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

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Abstract

We exploit the 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 that remained under the supervision of national authorities, firms borrowing from SSM-supervised banks reduced (increased) investment in intangible assets (tangible investment and cash holdings). These effects do not pre-date the supervisory reform, and do not obtain in non-SSM jurisdictions. The reallocation of investment towards physical assets is stronger in intangible-intensive industries, suggesting that more centralized bank supervision can slow down the shift from the "old" to the "new" economy.

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1 Introduction

The distance between supervisors and banks might have an important impact on banks' risk-taking behavior. Recent empirical research has shown the importance of supervisory architecture and thus distance between supervisors and banks for banks' risk-taking (Agarwal et al., 2014). The significant relationship between supervisory architecture and bank lending raises the question of whether this has also implications for the real sector. This paper assesses whether supervisory architecture has implications for firm borrowing, real sector investment and thus sectoral composition of economies, using the announcement of centralized bank supervision in 2012 in the euro area, and of its introduction in 2014, as natural experiment.

Theory provides opposing hypotheses on the effect of supervisory architecture on bank lending and thus corporate finance. On the one hand, as bank supervision exhibits scale economies, centralized supervision might be more effective (Eisenbach, Lucca, and Townsend 2016). Centralised supervision might be better able to reduce the risk of banks arbitraging differences in regulatory stringency across countries (Dell'Ariccia and Marquez, 2006) and can increase supervisory independence (Rochet, 2008). On the other hand, Laffont and Tirole (1993) argue that local supervision can improve monitoring of firms. Carletti, Dell'Ariccia and Marquez (2016) point to lower incentives for local supervisors to collect information if supervisory decisions are centralized. Colliard (2020) argues that local supervisors might be better able to extract information from banks than a centralized supervisor.

We use the introduction of the Single Supervisory Mechanism in 2014 in the euro area as natural experiment to test these hypotheses. Matching firm-level balance sheet data to firms' main lender across 323,644 firms and 578 banks in 13 euro area countries over the period 2010 to 2015, we find that relative to firms borrowing from banks that remained under the supervision of national authorities, firms borrowing from SSM-supervised banks reduced investment in intangible assets, while they increased tangible investment and cash holdings. These effects do not pre-date the supervisory reform and do not obtain in non-SSM jurisdictions. The reallocation of investment towards physical assets is stronger in intangible-intensive industries, suggesting that more centralized bank supervision can slow down the shift from the "old" to the "new" economy.

On 29 June 2012, the heads of state and government of euro-area countries issued a statement announcing that the Commission would present proposals for the creation of a single supervision 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 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 on the 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" (supervised directly by the SSM) and "Less Significant Institutions" (supervised by national authorities) was published.[1] With this, the 2014 Comprehensive Assessment, which included a risk assessment, balance sheet assessment and an asset quality review, was a financial health check of 130 banks in the euro area, covering approximately 82% of total bank assets. The results were published on 26 October 2014, and on 4 November the SSM was born.

As of 2020, the ECB directly supervises the 117 significant banks of the participating countries. The actual supervisory activities are conducted by joint supervisory teams (JSTs) involving both ECB staff and national supervisory staff. Banks that are not considered significant are known as less significant institutions (or LSIs) and continue to be supervised by their national supervisors, in close cooperation with the ECB.

The contrasting theoretical predictions of the literature on banks' reactions to changes in the supervisory architecture also imply different hypotheses on the effect of such changes for corporate finance and investment decisions. If local supervisors provide more rigorous supervision than centralized supervisors, we would expect firms whose lenders change to centralized supervision to increase their investment, including into less collateralizable assets, such as intangible capital. If on the other hand

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

centralized supervisors are more effective, banks might tighten lending standards and increase collateral requirements, with negative implications for investment, especially in intangible assets, which are less collateralizable.

We combine firm- and bank-level data to test these hypotheses. Specifically, we gauge whether investment changes differently after the introduction of the SSM for firms borrowing from banks directly subject to SSM supervision than for firms borrowing from banks that continue to be under national supervision.

We find that relative to firms that borrowed from banks that remained under the supervision of national authorities, firms borrowing from SSM-supervised banks reduced investment in intangible assets. This result is remarkably robust across specifications that account for non-similarities between "control" and "treated" firms, for bank-fixed effects, for time-varying firm-specific shocks, as well as for the unbalanced property of the panel and for model misspecification. It is robust to controlling for unobservable firm heterogeneity, for country-sector-specific trends, and for time-variant firm characteristics. We also find that following the reform in supervisory architecture, firms borrowing from SSM-supervised banks increased cash holdings and investment in tangible assets. These results are, however, less consistent across specification. We do not observe a concurrent change in firm employment, one way or another.

The evidence also suggests that the decline in intangible assets and the increase in tangible investment largely take place during the two years between the announcement and the introduction of the SSM, when banks were subject to exceptional scrutiny of their balance sheets due to the Comprehensive Assessment. Once the SSM took over in late 2014, the data tentatively suggests that all types of investment declined, with the exception of current assets. This is consistent with the idea that firms initially responded to the intensification of their creditors' supervision by investing in assets that are more easily collateralized, and later by hoarding cash.

At the same time, we find a strong growth in tangible assets in R&D-intensive industries. Such industries are instrumental in contributing to productivity-driven long term growth in modern knowledge-based economies. In line with economic efficiency, they should see a steady stream of investment in intangible assets, such as R&D. Finding the opposite suggests that more intense bank supervision can

force innovative firms to engage in safer investment, and thus slow down the shift from the "old" to the "new" economy.

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

Finally, we show that firms borrowing from banks that came under SSM supervision reduced their overall debt after the implementation of the SSM, compared to firms borrowing from banks not subject to SSM supervision, suggesting that lending retrenchment might have been one channel through which firms were forced to adjust their investment.

In summary, our findings are consistent with hypotheses that posit a dampening effect of centralized supervision on banks' lending and thus a shift of firms' investment towards assets that are more easily collateralizable. They are also consistent with theories that focus less on the distance between banks and supervisors and more on the positive effect of centralized supervision on the independence and rigor of bank supervisors.

Our paper contributes to several strands of research. First, it relates to the literature on optimal supervisory architecture. Beck, Todorov, and Wagner (2013) show that the timing of supervisory interventions is correlated with the share of a banks foreign shareholders, deposits, and assets. Behn, Haselman, Kick, and Vig (2017) show that bail-out decisions taken by German politicians sitting on the board of failing banks lead to inefficient bail-outs, implying that the proximity of public authorities to the bank is undesirable in this case. Calzolari, Colliard, and Loranth (2019) show that centralized

supervision can induce multinational banks to change their legal structure, so as to extract more subsidies from deposit insurance. Boyer and Ponce (2012) caution that a central supervisor will be weaker against lobbying efforts than separate supervisors. Gornicka and Zoican (2016), Foarta (2018), and Segura and Vicente (2018) focus on the impact of bail-outs and recapitalizations in the Banking Union. Finally, Repullo (2018) theoretically assesses the optimal allocation of responsibilities, i.e., information collection and liquidation decisions, between a local and a central supervisor. While this literature focuses on the stability implications of the supervisory architecture, our paper focuses on the real effects of one specific change in this architecture by introducing direct supra-national supervision of banks.

Second, our paper also adds to a small but expanding literature on the effect of supervisory architecture on bank behavior. Using variation from the fact that state banks in the US are supervised by state or federal supervisors on a rotating basis, Agarwal, Lucca, Seru, and Trebbi (2014) show that federal supervisors are twice as likely as state supervisors to downgrade the bank they supervise, suggesting that local supervisors are more lenient than central supervisors.[2] Gopalan, Kalda, and Manela (2017) show that closing local branches of the federal authority responsible for supervising nationally-chartered banks in the US leads neighbouring banks to take significantly more risks, suggesting that geographic proximity increases supervisory efficiency. This finding is confirmed by Delis and Staikouras (2011) who show a negative relationship between the number of on-site inspections and bank risk. Our paper adds to this literature focusing on a systematic change in supervisory architecture, moving banks that make up 80% of total banking sector assets in the euro area into a new supervisory framework, with a more prominent role for centralized rather than local (national) supervisors.

Third, our paper also adds to a small empirical literature focusing specifically on the effect of the introduction of the SSM on banks' behavior in the euro area. Fiordelisi, Ricci and Stentella Lopes (2017) show that banks that would come under the supervision of the SSM reduced their lending activities and increased their capital ratios in comparison with banks below the asset threshold for supervision by the SSM). This is in line with the findings of Eber and Minoiu (2016) who show that

[2]See also Kang, Lowery, and Wardlaw (2015) and Rezende (2016).

SSM-supervised banks reduced their asset size and reliance on wholesale debt over the period 2012-15, compared with banks that did not fall under the supervision of the SSM. In particular, weaker banks reduced origination of new loans. Our paper adds to this literature focusing on the effect of the SSM introduction on firms' funding and asset structure, thus real sector repercussions of the change in supervisory architecture.

2 Data

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

2.1 Firm-level data

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

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

the data set contains about 100 million firm-year observations, but about a quarter of those relate to firms that have not provided financial information in any given year.

For our analysis, we take companies with financial data in the period $2010-2015$, and we work with unconsolidated accounts. We start with a total of 46,080,758 firms. We first note that the number of firms varies significantly by country. For example, there are on average 372 firms per year in Cyprus, and 664,469 firms per year in France. Therefore, we make sure that we only analyse countries with good firm coverage in Orbis. To that end, we compare the number of firms in Orbis to official data on the number of firms per country in Eurostat. We find that while some countries are well represented in Orbis, some have very low coverage. Consequently, we drop countries for which Orbis coverage relative to Eurostat is below 10%. These countries are the Czech Republic (8% coverage), Greece, Lithuania (5% coverage), Malta (4% coverage), Poland (3% coverage), and Cyprus (1% coverage). We are left with the remaining 22 EU countries.

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

We also drop country-specific sectors, such as agriculture and mining; sectors with high government ownership, such as public administration; and heavily regulated sectors, such as finance. For our analysis we retain only firms in Manufacturing (NACE Rev. 2 Section C), Construction (F), Wholesale and retail trade (G), Transportation and storage (H), Accommodation and food service activities (I), Information and communication (J), Professional, scientific and technical activities (M) and we drop

firm-year observations if there are less than 10 firms in each NACE Rev. 2 digit 4 sector. Finally, we winsorize all variables at the 1% level.

In addition, the ORBIS database provides, for each company, the name of the main bank the company conducts business with is also provided. This allows us to identify whether a company is related to a bank which became directly supervised by the SSM when it was established, or whether it is related to a bank which is only indirectly supervised by the SSM. We follow the downloading methodology and cleaning procedure described in Kalemli-Ozcan, Laeven, and Moreno (2018) in order to ensure the database is nationally representative and contains minimal missing information.

The bank relationship variable provided is a text self-reported variable and thus can contain typos. We manually check each observation to make sure the match with the list of directly and non-directly supervised banks is done properly. This variable is not available for all countries in the dataset. Our sample is restricted to 13 euro area countries for which we have this information: Austria, Estonia, France, Germany, Greece, Latvia, Luxembourg, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain. We also make use of firms in Hungary, a non-euro area country, for a robustness check of our results. After applying all these procedures, we are left with 323,644 unique firms over the sample period 2010−2015, and a maximum of 1,923,123 firm-year observations for 13 European countries.

In Table 1, we summarize the main variables used in the analysis. On average, during the full sample period (2010–2015), firm investment during that period grew by 2.0%. This is largely driven by an increase in other fixed assets and in current assets (by 2.2% in both cases). At the same time, tangible and intangible assets decline across the board, by 4.3% and 6.6%, respectively. We also show that during the pre-SSM period (2010–2012), there were important differences between firms associated with Significant Institutions (SSM banks), and firms associated with Less Significant Institutions (non-SSM banks). On average, firms with credit relationships with SSM banks are smaller in terms of assets, larger in terms of sales, have a higher cash-to-assets ratio, and are older. These differences are statistically significant, and we use this information in robustness tests.

2.2 Bank-level data

We also make use of bank-level information coming from supervisory data registries, in particular, Financial Reporting (FINREP). FINREP contains detailed information on balance sheet items for all (direct and indirect) SSM-supervised MFIs in the euro area. MFIs are obliged to provide this information as part of their supervisory requirements. Data are available since 2014.

We use these data to obtain loan exposures by geographical and sectoral breakdown for all SSM-supervised MFIs in the euro area. We can therefore calculate what is the share of total loans for each sector-country coming from directly supervised SSM firms. The sector classification is the NACE Rev. 2 and therefore consistent with the sector classification provided in ORBIS.

3 Empirical strategy

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

$$\frac{I_{fbcst}}{K_{fcst-1}} = \beta SSM_{fbcst} \times Post_t + \gamma X_{fbcst-1} + \delta X_{fbcst-1} \times Post_t + \mu_f + \phi_{cst} + \varepsilon_{fbcst}, \qquad (1)$$

where I_{fcst} is investment by firm f, borrowing from bank b, located in country c, operating in sector s in year t. and K_{fcst-1} is that same firm's stock of tangible capital at the end of the previous year. I_{fcst} is calculated as the year-on-year change in the firm's capital, $K_{fcst} - K_{fcst-1}$. We distinguish between tangible and intangible investment. Specifically, *tangibleinvestment* stands for investment in assets such as buildings, machinery and equipment. *Intangibleinvestment* stands for investment in assets such as R&D and on-the-job training. The difference between the two types of assets is that tangible assets are preferred by banks in creditor contracts, as unlike intangible assets, they are redeployable. *Otherassets* stands for other fixed assets on the firms' balance sheets which are neither

tangible nor intangible. *Currentassets* stands for cash and other short term assets that are expected to be converted to cash within a year. Finally, *Totalassets* stands for the sum of tangible, intangible, and current assets.

Turning to the explanatory variables, SSM is a dummy variable equal to one if the firm is borrowing from a Significant Institution, i.e., from a bank which after 2013 was placed under the direct supervision of the Single Supervisory Mechanism. $Post_t$ is a dummy variable equal to one in 2013–2015. We choose 2012 as the last year of the pre- period because the list of significant versus less significant institutions was announced in March 2013, which is when the Comprehensive Assessment started for those. Later, for robustness, we perform a test where $Post_t$ takes a value of one only in 2014, which is when the Single Supervisory Mechanism officially came into force.

$X_{fbcst-1}$ denotes a vector of lagged control variables including the logarithm of total assets, the ratio of cash flow to total assets, the ratio of sales to total assets, and age. Its inclusion allows us to capture the independent impact of various firm-specific developments, such as shocks to overall debt, profits, cash flow, or assets. Furthermore, the inclusion of the interaction $X_{fbcst-1} \times Post_t$ accounts for the time-varying effect of firm-specific controls on firms' investment patterns.

We include firm-fixed effects μ_f to control for unobservable firm-specific time-invariant factors explaining variation in investment behavior. The term ϕ_{cst} is an interaction of country, sector and year dummies, which absorbs any time-varying shocks to demand or to technology specific to a particular sector in a particular country during a particular year (e.g., construction services in Spain or production of heavy machinery in Germany in 2014). In this way, identification is achieved by comparing the average investment levels of two observationally equivalent firms in the same country borrowing from significant versus less significant financial institutions.[3] Finally, ε_{fbcst} is the idiosyncratic error term. In all regressions, we cluster the standard errors at the country-year level.

We do not include the variable SSM 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 variable *Post* on its own because its direct effect on investment is absorbed by the country-sector-year fixed

[3]To control more tightly for the confounding effect of regional factors, such as demand or technology, on individual sectors, in robustness tests we also include an interaction of region, sector, and year dummies.

effects.

The coefficient of interest is β. A negative coefficient β would imply that all else equal, investment declines for firms whose bank is now subject to more stringent supervision, relative to firms whose lender is subject no change in supervision. The point estimate of β thus measures the numerical change in investment from switching the firm from the control group to the treatment group.

4 Empirical results

We first discuss our baseline results of the relationship between changes in the supervisory architecture and changes in firm investment, before presenting a number of robustness tests. We then explore variations of our baseline results across different sectors and explore variation in firm debt with changes in supervisory architecture.

4.1 Baseline result

In Table 2, we present the baseline results of the paper; specifically, the results from four different versions of Model (1) where the dependent variable is, in turn, $Tangibleassetsgrowth$, $Intangibleassetsgrowth$, $Otherfixedassetsgrowth$, and $Currentassetsgrowth$. All regressions include firm fixed effects, country-sector-year fixed effects, and firm covariates.

The results in column (1) of Table 2 show that total assets of firms borrowing from SSM banks increase more than total assets of firms that borrow from banks that stay under decentralized supervision. Before we go to the main question of the paper—the effect of supervision on the composition of firm investment—we start with the regression of the growth in total assets on the change in supervision. Column (1) of Table 2 reports the point estimate from this test. We find that growth in total assets increases significantly after the introduction of the SSM, by about 0.37 percentage points. Given a mean value of 1.97% across our sample, the point estimate implies that over the two years after the reform of the supervisory architecture in Europe, total firm capital increased by 19% percent more than it would have in the absence of the reform, for firms borrowing from banks that were

affected by the reform. Given that around four-fifths of the firms in our sample are borrowing from such banks, the point estimate implies that total firm assets in the economy grew by 15.2% percent more.

The results in the remainder of Table 2 suggest that the increase in total assets, for firms borrowing from significant versus insignificant banks, after the announcement of the SSM is driven by a significant increase in tangible assets (column (2)) and in current assets (column (5)). The former are assets such as buildings, machines, and equipment which are easy to collateralize and redeploy in case of firm bankruptcy. The latter are mostly cash and short-term assets that can be easily converted into cash. Overall, after the announcement of the SSM, and relative to firms borrowing from Less Significant Institutions, firms borrowing from SSM-supervised banks reallocate investment towards physical assets at a rate higher by 5%, and towards current assets at a rate higher by 14%, of the sample mean growth in the respective asset class.

We also find a significant decline in intangible investment for firms borrowing from SSM-supervised bank, relative to similar firms with a credit relationship with banks supervised by national authorities (column (3)). This investment is related to assets such as R&D that are difficult to collateralize as the bank cannot easily redeploy them. Given an average year-on-year decline in intangible investment in the full sample of 6.57 percentage points, a point estimate of -0.0049 suggests that for firms borrowing from SSM-supervised banks, intangible investment decreased by 7.5% faster. We also find that there is no significant change in other fixed assets for the treatment relative to the control group.

In summary, the evidence in Table 2 is consistent with the idea that the centralization of supervision following the announcement and implementation of the SSM was not associated with a decline in firm investment, but did affect strongly the composition thereof. In particular, firms moved away from intangible investment and towards investment in physical assets and in cash. Intangible investment is associated with TFP-enhancing activities, which are fundamental for economies at the forefront of technological progress (cite). The evidence therefore suggests that the SSM pushed banks to support less the "new", knowledge-based economy and more the "traditional", capital-based economy.

We also need to mention that the explanatory power of the tests is quite high. In the range of five different specifications, the variation in attachment to particular sets of banks, together with firm

fixed effects and country-sector-year fixed effects, explains between 19% and 36% of the variation in investment rates over time.

4.2 Parallel trends and falsification

There are two biases that may be compromising our analysis and that we need to address. The first bias is that the trends we capture precede the announcement and implementation of the SSM. In other words, firms borrowing from banks that switched from national to supra-national supervision were reallocating investment away from intangible and towards tangible assets already before the Banking Union. If so, then we are simply picking a continuation of longer-term trends. A second bis might that around 2013, tangible investment increased and intangible investment declined for all firms borrowing from SSM-eligible (i.e., larger) banks, regardless of whether the SSM actually took over the supervision of these banks. While both possibilities are not immediately defensible, we need to formally address them, before we can have full confidence in our findings.

The results in Table 3 mitigate the concerns that our findings are driven by trends independent of the change in supervisory architecture. In Panel A, we test for the parallel-trends assumption, i.e., for whether the treatment and the control group were subject to the same trend in investment before the treatment took place, or not. We now split the pre-treatment period into year 2011 and year 2012, and we compare investment rates across the two years. If the same trends documented in Tables 2–6 are already visible before 2012, then the parallel-trends assumption would be violated and our results would be compromised. However, the estimates reported clearly suggest that there were no different trends across treatment and control firms before the announcement and the implementation of the SSM. The only significant effect is a decline in the growth of current assets in 2012, relative to 2011. At the same time, this is the opposite of what is observed after the advent of the SSM, and the effect is only significant at the 10% statistical level.

In Panel B, we apply our empirical setting and estimation to a country whose banks did not fall under the SSM in 2013 and on. We choose Hungary, which has the best coverage of all non-euro area countries, in terms of firms in Orbis as a share of all firms in the country according to Eurostat (for details, see Kalemli-Ozcan, Laeven, and Moreno, 2018). We then apply the SSM criterion to the

banks which the Hungarian firms in Orbis have a credit relationship with. According to those, had Hungary been eligible to transition to the SSM, three banks would have been treated as "significant": OTP, Erste Bank, and KH Bank. 42 percent of the firms in the sample are borrowing from one of these three banks. We then re-estimate Model (1) on the same sample period, using the distinction significant versus less significant institution in the Hungarian context. The estimates form these tests strongly suggest that there are no differences in investment pattern across the two groups of firms, before and after the start of the euro-area Banking Union. We conclude that the main results in our paper are driven by the effect of supervision, rather than by a global trend by firms borrowing from large banks.

4.3 Alternative tests: Robust sample

We now run a number of robustness tests, aimed at making sure that the results reported in Table 2 are not an artefact of using a particular sample of firms. In what follows, we provide estimates from regressions where we use a balanced panel, and a matched sample of "treatment" and "control" firms.

4.3.1 Balancing the number of firms across classes of investment

We start by noting that the different tests reported in Table 2 are based on a different number of firms and observations. For example, there are 1,887,817 observations in column (5) (growth in current assets), but only 690,945 observations in column (3) (intangible assets growth). This is because we only require that each firm in the regressions has at least one observation during the pre- and at least one observation during the post- period. At the same time, intangible assets are observed for fewer firms (177,764, relative to 317,801 with information on current assets). Moreover, for the average firm, intangible assets are reported for fewer years than tangible or current assets, for example.

We therefore re-estimate Model (1) and require that each firm in the regression has at least one observation during the pre- and at least one observation during the post- period, for each of the four types of assets in columns (2)–(5) of Table 2. The panel is still unbalanced because some firms have only two observations (one pre- and one post-), while others have six such observations (three during

the pre- and three during the post- period). Nevertheless, the sample is now balanced across different regressions, in that each firm in each regression has the minimum number of observations for each type of asset.

The results from the balanced sample in Table 4 confirm our baseline results. Even though in some cases, the number of observations declines by as much as two-thirds, the pattern is strikingly consistent with the one documented in Table 2. Once again, we find that after the announcement and implementation of the SSM, and relative to firms borrowing from less significant banks, firms borrowing from SSM-supervised banks experienced an increase in tangible fixed assets (1) and and increase in current assets (column (4)). At the same time, investment in intangible assets declines (column (2)) All three effects are significant at least at the 10% statistical level. In addition, in this balanced sample, we also find that other fixed assets increase as well, for firms borrowing from SSM-supervised banks, versus firms borrowing from banks supervised by national authorities (column (3)).

4.3.2 Matched sample

Controlling for firm-level heterogeneity, as we have done so far, may not be sufficient if the treatment and control sample are too different, based on observables. Indeed, Table 1 documents significant differences across firms, depending on which group of banks they have a credit relationship with. In particular, firms borrowing from banks that switched from being supervised by national supervisors to being supervised directly by the SSM are smaller and have higher sales-to-assets and cash flow-to-assets ratios. Simply controlling for these on the right-hand side of the regressions might be insufficient if the distributions of these variables across treated and control samples do not overlap sufficiently (see Rosenbaum and Rubin, 1983).

To address this point, we proceed to apply a propensity-score matching criterion for choosing the treatment and control observations. In particular, for each firm, we calculate a propensity score based on pre-treatment observations (i.e., before 2012) of four of the five right-hand-side variables used in Table 5: the natural logarithm of total assets; the ratio of sales to assets; the ratio of cash flow to assets; and firm age. These are firm-specific variables that exhibit statistically significant differences

across the two sub-sample of firms, according to Table 2. We then use this propensity score to match observations across groups, dropping observations where the propensity score is smaller than 0.77 (the tenth percentile of the propensity score).

The estimates reported in Table 5 show that our results are confirmed in the matched sample. Even with this very restrictive approach, we continue finding that after the announcement and implementation of the SSM, and relative to firms borrowing from banks supervised by national authorities, firms borrowing from SSM-supervised banks experienced a decline in tangible assets (column (2)), with this effect being significant at the 5% statistical level. This is counterbalanced by an increase in tangible fixed assets (column (1)) and in current assets (column (4)). However, in the former case, the effect is marginally insignificant at the 10% statistical level. The coefficient sizes in the case of tangible and current assets are similar to the ones in Table 2, further reassuring us that the results so far are not driven by firm-differences between the treatment and the control samples. We conclude that the broad reallocation of investment away from intangible capital and towards tangible assets and cash that we observe in the aftermath of the SSM is not driven by comparing observationally dissimilar firms.

4.4 Alternative tests: Robust model

Next, we run a number of robustness tests, aimed at making sure that the results reported in Table 2 are not an artefact of using a particular model specification. In what follows, we provide estimates from regressions where we control for time-variant firm-specific shocks and for bank connections, we account for the possibility that shocks to different types of investment are correlated, and we control for potential within-firm autocorrelation over time.

4.4.1 Controlling for time-varying firm-level characteristics

Another possibility that we need to address is that the model estimated in Table 2 is mis-specified because we do not control for other firm-level characteristics that can be correlated with investment decisions. In particular, changes in investment may be a function of the firm's size, debt, or prof-

itability. The country-sector-year fixed effects that we employ allow us to control for trends that are common across firms within a country-sector, therefore, we are accounting for unobservable country-sector trends (such as TFP growth in the textile industry in Greece). Nevertheless, many of the important trends that drive investment can be at the firm rather than country-sector level.

To that end, in Table 6 we re-estimate the full version of Model (1), including on the right-hand side a set of firm-specific controls: the natural logarithm of total assets; the ratio of sales to assets; the ratio of total debt to assets; the ratio of cash flow to assets; and age. To address the possibility that these are jointly determined with investment, we measure these firm controls with a 1-year lag. Furthermore, we also include the interactions of these variables with the variable *Post*, though we do not report the coefficients. In this way, we allow for the possibility that the impact of, for example, debt overhang on intangible investment is different before and after the announcement of the SSM.

The estimates in Table 6 continue to confirm the main results, even though on a lower significance level. After the introduction of centralized supervision, and relative to firms borrowing from banks that continued being supervised by national authorities, firms borrowing from SSM-supervised banks experience an increase in tangible fixed assets (1) and in current assets (column (4)). We note, however, that the magnitudes are smaller than the ones we estimated in Table 2. Moreover, in both cases, the point estimate on the main explanatory variable is no longer significant. At the same time, we continue finding that investment in intangible assets by firms borrowing from SSM-supervised banks declined after the announcement of the SSM (column (2)). This effect is of similar magnitude to the one documented in Table 2, and it is significant at the 5% statistical level.

4.4.2 Controlling for bank-level omitted variables

Another way in which the model estimated in Table 2 can be mis-specified is that in Model (1), we do not control for other, non-SSM related shocks that may be affecting the level and composition of banks' credit supply. To address this possibility, in Table 7 we re-estimate Model (1) after including bank fixed effects, in addition to firm fixed effects and interactions of country, sector, and year dummies. By including bank fixed effects, we lose banks that are only lending to one firm in the data set. The sample is thus reduced marginally (e.g., by 376,475 observations in column (1)).

The results in Table 7 continue to confirm the main results of the paper: namely, investment in intangible assets by firms borrowing from SSM banks continues to decline after the announcement of the SSM (column (2)), an effect significant at the 5%-level. While we also find positive coefficients in the regressions of tangible investment and changes in current assets, these estimates are not statistically significant.

4.4.3 Alternative model: Seemingly Unrelated Regressions

We have so far estimated Model (1) for various types of investment, one equation at a time. The assumption implicit in this approach is that decisions on how to adjust a particular type of investment over time are taken in isolation. This may not necessarily be the case; in fact, it is fairly likely that the reallocation of investment is driven by a joint process, which at a minimum implies that the errors in the five different equations may be correlated. To account for this possibility, we estimate the five variants of Model (1) reported in Table 2 using Seemingly Unrelated Regressions (SUR). This allows us to flexibly assume that the errors in the five equations are correlated.

The estimates from this test are reported in Table 8 and broadly confirm the main result of the paper. Namely, we continue finding an increase in tangible investment and in current assets, and a decline in intangible investment, for firms borrowing from SSM-supervised banks relative to firms borrowing from locally supervised banks, with coefficient estimates significant at the 10%-level. We conclude that we can be fairly certain that our results are not driven by failing to account for common shocks to the various types of investment.

4.4.4 Alternative model: Collapsed data

One final issue with our preferred model that we need to address is the possibility that within a firm, investment decisions may be correlated over time. By estimating a model where changes in investment are observed within a firm for as much as 6 years in a row, we have introduced 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 now collapse the underlying annual data into one observations per bank-period. More precisely, we

aggregate information on the four different types of investment under consideration into one pre-SSM observation (i.e., over the period 2010–2012), and one post-SSM observation (i.e., over the period 2013–2015).

We report the estimates from these alternative tests in Table 9 and find that even in this considerably more restrictive specification, the estimates continue to lend strong support to the notion that supervisory reform is followed by a reallocation of investment. In particular, firms borrowing from SSM-supervised banks decrease significantly their investment in intangible assets (column (2)), and increase significantly their investment in current assets (column (4)), with coefficient estimates significant at least at the 10%-level.

4.5 Stress tests or supervision?

In our main tests, we have made the sampling choice to compare the evolution of firm investment over the period 2013–2015, relative to the period 2010–2012. The three-year post-period includes both the period of the Comprehensive Assessment, which included an Asset Quality Review (AQR) and stress tests and which started in 2013 and concluded in October 2014, and one year after the start of the SSM in November 2014. It is reasonable to hypothesize that the two forces may have had a different impact on the reallocation of investment within firms, with potentially only one of them driving the overall results in the paper. We now put this question to the test, in the process also utilizing a different data source (the FINREP and COREP of the SSM).

4.5.1 Firm investment before and after 2014, Orbis data

We first re-run Equation (1) on two different sample periods. The first period encompasses 2010–2014. Therefore, there are three years of observations during the pre- period (2010–2012), and two years of observations during the post- period (2013 and 2014). The post- period thus captures only the AQR, and stops at the start of the SSM.

The estimates from these tests are reported in Panel A of Table 10. We find that during the period of the AQR, and relative to the pre-AQR period, firms borrowing from significant banks experienced

a simultaneous increase in tangible fixed assets (1) and a decline in intangible assets (column (2)), relative to firms borrowing from less significant banks. We note that in the latter case, the magnitude of the effect larger than the one reported in Table 2, column (3). Both in the case of tangible and in the case of intangible investment, the effect is significant at the 5% statistical level. At the same time, we no longer find a significant increase in current assets after 2012.

Next, we re-run Equation (1) on the period 2013–2015. The *Post* dummy is now equal to one in 2015, and we are comparing the two years of the AQR to the first post-SSM year. The estimates from these tests are reported in Panel B of Table 10. We no longer find a significant decline in intangible investment, suggesting that the entire decline in intangible investment after 2012 took place during the AQR period. At the same time, we find that tangible investment declined significantly (column (1)), and current assets increased significantly (column (4)) during the first year of the SSM, with both coefficient estimates signficant at least at the 10%-level.

Our results thus provide some evidence for the idea that banks reacted differently to the short-run need to pass the AQR versus the introduction of long-term centralized supervision. Table 10 is consistent with the idea that during the AQR period, banks increased the safety of their lending operations by reallocating away from intangible, and towards tangible lending. At the same time, after the introduction of the SSM itself, banks reallocated lending in such a way as to make firms reduce investment and hoard on cash.

4.5.2 Firm investment after 2014, SSM data

We now provide an alternative analysis of the above question using bank-level data coming from supervisory records (FINREP templates). Because of superior data availability, this analysis also allows us to extend the investigation to all euro area countries. The FINREP data do not contain information about lending by individual banks to individual firms. Instead, the data are based on lending by an individual bank to all firms in a country-sector. Therefore, unlike in the tests so far, we proceed to estimate cross-country, cross-sector regressions. Because the SSM data only start in end-2014, we can only study the impact of the introduction of the SSM, and not of the AQR. In addition, because our Orbis data only run until end-2015, we only run a cross-sectional, rather than

a panel, regression.

In practice, we estimate the following equation:

$$\frac{I_{cst}}{K_{cst-1}} = \beta ShareSI_{cst-1} + \gamma X_{cst-1} + \mu_c + \phi_s + \varepsilon_{cs}, \tag{2}$$

where $fracI_{cst}K_{cst-1}$ is the log difference between end-2014 and end-2015, in country c and sector s, for four types of assets: tangible, intangible, other fixed, and current. $ShareSI_{cst-1}$ is the share of overall lending to country c and sector s in end-2014 that is done by Significant Institutions.

The further controls in the regression are defined as follows. X_{cst-1} is a vector of country-sector level controls which includes the average Tier 1 capital and the average NPL ratio of all banks lending to country c sector s, and the share of assets in c sector s out of total assets in country c. μ_c is a vector of country dummies, and ϕ_s is a vector of sector dummies. We cluster the standard errors at the country level.

The results in Table 11 suggest that after the introduction of the SSM firms in country-sectors that were more exposed to lending from SSM-supervised banks experienced a decline in tangible investment between 2014 and 2015, although this effect is significant only at the 15%-level.This is consistent with the effect documented in Panel B of Table 10, using Orbis data. Changes after 2014 in the other types of assets are not precisely estimated.

The evidence reported in Tables 10 and 11 therefore suggests that the concurrent decline in intangible and increase in tangible assets after 2012 is primarily an artefact of the Comprehensive Assessment conducted in 2013 and 2014. The start of the SSM in late 2014, on the other hand, appears to have been (weakly) associated with a decline in tangible investment. Finally, the evidence (weakly) points to an increase in the firms' propensity to hoard cash after the start of the SSM.

4.6 Industry heterogeneity

Is the effect we document in the paper identical across the different sectors of the economy? Or is it stronger for some sectors? One natural margin to examine in answering this question is the sector's

technological composition of investment. For example, some sectors at the forefront of the modern economy (biotech, high-tech, robotics) rely more on intangible investment, such as RD and human capital, and less on tangible investment, such as machines. Other, more traditional sectors (textile, timber) rely relatively more on tangible investment and to a lesser degree on innovation and human capital. The effect we document in this paper–a firm-level reallocation away from intangible and towards tangible investment–would have an even more profound effect if it took place in sectors that are technologically more suited to intangible asset growth.

To test for this possibility, we modify Model (1) in the following way. We create a sector-level variable which denotes the sector's technological R&D intensity. To that end, we follow Claessens and Laeven (2003) and use data on mature Compustat firms to calculate the median value, for each sector, of its R&D investment divided by sales. We do so for the pre-crisis period (1990–2000). Then we interact this value with the interaction of bank dependence and the *Post* dummy, as follows:

$$\begin{aligned} \frac{I_{fbcst}}{K_{fcst-1}} &= \beta_1 SSM_{fbcst} \times Post_t + \beta_2 SSM_{fbcst} \times Post_t \times Intang_s \\ &+ \gamma X_{fbcst-1} + \mu_f + \phi_{ct} + \varepsilon_{fbcst}, \end{aligned} \tag{3}$$

where $Intang_s$ is a sector-level benchmark that is common to all firms in the same sector. We omit the interactions $Intang_s \times Post_t$ and $SSM_{fbcst} \times Intang_s$ because they are subsumed in the country x industry x year fixed effects. The coefficient β_2 now measures the change in investment after the announcement of the SSM, for firms borrowing from affected versus non-affected banks, in intangible-intensive versus tangible-intensive sectors.

The results reported in Table 12 confirm our previous findings and show that the effect is stronger in sectors more reliant on intangible assets. The point estimate of β_1 confirms the evidence documented so far: firms affected by the change in supervision reduce intangible investment and increase tangible investment and current assets (cash). Importantly, the increase in tangible investment is significantly more pronounced for firms in intangible-asset intensive sectors (column (1)), an estimate that is significant at the 10%-level. Our evidence thus suggests that the reallocation away from more towards less TFP-enhancing investment is affecting the sectoral asset composition, too, with more innovative sectors moving towards assets that are to a lesser degree associated with innovation.

4.7 The evolution of firm debt

Our evidence raises the natural question of the channel whereby changes in the quality of supervision affect firm investment. One possibility is a reduction in bank lending. A stricter supervisor can ask banks to lower the risk of their asset portfolio. Banks may respond to this demand by shrinking their lending portfolio and increasing their (sovereign) bond portfolio, which would account for the reduction in intangible investment at the firm level that we document. A second possibility is a change in the manner of lending. Banks may be extending the exact same amount of loans to non-financial corporations, but under stricter collateral rules. In this case, firms would be forced to change their investment pattern towards one where relatively more tangible assets are generated. This would account for both the increase in tangible investment and the decline in intangible investment that we document.

While Orbis data do not include information on loan conditionality, we can test for changes in firm borrowing following the change in supervisory architecture. In addition to other types of financial information, firms report their overall indebtedness. We already use this information in Table 5, and summarize it in Table 1. We can now use it as an outcome variable, and check for the impact of supervision on total debt, for treated relative to control firms.

To that end, we estimate the following model:

$$\frac{Debt_{fbcst}}{Assets_{fcst-1}} = \beta SSM_{fbcst} \times Post_t + \mu_f + \phi_{ct} + \varepsilon_{fbcst}, \tag{4}$$

where the dependent variable is now the firm's total debt, scaled by the firm's total assets. As before, the main variable of interest is the interaction between an indicator variable equal to one if the firm has a credit relationship with a bank affected by the introduction of the SSM, and an indicator variable equal to one after 2012, for all firms. The regressions also include firm and country-year fixed effects.

The results in Table 13 provide some (weak) evidence that borrowing declined for firms linked to banks subject to the change in supervisory architecture. We estimate Equation (4) using three samples: the full sample over 2010–2015 (as in Table 2), the full sample over 2010–2014 (as in Table

10, Panel A), and the matched sample over 2010–2015 (as in Table 5). The evidence points to an overall reduction in total indebtedness at the firm level, by between 0.22 percent and 0.46 percent of total assets. The results are strongest–in the statistical sense–in the period that ends right at the start of the SSM (column (2)), where the reduction is significant at the 5% statistical level. In contrast, in the matched sample, the overall effect is less than half the size, and insignificant.

We conclude that there is some evidence in the data to support the idea that following the intensification of supervision, banks have reduced lending to non-financial corporations. This effect could partially explain the reduction in intangible investment that we document in Tables 2–10. At the same time, an effect that we cannot document (safer lending based more than before on tangible collateral) could be at play, helping to explain the (weak) increase in tangible assets at the firm level.

4.8 Employment

One final remaining question concerns the degree of complementarity between investment and employment. The extent to which capital and labor are complements or substitutes in production is typically driven by the firm's technology. At the same time there may be important differences among various types of investments. For example, in the presence of strong skill bias, labor should move in the same direction as intangible investment. In contrast, if labor is mostly low-skill, it will likely move in the same direction as investment in fixed assets, such as land, building, and machines. Moreover, the impact of supervisory reform on employment is an important question on its own, and its answer provides additional insights to the welfare implications of the policy we study.

In Table 14, we estimate the following model:

$$\frac{Employment_{fbcst} - Employment_{fcst-1}}{Employment_{fcst-1}} = \beta SSM_{fbcst} \times Post_t + \mu_f + \phi_{ct} + \varepsilon_{fbcst}, \tag{5}$$

where the dependent variable is now the change in the firm's total employment. Note that Orbis does not allow us to distinguish between skilled and unskilled labor. As before, the main variable of interest is the interaction between an indicator variable equal to one if the firm has a credit relationship with a bank affected by the introduction of the SSM, and an indicator variable equal to one after 2012,

for all firms. The regressions also include firm and country-year fixed effects.

The results in Table 14 show no discernible effect of the announcement of the SSM on firm employment, suggesting that the main margin of adjustment was not a decline in overall firm activity, but a reallocation of investment across different types of assets. As in Table 13, we run the regression on the full sample of firms during the full sample period, on the full sample of firms during the pre-SSM period, and on the matched sample during the full sample period. The coefficient of interest does not enter significantly in any of the regressions.

5 Conclusion

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

In this paper, we take this theoretical ambiguity to the data, using the introduction of the SSM as an exogenous shock to how some (but not all) firms' lenders are supervised. We find that relative to firms that borrowed from banks that remained under the supervision of national authorities, firms borrowing from SSM-supervised banks reduced investment in intangible assets and increased cash holdings and investment in tangible assets after the reform in supervisory architecture. This effect is robust to controlling for observable and unobservable firm heterogeneity, to controlling for country trends, to looking at longer and shorter time windows, and to comparing very similar distributions of treated and control firms. The main effect in the paper is confirmed by tests which use supervisory data, and it is stronger in intangible-intensive industries.

Our results suggest that more centralized bank supervision is associated with a decline in lending

to firms, which is accompanied by a shift towards more tangible-collateral-based lending. This is an instructive result, in light of the fact that in the long run, capital investment accounts for 40%, and RD investment for 60%, of economic growth (Fernald and Jones, 2014). The combination of the two effects we document thus raises the possibility that centralized bank supervision can slow down the shift from the "old", capital-based, to the "new", knowledge-based, economy. While a natural corollary of our results is the expectation of reduced innovation, we leave these questions to future research.

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Table 1. Summary statistics: Pre-treatment

	(1)	(2)	(3)	(4)
	Full sample	SSM = 0	SSM = 1	Difference
Panel A. Investment and employment, 2010—2015				
Δ Total assets	0.0197			
Δ Tangible assets	-0.0431			
Δ Intangible assets	-0.0657			
Δ Other fixed assets	0.0217			
Δ Current assets	0.0220			
Δ Employment	-0.0016			
Panel B. Firm-specific controls, 2010—2012				
Log (Assets)	13.9792	14.2340	13.9203	0.3137***
Sales / Assets	1.6403	1.6067	1.6481	-0.0415***
Debt / Assets	0.4773	0.2762	0.5215	-0.2453
Cash / Assets	0.0581	0.0506	0.0598	-0.0092***
Age	20.1452	19.6790	20.2529	-0.5739***

Note: The Table summarizes the variables used in the empirical tests. The sample period is 2010—2015. Only firms that report a credit association with at least one bank are included. In column (1), summary statistics are reported for the full sample of firms: over 2010—2015 in Panel A, and over 2010—2012 in Panel B. In column (2), summary statistics are reported for firms with a credit relationship with a less significant institution (SSM=0). In column (3), summary statistics are reported for firms with a credit relationship with a significant institution (SSM=1). In column (4), comparison-in-means from a two-sided Mann-Whitney test are reported. 'Δ Total assets' denotes the year-on-year percentage change in the firm's total assets. 'Δ Tangible assets' denotes the year-on-year percentage change in the firm's tangible assets. 'Δ Intangible assets' denotes the year-on-year percentage change in the firm's intangible assets. 'Δ Other fixed assets' denotes the year-on-year percentage change in the firm's other fixed assets total assets. 'Δ Current assets' denotes the year-on-year percentage change in the firm's current assets. 'Δ Employment' denotes the year-on-year percentage change in the firm's employees. 'Log (Assets)' denotes the natural logarithm of the firm's total assets. 'Sales / Assets' denotes the ratio of the firm's total sales to the firm's total assets. 'Debt / Assets' denotes the ratio of the firm's total debt to the firm's total assets. 'Cash / Assets' denotes the ratio of the firm's cash flow to the firm's total assets. 'Age' is the firm's age in years. Data come from Orbis.

Table 2. Bank supervision and firm investment: Main result

	(1)	(2)	(3)	(4)	(5)
	Δ Total Assets	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0037***	0.0020**	-0.0049***	-0.0002	0.0031**
	(0.0010)	(0.0010)	(0.0019)	(0.0009)	(0.0015)
Firm FEs	Yes	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes	Yes
Clustering			Country × Year		
Observations	1,923,123	1,742,553	690,945	1,185,497	1,887,817
R-squared	0.22	0.29	0.36	0.23	0.19

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's total assets (column (1)); the year-on-year percentage change in the firm's tangible assets (column (2)); the year-on-year percentage change in the firm's intangible assets (column (3)); the year-on-year percentage change in the firm's other fixed assets (column (4)); and the year-on-year percentage change in the firm's current assets (column (5)). 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation after 2012 are included, for each individual variable in columns (1)–(5). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2015. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 3. Bank supervision and firm investment: Placebo tests

Panel A. Pre-SSM

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2011 × SSM	-0.0007	0.0005	0.0019	-0.0015*
	(0.0007)	(0.0021)	(0.0012)	(0.0008)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering		Country × Year		
Observations	558,727	219,785	363,763	617,582
R-squared	0.60	0.64	0.54	0.48

Panel B. Hungary

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Post 2012 × SSM	0.0084	0.0059	0.0018	-0.0044
	(0.0052)	(0.0115)	(0.0084)	(0.0030)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering		Country × Year		
Observations	24,692	20,110	21,542	24,934
R-squared	0.30	0.33	0.30	0.19

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2011' is a dummy variable equal to one in 2012 and later. 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation after 2011 are included, for each individual variable in columns (1)–(4). In Panel B, the sample is restricted to firms in Hungary (a country that is not part of the SSM). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2011—2012 inPanel A, and 2010–2015 in Panel B. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 4. Bank supervision and firm investment: Only firms for which all types of investment are observed

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0025*	-0.0038**	0.0031**	0.0038***
	(0.0015)	(0.0020)	(0.0014)	(0.0015)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering	Country × Year			
Observations	609,242	553,663	569,360	628,363
R-squared	0.27	0.35	0.23	0.18

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation after 2012 are included, for all dependent variables in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2015. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 5. Bank supervision and firm investment: Matched sample

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0016	-0.0035**	-0.0004	0.0033**
	(0.0011)	(0.0018)	(0.0009)	(0.0015)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering		Country × Year		
Observations	1,528,002	572,907	1,016,488	1,647,225
R-squared	0.29	0.37	0.23	0.18

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation after 2012 are included, for each individual variable in columns (1)–(4). In each column, the treatment and control groups are chosen based on a propensity-score matching procedure, based on pre-2013 observations of 'Log (Assets)', 'Sales / Assets', 'Cash / Assets', and 'Age'. Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2015. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 6. Bank supervision and firm investment: Controlling for lagged firm characteristics

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0011	-0.0041**	-0.0003	0.0018
	(0.0011)	(0.0020)	(0.0009)	(0.0015)
Firm controls	Yes	Yes	Yes	Yes
Post 2012 × Firm controls	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering			Country × Year	
Observations	1,409,134	616,571	1,013,772	1,494,430
R-squared	0.31	0.36	0.24	0.29

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

Table 7. Bank supervision and firm investment: Controlling for bank connections

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0016	-0.0063**	-0.0021	0.0004
	(0.0020)	(0.0031)	(0.0025)	(0.0015)
Firm FEs	Yes	Yes	Yes	Yes
Bank FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering	Country × Year			
Observations	1,546,648	627,734	1,042,552	1,680,848
R-squared	0.29	0.36	0.23	0.19

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation after 2012 are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2015. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 8. Bank supervision and firm investment: SUR

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0020*	-0.0016*	0.0008	0.0018*
	(0.0012)	(0.0009)	(0.0012)	(0.0011)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering		Country × Year		
Observations	536,437	536,437	536,437	536,437
R-squared	0.23	0.23	0.21	0.21

Notes: The Table reports the point estimates from Seemingly Unrelated Regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation after 2012 are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2015. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 9. Bank supervision and firm investment: Collapsed data

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed Assets	Δ Current assets
Post 2012 × SSM	0.0021	-0.0038*	0.0005	0.0032**
	(0.0014)	(0.0023)	(0.0011)	(0.0016)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Period FEs	Yes	Yes	Yes	Yes
Clustering		Country × Period		
Observations	618,250	268,006	447,578	644,912
R-squared	0.60	0.62	0.53	0.52

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

Table 10. Bank supervision and firm investment: AQR versus SSM

Panel A. 2010—2014

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0026**	-0.0053**	0.0004	0.0021
	(0.0011)	(0.0021)	(0.0011)	(0.0016)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering		Country × Year		
Observations	1,454,701	576,149	984,870	1,572,937
R-squared	0.33	0.39	0.28	0.22

Panel B. 2013—2015

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed Assets	Δ Current Assets
Post 2014 × SSM	-0.0024*	0.0013	0.0009	0.0029**
	(0.0014)	(0.0018)	(0.0011)	(0.0012)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering		Country × Year		
Observations	810,700	325,102	559,645	921,507
R-squared	0.45	0.49	0.39	0.33

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and later. 'Post 2014' is a dummy variable equal to one in 2015. 'SSM' 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 before and at least one observation after are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2014 (Panel A), and 2013—2015 (Panel B). Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 11. Bank supervision and firm investment: Post-2014, SSM data

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current Assets
Share SI loans	-0.1580	0.0722	-0.2407	-0.2220
	(0.1019)	(0.3140)	(0.3640)	(0.1696)
Share dependent variable	-0.2096	1.8130**	0.7252	-0.1809
	(0.3530)	(0.7842)	(0.5830)	(0.5411)
Tier 1 capital	0.0470	1.7901*	1.4995***	0.4890*
	(0.3192)	(1.0255)	(0.3249)	(0.2915)
NPLs	0.1533	1.2740	-0.1898	-0.2043**
	(0.1908)	(1.1867)	(0.2168)	(0.0726)
Country FEs	Yes	Yes	Yes	Yes
Sector FEs	Yes	Yes	Yes	Yes
Clustering			Country	
Observations	326	326	326	326
R-squared	0.23	0.20	0.22	0.30

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the country-sector average of the log difference between 2014 and 2015 in the firm's tangible assets (column (1)), the firm's intangible assets (column (2)), the firm's other fixed assets (column (3)), and the firm's current assets (column (4)). 'Share SI loans' is the share of total lending to a country-sector in 2014 that is provided by significant institutions. 'Share dependent variable' is the value of the respective dependent variable in a country-sector in 2014, divided by the respective dependent variable in the country in 2014. 'Tier 1 capital' is the country-sector average of all banks lending to a country-sector in 2014. 'NPLs' is the average share of non-performing loans in a country-sector in 2014. In all regressions, the aggregates are based on firms with at least one observation in 2014 and at least one observation in 2015, for each individual variable in columns (1)–(4). Data come from the SSM FINREP and from Orbis. All regressions include fixed effects as specified. The sample period is 2014—2015. Standard errors clustered at the country level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 12. Bank supervision and firm investment: Interaction with intangible intensity

	(1)	(2)	(3)	(4)
	Δ Tangible assets	Δ Intangible assets	Δ Other fixed assets	Δ Current assets
Post 2012 × SSM	0.0017*	-0.0056***	-0.0004	0.0032**
	(0.0010)	(0.0019)	(0.0009)	(0.0015)
Post 2012 × SSM × Intangible intensity	4.0464*	5.8434	2.7792	-1.3712
	(2.6714)	(4.8794)	(2.8485)	(4.8734)
Firm FEs	Yes	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes	Yes
Clustering	Country × Year			
Observations	1,742,553	690,945	1,185,497	1,887,817
R-squared	0.29	0.36	0.23	0.19

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's tangible assets (column (1)); the year-on-year percentage change in the firm's intangible assets (column (2)); the year-on-year percentage change in the firm's other fixed assets (column (3)); and the year-on-year percentage change in the firm's current assets (column (4)). 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' is a dummy variable equal to one if the firm's main bank is a significant institution. 'Intangible intensity' is a sector-specific median ratio of R&D investment to total assets, from Claessens and Laeven (2003). In all regressions, only firms with at least one observation before and at least one observation after 2012 are included, for each individual variable in columns (1)–(4). Data come from Orbis. All regressions include fixed effects as specified. The sample period is 2010—2015. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 13. Bank supervision and firm debt

	(1)	(2)	(3)
	Δ Total debt		
	Full sample	2010—2014	Matched sample
Post 2012 × SSM	-0.0022*	-0.0032**	-0.0020
	(0.0014)	(0.0016)	(0.0014)
Firm FEs	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes
Observations	1,042,799	869,366	1,013,149
R-squared	0.25	0.29	0.25

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's total debt. 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation of the change in total debt after 2012 are included. All regressions include fixed effects as specified. The sample period is 2010—2015 (columns (1) and (3)) and 2010–2014 (column (2)). The sample includes all firms (columns (1) and (2)) and the sample of firms where the treatment and control group are chosen based on propensity score matching, based on pre-2013 observations of 'Log (Assets)', 'Sales / Assets', and 'Cash / Assets'. In all regressions, only firms with at least one observation before and at least one observation after 2012 are included, for each individual variable in columns (1)–(3). Data come from Orbis. All regressions include fixed effects as specified. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.

Table 14. Bank supervision and employment

	(1)	(2)	(3)
	Δ Employment		
	Full sample	2010—2014	Matched sample
Post 2012 × SSM	0.0011	0.0017	0.0009
	(0.0012)	(0.0016)	(0.0017)
Firm FEs	Yes	Yes	Yes
Country × Sector × Year FEs	Yes	Yes	Yes
Observations	406,585	331,835	360,389
R-squared	0.23	0.26	0.24

Notes: The Table reports the point estimates from OLS regressions. The dependent variable is the year-on-year percentage change in the firm's employment. 'Post 2012' is a dummy variable equal to one in 2013 and later. 'SSM' 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 before and at least one observation of the change in total debt after 2012 are included. All regressions include fixed effects as specified. The sample period is 2010—2015 (columns (1) and (3)) and 2010–2014 (column (2)). The sample includes all firms (columns (1) and (2)) and the sample of firms where the treatment and control group are chosen based on propensity score matching, based on pre-2013 observations of 'Log (Assets)', 'Sales / Assets', 'Cash / Assets', and 'Age'. In all regressions, only firms with at least one observation before and at least one observation after 2012 are included, for each individual variable in columns (1)–(3). Data come from Orbis. All regressions include fixed effects as specified. Standard errors clustered at the country-year level are reported in parentheses where ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent statistical level, respectively.