Country $\times$ Year	
Observations	1,026	1,026
R-squared	0.33	0.34

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 between 2015 and 2018. '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 2009—2018. Data come from IBSI. All regressions include fixed effects as specified. Standard errors clustered by country-year are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

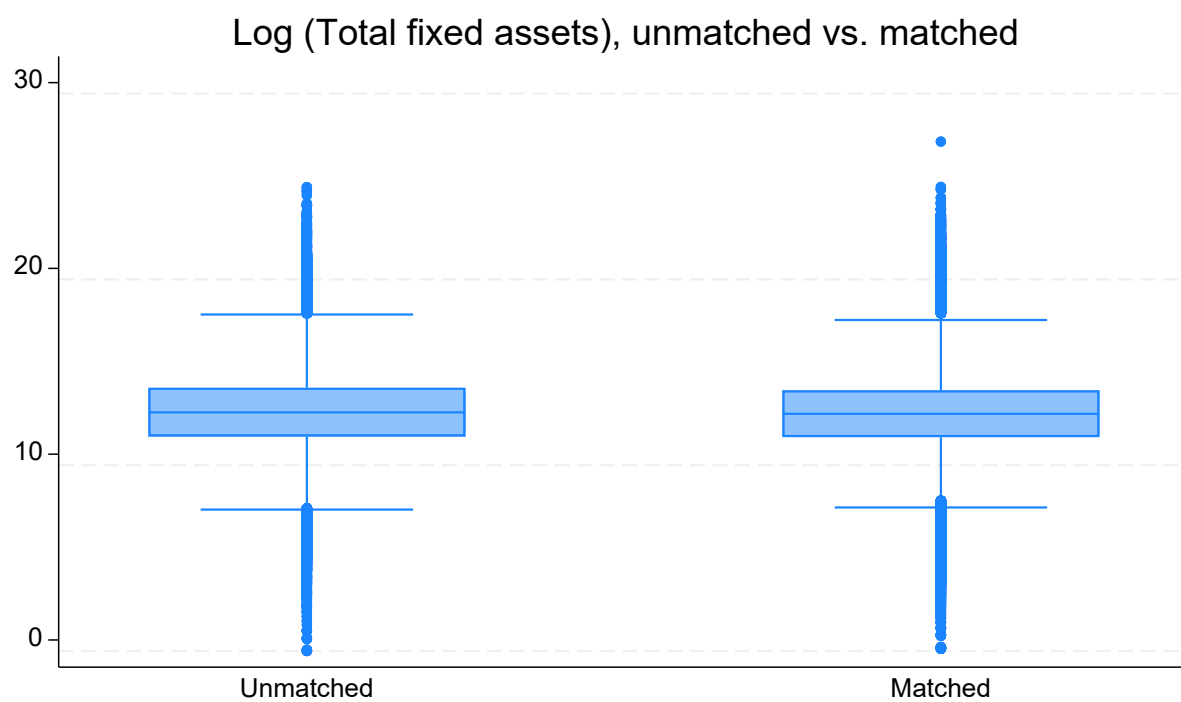
Table 8. Bank supervision and collateral requirements: SAFE data

	(1)
	Collateral requirements
Post 2012 × SI	0.04619** (0.02308)
Post 2014 × SI	0.02934** (0.01400)
Firm FEs	Yes
Country × Wave FEs	Yes
Sector × Wave FEs	Yes
Clustering	Country × SI
Observations	71,303
R-squared	0.87

Notes: The Table reports the point estimates from an OLS regression. The dependent variable is a dummy equal to one if the firm's main creditor increased the collateral requirements on loans in the past 6 months, and to zero if collateral requirements decreased or stayed the same. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. Data come from the Survey on the Access to Finance of Enterprises (SAFE). The regression includes fixed effects as specified. The sample period is 2009—2018. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Figures and Tables

Appendix Figure 1. Balancing properties of firm size, unmatched versus matched



Appendix Table 1. Bank supervision and the composition of firm investment: Terciles

	(1)	(2)
	Intangible assets share	
	OLS	Poisson pseudo-maximum likelihood
Post 2012 × SI	-0.00068 (0.00121)	-0.12166*** (0.06901)
Post 2014 × SI	-0.00210*** (0.00053)	-0.18753*** (0.05746)
Post 2012 × SI × Tercile I	-0.00171* (0.00092)	-0.09287*** (0.03991)
Post 2012 × SI × Tercile II	-0.00163 (0.00183)	0.07616* (0.04459)
Post 2012 × SI × Tercile III	0.00120 (0.00808)	0.12609 (0.08253)
Post 2014 × SI × Tercile I	-0.00115 (0.00184)	-0.01638 (0.07015)
Post 2014 × SI × Tercile II	-0.00149 (0.00268)	0.13340*** (0.06255)
Post 2014 × SI × Tercile III	0.009219*** (0.00299)	0.20382*** (0.06545)
Firm FEs	Yes	Yes
Country × Year FEs	Yes	Yes
Sector × Year FEs	Yes	Yes
Post 2012 × Tercile dummies	Yes	Yes
Post 2014 × Tercile dummies	Yes	Yes
Clustering		Country × SI
Observations	869,192	601,316
R-squared	0.89	0.39

Notes: The Table reports the point estimates from an OLS regression (column (1)) and a Poisson pseudo-maximum likelihood regression (column (2)). The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. 'Tercile I', 'Tercile II' and 'Tercile III' are dummy variables equal to one if the firm is in the first, second, or third tercile, respectively, of the distribution of non-zero intangible shares pre-2012, with firms with 0 intangibles pre-2012 in the reference group. In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. The regression includes fixed effects as specified. The sample period is 2009–2018. The regression is based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI 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: Tangible and intangible assets

	(1)	(2)
	Log (Total tangible assets)	Total intangible assets
Post 2012 × SI	0.00180 (0.00230)	-0.07235*** (0.01084)
Post 2014 × SI	0.00982** (0.00409)	0.00662 (0.02290)
Firm FEs	Yes	Yes
Country × Year FEs	Yes	Yes
Sector × Year FEs	Yes	Yes
Clustering	Country × SI	
Observations	869,959	474,684
R-squared	0.94	0.99

Notes: The Table reports the point estimates from OLS (column (1)) and a Poisson pseudo-maximum likelihood (column (2)) regressions. The dependent variable is the natural logarithm of the firm's tangible fixed assets (column (1)), and the firm's intangible fixed 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 between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included, for each individual variable in columns (1)–(2). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009–2018. All regressions are based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI 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 the composition of firm investment: Firm controls

	(1)	(2)
	Intangible assets share	
Post 2012 × SI	-0.00121** (0.00054)	-0.00107** (0.00044)
Post 2014 × SI	-0.00108** (0.00043)	-0.00097* (0.00052)
Firm FEs	Yes	Yes
Firm controls	Yes	No
Post 2012 × Firm controls	Yes	Yes
Post 2014 × Firm controls	Yes	Yes
Country × Year FEs	Yes	Yes
Sector × Year FEs	Yes	Yes
Clustering		Country × SI
Observations	871,761	761,189
R-squared	0.92	0.92

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. 'Firm controls' include 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age', 1-period lagged (column (1)) and fixed in 2012 (column (2)). In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009—2018. All regressions are based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI 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 the composition of firm investment: Robust clustering

	(1)	(2)	(3)
	Intangible assets share		
Post 2012 × SI	-0.00127** (0.00050)	-0.00127*** (0.00037)	-0.00080* (0.00049)
Post 2014 × SI	-0.00162** (0.00062)	-0.00162*** (0.00030)	-0.00150* (0.00090)
Firm FEs	Yes	Yes	Yes
Country × Year FEs	Yes	Yes	Yes
Sector × Year FEs	Yes	Yes	Yes
Clustering	Country	Country SI × Year	Bank × Period
Observations	871,761	871,761	477,873
R-squared	0.89	0.89	0.91

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. ‘Post 2012’ is a dummy variable equal to one in 2013 and 2014. ‘Post 2014’ is a dummy variable equal to one between 2015 and 2018. ‘SI’ is a dummy variable equal to one if the firm’s main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009–2018. All regressions are based on the sample from Table 1, where treated and control observations are matched on ‘Log (Assets)’, ‘Net worth’, ‘Debt / Assets’, ‘Cash / Assets’, ‘Log (Sales)’, ‘Log (Employment)’, ‘Intangible share’, and ‘Age’. Standard errors clustered by country (column (1)), country-SI-year (column (2)), and bank-period (column (3)) 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 the composition of firm investment: Robust model

	(1)	(2)
	Intangible assets share	
Post 2012 × SI	-0.00080* (0.00052)	-0.00571*** (0.00117)
Post 2014 × SI	-0.00150** (0.00060)	-0.00239* (0.00129)
Firm FEs	Yes	Yes
Bank FEs	Yes	No
Country × Year FEs	Yes	Yes
Sector × Year FEs	Yes	Yes
Clustering		Country × SI
Observations	477,873	871,598
R-squared	0.91	0.97

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009–2018. All regressions are based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. In column (2), observations are weighted by firm assets. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 6. Bank supervision and the composition of firm investment: Intensity of supervisory reform

	Intangible assets share
Post 2012 × Affected	-0.00019** (0.00007)
Post 2014 × Affected	-0.00024*** (0.00008)
Firm FEs	Yes
Country × Year FEs	Yes
Sector × Year FEs	Yes
Clustering	Country × SI
Observations	866,137
R-squared	0.89

Notes: The Table reports the point estimates from an OLS regression. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'Affected' measures the difference between 15 (maximum value) and the country-specific value of the Supervisory Power Index (from Loipersberger, 2018) before the SSM reform, for firms whose main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. The regression includes fixed effects as specified. The sample period is 2009—2018. The regression is based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 7. Bank supervision and the composition of firm investment: Accounting for the effect of the Global Financial Crisis

	(1)	(2)
	Intangible assets share	
Post 2012 × SI	-0.00118** (0.00045)	-0.00131** (0.00047)
Post 2014 × SI	-0.00144*** (0.00036)	-0.00164*** (0.00050)
Post 2012 × GFC assistance		0.00027 (0.00038)
Post 2014 × GFC assistance		0.00065 (0.00063)
Firm FEs	Yes	Yes
Country × Year FEs	Yes	Yes
Sector × Year FEs	Yes	Yes
Clustering		Country × SI
Observations	821,909	871,761
R-squared	0.89	0.89

Notes: The Table reports the point estimates from an OLS regression. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. 'GFC assistance' is a dummy variable equal to one if the firm's main bank received public assistance during the Global Financial Crisis. In all regressions, only firms with at least one observation during each period are included. In column (1), we drop firms borrowing from banks that received public assistance during the Global Financial Crisis. Data come from Orbis. The regression includes fixed effects as specified. The sample period is 2009–2018. The regression is based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 8. Bank supervision and the composition of firm investment: Full sample of banks

	(1)
	Intangible assets share
Post 2012 × SI	-0.00162*** (0.00032)
Post 2014 × SI	-0.00135** (0.00048)
Firm FEs	Yes
Country × Year FEs	Yes
Sector × Year FEs	Yes
Clustering	Country × SI
Observations	1,188,442
R-squared	0.87

Notes: The Table reports the point estimates from an OLS regression. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. The regression includes fixed effects as specified. The sample period is 2009–2018. The regression is based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. The regression includes the full original sample of banks. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 9. Bank supervision and the composition of firm investment: Collapsed data

	(1)
	Intangible assets share
Post 2012 × SI	-0.00115* (0.00073)
Post 2014 × SI	-0.00192* (0.00010)
Firm FEs	Yes
Country × Year FEs	Yes
Sector × Year FEs	Yes
Clustering	Country × SI
Observations	225,815
R-squared	0.93

Notes: The Table reports the point estimates from an OLS regression. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. Data are aggregated in three observations per firm, one average for the 2009–2012 period, one average for the 2013–2014 period, and one average for the 2015–2018 period. Data come from Orbis. The regression includes fixed effects as specified. The sample period is 2009–2018. The regression is based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 10. Bank supervision and the composition of firm investment: SSM banks capital ratios

	(1)	(2)
	Intangible assets share	
Post 2012 × CA Fail	0.0046 (0.0116)	-0.0064 (0.0093)
Post 2014 × CA Fail	0.0159 (0.0110)	0.0075 (0.0096)
Firm FEs	Yes	Yes
Country × Year FEs	Yes	Yes
Sector × Year FEs	Yes	Yes
Clustering	Country × SI	
Observations	586,540	586,540
R-squared	0.90	0.90

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the ratio of intangible fixed assets to the sum of tangible fixed assets and intangible fixed assets. 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'CA Fail' is a dummy variable equal to one if the firm's main bank failed the Comprehensive Assessment at the 5% (column (1)) or at the 8% (column (2)) capital threshold. In all regressions, only firms with at least one observation during each period are included. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2009—2018. All regressions are based on the sample from Table 1, where treated and control observations are matched on 'Log (Assets)', 'Net worth', 'Debt / Assets', 'Cash / Assets', 'Log (Sales)', 'Log (Employment)', 'Intangible share', and 'Age'. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Appendix Table 11. Bank supervision and alternative funding sources: SAFE data

	(1)	(2)
	Used bonds	Used equity
Post 2012 × SI	0.61955*** (0.15275)	0.09704 (0.05819)
Post 2014 × SI	0.56904*** (0.07727)	0.12382* (0.06938)
Firm FEs	Yes	Yes
Country × Wave FEs	Yes	Yes
Sector × Wave FEs	Yes	Yes
Clustering	Country × SI	Country × SI
Observations	7,972	31,902
R-squared	0.94	0.91

Notes: The Table reports the point estimates from an OLS regression. The dependent variable is a dummy equal to one if in the past 6 months the firm used as a source of financing bonds (column (1)) or equity (column (2)). 'Post 2012' is a dummy variable equal to one in 2013 and 2014. 'Post 2014' is a dummy variable equal to one between 2015 and 2018. 'SI' is a dummy variable equal to one if the firm's main bank is a significant institution. In all regressions, only firms with at least one observation during each period are included. Data come from the Survey on the Access to Finance of Enterprises (SAFE). The regression includes fixed effects as specified. The sample period is 2009—2018. Standard errors clustered by country-SI are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

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