# Restoring Confidence in Systemically Important Banks: SSM Effects on Bank Performance

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# Abstract

Under the Single Supervisory Mechanism (SSM), which was introduced in 2014 in response to the European sovereign debt crisis, the European Central Bank directly supervises major euro area banks. We examine whether the SSM has contributed to the recovery of SSM banks. We find positive effects on SSM banks' return on assets and return on risk-weighted assets (RORWA). Robustness checks show that the SSM effects are not just placebo effects or large-bank effects. A breakdown of the RORWA into its components suggests that the main reason for the positive SSM effects is restored confidence in the soundness of SSM banks.

*Keywords:* ECB Single Supervisory Mechanism; bank profitability; capital requirements; risk-weighted assets

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# 1. Introduction

The Single Supervisory Mechanism (SSM) was introduced in November 2014 in response to the global financial crisis of 2007–2008 and the subsequent European debt crisis to restore confidence in the European banking sector and to strengthen the resilience of euro area banks. Before the SSM, all euro area banks were supervised by national authorities. Under the SSM, more than 110 "significant" euro area banks (SSM banks for short) are directly supervised by the European Central Bank (ECB), while "less significant" banks continue to be supervised by national authorities.<sup>2</sup> Other regulatory and macroeconomic changes (e.g., Basel III and the negative interest rate environment) have taken place since 2014, but these changes affect all banks in the euro area. This makes direct ECB supervision in the SSM the only major regulatory change since 2014 that applies only to SSM banks.<sup>3</sup>

When supervising SSM banks, the ECB forms supervisory teams consisting of ECB supervisors and national supervisors. The teams are led by the ECB and the national supervisors act independently under the SSM. Decisions are made by the ECB's Supervisory Board and approved by the Governing Council. Since a central supervisory authority has more resources and a broader view of the banking sector, the supervision of SSM banks is more consistent and probably also stricter than supervision by national authorities (Ampudia et al., 2019).<sup>4</sup>

The introduction of the SSM raises a number of immediate questions. Low profitability may tempt banks to hunt for yield and take excessive risks (Jensen and Meckling, 1976; Keeley, 1990). Sufficient bank profitability is, therefore, a prerequisite for a resilient banking system.<sup>5</sup> The question, then, is whether the

<sup>&</sup>lt;sup>2</sup>A bank is considered significant if it at least meets one of the following criteria: its assets exceed 30 billion euro, it is important for the country or the euro area as a whole, it has important cross-border activities, it has requested or received funding from the European Stability Mechanism or the European Financial Stability. Together, the significant banks hold about 82% of all banking assets in the euro area. SSM banks are therefore typically the largest banks in a country. However, less significant banks in large euro area countries can be larger than SSM banks in small euro area countries.

<sup>&</sup>lt;sup>3</sup>The SSM is one of the two pillars of the euro area banking union. The other pillar, the Single Resolution Mechanism, entered into force on January 1, 2016, in all member states and applies to all euro area banks. Therefore, the Single Resolution Mechanism does not compromise the identification of SSM effects. The planned Common Deposit Guarantee Scheme has not yet been successfully implemented as a third pillar in the European banking union.

<sup>&</sup>lt;sup>4</sup>Consistent with this view, Agarwal et al. (2014) find that US federal supervisors are more rigorous than US state supervisors.

<sup>&</sup>lt;sup>5</sup>But see, Martynova et al. (2020) for an opposing view.

SSM has an impact on the profitability and risk-taking of SSM banks, and if so, why does the SSM have an impact? Do important SSM effects arise from adjustments made by SSM banks or from increased confidence in SSM banks? Which components of profitability are particularly affected by the SSM?

In this paper, we seek to answer these questions by examining the impact of the SSM on the SSM banks' return on assets, risk weights, and the return on risk-weighted assets (also known as return on risk-adjusted capital), as these variables capture the profitability and risk-taking of the SSM banks. To identify the nature of the SSM effects, we estimate direct SSM effects and indirect SSM effects resulting from adjustments to key bank-specific variables and examine how the SSM affects the income, cost, and risk components of bank profitability.

A priori, it is not clear how the SSM affects bank profitability. For example, higher capital requirements imposed by stricter ECB supervision may reduce profitability (at least in the short run). At the same time, more strictly supervised banks may be perceived as safer, which may lower banks' funding costs and thereby increase profitability. Moreover, since the financial crisis of 2008, the profitability of European banks has been rather weak (Kok et al., 2023; Detragiache et al., 2018). One would therefore like to know whether the SSM has helped to improve the profitability of SSM banks or whether the SSM has helped to the profitability of SSM banks or whether the SSM has depressed the profitability of these banks even further.

We examine how the SSM affects average risk weights because risk weights link a bank's risk profile to its required regulatory capital. Riskier lending strategies result in higher risk weights and require more capital to meet minimum capital ratios. Risk weights are therefore an important target of on-site bank inspections, especially because banks can use their own internal ratings-based models to compute risk weights. Direct ECB supervision may influence the average risk weight because of underestimated risks or more risk-taking. If supervisors find that an internal model underestimates risk, a bank must increase risk weights for a given portfolio. A bank's average risk weight may also increase because of a riskier portfolio.

We examine the impact of the SSM on the return on risk-weighted assets because this measure reflects the combined effect of the SSM on profitability and risk-taking. The nominator of the return on risk-weighted

assets – net operating income before credit impairment and tax – captures the impact of the SSM on the income component of bank profitability. The denominator – risk-weighted assets – captures the riskiness of a bank's portfolio. For a given portfolio, higher income increases the return on risk-weighted assets. A less risky portfolio also increases the return on risk-weighted assets because it reduces risk weights and therefore the amount of risk-weighted assets. A positive effect of the SSM on the return on risk-weighted assets, therefore, reflects higher profits due to higher revenues, lower costs, or less risk-taking, while a negative SSM effect indicates the opposite.

To learn more about the nature of SSM effects, we distinguish between total (or overall) SSM effects, direct SSM effects, and indirect SSM effects (Pearl, 2009; VanderWeele, 2015). We empirically examine whether SSM effects are mainly indirect effects resulting from the adjustment of key bank-specific variables in response to ECB supervision, or whether the SSM effects are mainly direct effects that do not result from such adjustments and may reflect market participants' greater confidence in the stability of SSM banks (Altavilla et al., 2020) and improved risk management in SSM banks.

To further narrow down the sources of the SSM effects, we examine how the SSM affects the components of the return on risk-weighted assets of SSM banks. We consider four components: the income component, lending and deposits, the cost component, and the risk component. For these components, we estimate the total effects of the SSM.

We use three econometric approaches to estimate SSM effects, namely a standard difference-in-differences approach, a panel approach with unobserved bank-specific fixed effects, and a panel approach with individually time-dependent unobserved bank-specific effects. We also use the last two models to decompose the total SSM effects into direct and indirect SSM effects. The results from all three models suggest that the SSM has economically relevant positive effects on the return on assets of SSM banks and even stronger positive effects on the return on risk-weighted assets. We find that these positive effects are mainly direct SSM effects. Our empirical analysis of the components of the return on risk-weighted assets suggests that the SSM effects are consistent with increased confidence in SSM banks and improved risk management.

In this paper, we extend the empirical literature on the SSM in several directions. We extend the work of Avgeri et al. (2021) by empirically examining the impact of the SSM on the return on assets, risk weights, and the return on risk-weighted assets using a large panel dataset containing bank-level data for the period 2005–2019 for sixteen euro area countries. To our knowledge, we are the first to investigate the impact of the SSM on risk weights for computing regulatory capital and on the return on risk-weighted assets. By examining the relative importance of direct and indirect SSM effects and their impact on the components of the return on risk-weighted assets, we are also the first to identify the most important sources of SSM effects.

Most SSM banks were hit hard by the global financial crisis of 2007–2008 and the European sovereign debt crisis of 2009–2012. In particular, the return on assets of SSM banks was lower than that of non-SSM banks. If the SSM has indeed contributed to the recovery and stability of SSM banks, then one would expect the SSM to have a positive impact on profitability and risk management, as stricter supervision under the SSM should lead to improved risk management and increase confidence in the soundness of SSM banks. Without the SSM as the main supervisor, banks might not have the incentive to improve their risk management, since they do not get the validation of their soundness by an institution that has the same reputation as the ECB.

The literature on auditing games (Fellingham and Newman, 1985; Cook et al., 1997; Coates et al., 2002) between firms (managers) and auditors helps explain why better auditing can lead to better firm performance. Firms might misreport, and auditors choose their effort to detect potential fraud. In the context of the SSM, better auditing quality leads to less fraud. However, it is also very important for banks how much the "market" trusts the audited balance sheet and income statement, and this depends, among other things, on the trustworthiness of the auditor (Holm and Zaman, 2012; Mueller et al., 2015). In the context of rating agencies, Teoh and Wong (1993) show that the reputation of an auditor lends credibility to the earnings report it audits. They also show that the size of an auditor is correlated with the quality of the auditor. In addition, Mansi et al. (2004) find that auditor quality and tenure matters to investors, leading to higher stock market returns and lower borrowing costs for the audited firms. Therefore, given the independence of the ECB and the extensive resources devoted to the supervision of SSM banks, we expect that the SSM has improved the reputation of SSM banks and thus their performance.

Our empirical results are consistent with the hypothesis that the SSM has improved the reputation and performance of SSM banks. While the SSM increases the operating costs of SSM banks, we find positive SSM effects on SSM banks' return on assets and, in particular, on the return on risk-weighted assets, which relates profitability to risk-taking. This result is similar to Hirtle et al. (2020) who find for US banks that stricter supervision does not reduce their profitability. Moreover, we find that the SSM mainly has a direct impact on the return on risk-weighted assets of SSM banks. This, together with a detailed empirical analysis of the components of the return on risk-weighted assets, suggests that the positive effects of the SSM are due to better risk management and, in particular, greater confidence in the soundness of SSM banks.

We proceed as follows. In the next section, we describe our econometric models. In Section 3, we describe our data, and in Section 4, we discuss our empirical results on profitability and risk-taking of SSM banks. In Section 5, we present several robustness checks. In Section 6, we discuss our empirical findings about the SSM effects on the components of profitability. In the last section of the paper, we draw our conclusions.

# 2. Empirical Strategy

In this section, we outline the econometric models we use to estimate SSM effects and describe how we estimate direct, indirect, and total SSM effects.

#### 2.1. Econometric Models

The first model we use is a standard difference-in-differences (DiD) model,

$$y_{igt} = a + \gamma \cdot g_i + \lambda_t + \delta \cdot SSM_{it} + X'_{it}\beta + \epsilon_{it}, \qquad (1)$$

in which  $y_{igt}$  is the outcome variable for bank *i* of group *g* in year *t*,  $g_i$  is a dummy variable that takes the values of 1 if bank *i* is an SSM bank and 0 otherwise,  $\lambda_t$  is an aggregate time effect,  $X_{it}$  is a vector of

control variables, and  $\epsilon_{it}$  is an error term.  $SSM_{it} = (g_i \cdot I_t)$  is an indicator variable, where  $SSM_{it} = 1$  if bank *i* is an SSM bank ( $g_i = 1$ ) and the SSM is effective ( $I_t = 1$ ) at time *t*. By comparing differences in the outcomes for the group of SSM banks with those of the group of non-SSM banks before treatment and after treatment, the coefficient  $\delta = (E[y_{i1t}|I_t = 1, t, X_{it}] - E[y_{i1t}|I_t = 0, t, X_{it}]) - (E[y_{i0t}|I_t = 1, t, X_{it}] - E[y_{i0t}|I_t = 0, t, X_{it}])$  yields the effect of the SSM on SSM banks.

The identification of  $\delta$  in Eq. (1) requires parallel trends in the outcomes for non-SSM banks and SSM banks had they not been treated. Since in the SSM direct supervision by the ECB depends on bank size, and SSM banks are typically larger than non-SSM banks, we always include the log of total assets in Eq. (1) as a control variable to eliminate any confounding effects of bank size.<sup>6</sup> Therefore, the parallel trends assumption should hold conditional on bank size in this model.

Our second model is a two-way fixed effects (FE) model with bank-specific fixed effects,

$$y_{it} = \mu_i + \lambda_t + \delta \cdot SSM_{it} + X'_{it}\beta + \epsilon_{it} , \qquad (2)$$

in which  $\lambda_t$ ,  $SSM_{it}$ , and  $X_{it}$  are defined as before and  $\mu_i$  is a bank-specific fixed effect capturing all timeconstant unobserved variables. By using only within variation, the model exploits the panel structure of the data and compares SSM banks before and after treatment. The effect of the SSM on SSM banks is  $\delta = E[y(1)_{it}|SSM = 1, \mu_i, t, X_{it}] - E[y(0)_{it}|SSM = 0, \mu_i, t, X_{it}]$  where  $y(1)_{it}$  is the outcome if bank *i* is treated and  $y(0)_{it}$  is the counterfactual outcome if bank *i* had not been treated. In the FE model, the non-SSM banks contribute to the estimation of  $\lambda_t$  and  $\beta$ , helping to predict the counterfactual outcomes for SSM banks. We again include the log of total assets to control for any confounding effects of bank size.

Our third model is an extension of the FE model (Polachek and Kim, 1994; Wooldridge, 2010) that allows for time-dependent bank-specific effects with individual slopes (FEIS), thereby avoiding the identifying assumption of parallel trends (Brüderl and Ludwig, 2015). The model is given by

<sup>&</sup>lt;sup>6</sup>In 2014, out of a total of 116 SSM banks, 112 banks were in the SSM because of bank size or bank size relative to GDP.

$$y_{it} = Z_i \alpha_i + \delta \cdot SSM_{it} + X'_{it}\beta + \epsilon_{it} , \qquad (3)$$

where  $y_{it}$ ,  $SSM_{it}$ ,  $X'_{it}$  are defined as in Eq. (2) and  $Z_i = (1, t)$ . The model compares SSM banks before and after treatment by using only individually detrended within variation to estimate the SSM effect  $\delta = E[y(1)_{it}|SSM = 1, \alpha_{1i}, \alpha_{2i}t, X_{it}] - E[y(0)_{it}|SSM = 0, \alpha_{1i}, \alpha_{2i}t, X_{it}]$ . As the unobserved effect is  $\alpha_{1i} + \alpha_{2i}t$ , the model allows for unobserved confounding variables whose effects on the treatment and outcome variables can change individually for each bank with time.

We relax the assumption of constant SSM effects by estimating the three models above with time-varying SSM effects. The DiD model with time-varying SSM effects is,

$$y_{igt} = \gamma_g + \lambda_t + \sum_{\tau=1}^q \delta_{+\tau} \cdot SSM_{i,t+\tau} + \sum_{\tau=0}^m \delta_{-\tau} \cdot SSM_{i,t-\tau} + X'_{it}\beta + \epsilon_{it} , \qquad (4)$$

where the *q* leads ( $\delta_{+1}$ , ...,  $\delta_{+q}$ ) capture anticipatory SSM effects before the year 2014 and the *m* lags ( $\delta_0$ , ...,  $\delta_{-m}$ ) capture time-varying SSM effects from 2014 onward. The SSM was announced in September 2012, and Fiordelisi et al. (2017) argue that banks could determine in 2013 whether the SSM would apply to them. Therefore, we allow for an anticipatory SSM effect in 2013 (i.e., *q* = 1). Analogously, the FE model with time-varying SSM effects is given by

$$y_{it} = \mu_i + \lambda_t + \sum_{\tau=1}^q \delta_{+\tau} \cdot SSM_{i,t+\tau} + \sum_{\tau=0}^m \delta_{-\tau} \cdot SSM_{i,t-\tau} + X'_{it}\beta + \epsilon_{it} , \qquad (5)$$

and the FEIS model with time-varying SSM effects is given by

$$y_{it} = Z_i \alpha_i + \sum_{\tau=1}^q \delta_{+\tau} \cdot SSM_{i,t+\tau} + \sum_{\tau=0}^m \delta_{-\tau} \cdot SSM_{i,t-\tau} + X'_{it}\beta + \epsilon_{it} .$$
(6)

# 2.2. Direct, Indirect, and Total Effects

As already mentioned, we distinguish between total, direct, and indirect SSM effects. We define indirect SSM effects as SSM effects mediated by adjustments of key bank-specific variables. For example, supervisors may ask SSM banks to hold more capital, forcing banks to raise their Tier 1 capital ratio accordingly. We define direct SSM effects as SSM effects that do not result from the adjustment of key bank-specific variables. Direct SSM effects could arise, for example, from greater confidence in SSM banks, which could help SSM banks attract deposits and obtain cheaper funding. Since our models are linear, the total SSM effect is the sum of the direct and indirect SSM effects. The (net) indirect SSM effect is, therefore, the difference between the total SSM effect and the direct SSM effect.

Since the FE and FEIS models use only within variation, we use these two models to estimate total and direct SSM effects. We estimate the direct SSM effects with a "long" regression and the total SSM effects with a corresponding "short" regression (VanderWeele, 2015). In the long and short regressions, we use bank size to control for SSM selection. The long regressions also include several other bank-specific variables to control for the indirect effects of the SSM. The short regressions exclude the additional bank-specific variables and therefore capture the total effects (i.e., the direct plus the indirect effects) of the SSM.

#### 3. Data

Our panel dataset consists of annual balance sheet, income statement, and Common Reporting Framework data for euro area banks over the period 2005–2019 from the SNL Financial's database. In some regressions, we also use structural variables at the country and euro area level. These data come from Bloomberg, the ECB, and the World Bank. Our initial sample of more than 2,600 banks includes every bank that reports to SNL. Out of these banks, 116 were SSM banks in 2014.

To eliminate outliers and reporting errors, we clean the data in four steps. We first remove all banks that

report a Tier 1 capital ratio below 4%.<sup>7</sup> Next, we remove a few banks that report twice with slightly different bank identifiers.<sup>8</sup> For ratios we calculate the interquartile range and discard values outside the four-fold interquartile range to eliminate reporting errors. Finally, we drop banks that report data for less than three years.

We measure bank profitability by the return on assets (ROA), defined as operating income minus operating expenses before credit impairment and tax divided by total assets. The operating income is calculated as the sum of net interest income, net fee, and commission income, net insurance income, realized and unrealized gains on securities, and net non-interest income. Operating expenses consist of labor costs, amortization of intangibles, and other expenses.

Under Basel regulations, risk weights must be calculated by dividing the risk-weighted assets by the exposure at default, which is not available in the SNL database. Thus, we use total assets as a proxy for the exposure at default and calculate the average risk weight (RW) by dividing the total risk-weighted assets by total assets. This approximation is also used by banks (Arroyo et al., 2012) and other market participants to examine risk-weighted assets in the context of solvency regulations (Vallascas and Hagendorff, 2013; Mariathasan and Merrouche, 2014; Beltratti and Paladino, 2016; Santos et al., 2020).

We calculate the return on risk-weighted assets (RORWA) by dividing net operating income before credit impairment and tax by risk-weighted assets. Net operating income before credit impairment and tax, is defined as in the calculation of return on assets. In the denominator, we use risk-weighted assets as reported by SNL.

In estimating the direct SSM effects, we use bank-specific variables and structural variables about a country's banking market and the macroeconomic environment. As explained earlier, we use the bank-specific variables to control for the indirect SSM effects. We include the structural variables because

<sup>&</sup>lt;sup>7</sup>Under Basel II, the minimum regulatory Tier 1 ratio was 4%. This ratio gradually increased to 6% as part of Basel III from 2014 onward. Technically, a Tier 1 ratio under 4% is possible, but in this case, regulatory authorities step in and take strict measures such as removing the bank's management, revoking the bank license, and (or) forcing the bank into resolution.

<sup>&</sup>lt;sup>8</sup>These banks have the following SNL IDs/names: 4255652, 4242082, Citibank Europe Plc, JSC Bankas Finasta AB, Lietuvos bankas, Luminor Bank AS, RCB Bank Ltd., Rigensis Bank AS, Swedbank AS, 4242265, TCS Group Holding Plc, UAB Medicinos Bankas, 4580293, 4569819, 4574631, 4782274 and 4257268.

they help explain the economic environment of banks, reducing the unexplained variation in the outcome variables and thereby increasing the precision of the estimated SSM effects.

Table 1 shows summary statistics for the variables in our dataset for future reference. As not all banks report all the required variables over the entire sample period, we report the data coverage percentage for each variable. In Appendix A we provide separate summary statistics for SSM banks (Table A.11) and non-SSM banks (Table A.12). The separate statistics indicate that SSM banks are on average larger than non-SSM banks and report lower risk weights. Moreover, no SSM bank uses the Standardized Approach to compute risk weights, while about 80% of the non-SSM banks in our sample use the Standardized Approach. Otherwise, SSM banks and non-SSM banks are broadly comparable.

Table 1	: Su	mmary	statistics
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	Min.	1 <sup>st</sup> Qu.	Median	Mean	3 <sup>rd</sup> Qu.	Max	Data Cov.
Dependent variables							
ROA	-1.56	0.58	0.85	0.88	1.15	3.27	58.10
RW	0.00	44.03	54.87	54.65	64.83	149.84	50.03
RORWA	-2.80	1.10	1.56	1.69	2.16	5.99	48.13
Bank-specific variables							
log(TA)	6.91	12.55	13.91	14.15	15.47	21.68	61.09
Deposit rate	0.00	0.57	1.25	1.74	2.29	9.53	54.71
Lending rate	0.00	3.44	4.56	5.02	6.08	15.97	46.49
NIM	-1.50	1.37	1.85	1.79	2.25	5.41	59.26
Net non-interest income ratio	-0.82	0.46	0.63	0.65	0.81	2.14	58.33
Net loan growth to non-banks	-29.57	-0.22	3.53	3.77	7.38	37.05	49.52
Non-bank deposit growth	-25.68	0.81	3.97	4.37	7.42	34.06	48.06
Operating expenses ratio	0.00	1.50	1.89	1.88	2.26	5.06	58.15
Loan loss reserve ratio	0.00	0.74	1.64	3.15	3.25	99.92	28.50
Total securities growth	-89.19	-9.80	0.00	0.83	10.90	90.31	49.43
TA growth	-25.21	-0.19	2.98	3.12	6.37	31.56	51.30
Labor Costs over TA	0.00	0.79	1.07	1.05	1.30	3.17	58.38
Tier 1 capital ratio	4.05	11.62	14.65	15.88	18.53	44.38	48.40
Leverage ratio (own)	0.00	6.03	8.00	8.45	10.18	25.23	48.09
Loans to TA	0.00	49.33	62.82	58.62	73.42	89.98	47.71
Loan-to-deposit ratio	0.00	71.73	92.10	99.39	118.85	302.51	45.17
Basel I	0.00	0.00	0.00	0.13	0.00	1.00	100.00
StA Approach	0.00	1.00	1.00	0.80	1.00	1.00	100.00
Mixed Approach	0.00	0.00	0.00	0.05	0.00	1.00	100.00
F-IRB	0.00	0.00	0.00	0.01	0.00	1.00	100.00
A-IRB	0.00	0.00	0.00	0.01	0.00	1.00	100.00
Structural variables							
Herfindahl index (ECB)	1.74	2.77	3.95	6.05	5.96	40.39	100.00
3M-Euribor	-0.36	-0.26	0.57	1.15	2.18	4.63	100.00
10Y gov bond yield	-0.25	0.96	2.74	2.60	3.98	22.50	99.62
GDP growth	-14.84	0.54	1.49	1.30	2.68	25.18	93.33
Inflation	-37.31	0.45	3.43	2.81	5.77	49.50	97.47

All bank-specific variables are from SNL. The Herfindahl index and the 3M-Euribor are from the ECB's statistical data warehouse. The 10Y gov bond yield is from Bloomberg. GDP growth and inflation are from the World Bank's World Development Indicators database.

For all variables this table shows the minimum (Min.), first quantile (1<sup>st</sup> Qu.), median (Median), mean (Mean), third quantile (3<sup>rd</sup> Qu.), maximum (Max) and data coverage (Data Cov.), which refers to the percentage of available observations if the panel was balanced. The data are reported annually and cover over 2,600 banks over the period 2005–2019 for the euro area.

ROA is the return on assets. RW is the average risk weight computed as risk-weighted assets divided by total assets (TA). RORWA is the return on risk-weighted assets. All ratios and returns are in percentage terms (1 refers to 1%).

Log(TA) is the logarithm of total assets.

The deposit rate is defined as interest expenses to non-banks divided by non-bank deposits. The lending rate is defined as interest income from non-banks divided by total non-bank gross loans. NIM is the net interest rate margin, defined as interest income from non-banks minus interest rate expenses from non-banks divided by total assets. The net non-interest income ratio is net non-interest income divided by total assets.

Net loan growth to non-banks is the growth rate of non-bank loans net of loan loss reserves. The operating expenses ratio is the sum of labor costs, amortization of intangibles and other expenses divided by total assets. The loan loss reserve ratio is defined as the loan loss reserves on the balance sheet divided by total gross loans. Total security growth is the growth rate of total securities.

TA growth refers to total asset growth. Labor costs over TA refers to labor costs divided by total assets. The Tier 1 capital ratio is the Tier 1 capital divided by risk-weighted assets. Leverage ratio is the Tier 1 capital divided by total assets. Loans to TA is non-bank loans divided by total assets. The loan-to-deposit ratio is the ratio of non-bank loans to non-bank deposits. Basel I refers to the Basel I approach, StA for the Standardized Approach, F-IRB for the Foundation Internal Ratings Based Approach, and A-IRB denotes the Advanced IRB Approach. In the Mixed Approach, banks use the StA, F-IRB and the A-IRB for different portfolios.

# 4. Empirical Results on Return on Assets, Risk Weights, and Return on Risk-Weighted Assets

We now discuss our empirical results on the effects of the SSM on the return on assets, the average risk weight, and the return on risk-weighted assets of SSM banks. In short, we find an economically relevant positive impact of the SSM on the return on assets of SSM banks and a relatively small impact on the average risk weight. In particular, the SSM has a fairly strong positive impact on the return on risk-weighted assets. In addition, the SSM mainly has a direct impact on profitability and risk weights. The indirect effects of the SSM are rather small.

Before we discuss the empirical results in detail, we check the plausibility of the parallel trends assumption that we need in the DiD model. Figure 1 shows the annual group averages of the return on assets, risk weights and the return on risk-weighted assets of SSM banks and non-SSM banks. As explained in Section 2.1, the parallel trends assumption should hold conditional on bank size. The charts therefore show size-adjusted group averages. As can be seen, during the pre-treatment period the trends in the outcome variables are broadly similar for both groups of banks. A test for parallel trends over the pre-treatment period also supports the parallel trends assumption, since in the test regression the interaction variable  $(g \cdot t)$  that captures differences in the group trends is never statistically significant (Table 2).

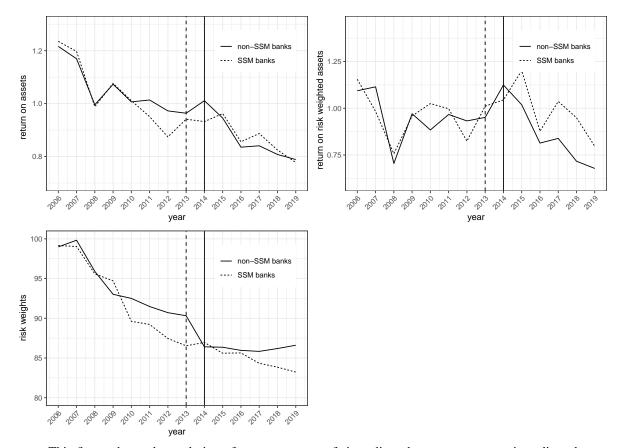


Figure 1: Size-adjusted group averages of return on assets, adjusted average risk weight, and return on risk-weighted assets.

This figure shows the evolution of group averages of size adjusted return on assets, size adjusted average risk weight, and size adjusted return on risk-weighted assets for SSM banks and non-SSM banks over the period 2006–2019. For the size adjustment, we regress each dependent variable on the logarithm of total assets and deduct the coefficient times the logarithm of total assets from the original dependent variable for each bank and each time period. Then we build the averages for SSM and non-SSM banks for each time period.

	ROA	RW	RORWA
Intercept	1.8019***	108.9135***	1.6165***
-	(0.1720)	(6.0835)	(0.3279)
$g \cdot t$	0.0028	0.4110	-0.0103
	(0.0114)	(0.3684)	(0.0186)
log(TA)	-0.0340***	-3.0812***	0.0305
-	(0.0106)	(0.3653)	(0.0195)
Year 2007	-0.1162***	1.3654	-0.2332***
	(0.0378)	(1.3042)	(0.0668)
Year 2008	-0.2682***	-1.8783	-0.4895***
	(0.0515)	(1.6818)	(0.1102)
Year 2009	-0.2503***	-5.1422***	-0.2275**
	(0.0555)	(1.8311)	(0.1014)
Year 2010	-0.3623***	-7.5177***	-0.2629***
	(0.0576)	(1.8304)	(0.1019)
Year 2011	-0.3655***	-11.2650***	-0.2117**
	(0.0564)	(1.7962)	(0.1010)
Year 2012	-0.3977***	-11.0766***	-0.2996***
	(0.0585)	(1.8433)	(0.1048)
R-squared	0.03	0.13	0.01
Adj. R-squared	0.03	0.13	0.01
Number of obs.	2,612	1,988	2,590

Table 2: Test for parallel trends over the pre-treatment period.

Source: SNL. Own calculations.

In the ROA model, the dependent variable is the return on assets.

In the RW model, the dependent variable is the risk weight.

In the RORWA model, the dependent variable is the return on riskweighted assets.

The variable  $g \cdot t$  is an interaction term between g, which is a dummy variable that takes the value of 1 if i is an SSM bank and 0 otherwise, and t is a linear time trend.

Year 2007–2012 are year dummies that are 1 when the observation is from the corresponding year and 0 otherwise. Log(TA) refers to the logarithm of total assets.

\*\*\*p < 0.01; \*\*p < 0.05; \*p < 0.1. We use cluster robust standard errors with clustering at the bank level.

We now turn to the effects of the SSM. As explained in Section 2.1, to control for selection into the SSM, all models contain bank size. In estimating total SSM effects, we only include bank size and thereby allow the SSM to affect the outcome variables directly and indirectly. In estimating direct SSM effects, we include additional bank-specific variables to control for indirect SSM effects, as well as some structural variables to capture the economic environment of the banks. We briefly introduce these variables at the end of the section.

We start with the total SSM effects on the return on assets of SSM banks (Table 3). The simple DiD model and the FE model yield a positive SSM effect on the return on assets of around 0.07 percentage points (pp). In the models with time-varying SSM effects, the effects increase over time from virtually

zero to about 0.11 pp in the years 2018 and 2019. Given that the average return on assets over the sample period is 0.88, the estimated effects are economically significant. The FEIS model, which does not require parallel trends, yields larger SSM effects. Sometimes the effects are up to three times larger than the effects from the DiD and FE models. The relatively large difference to the DID and FE estimates suggests that the unobserved bank-specific effects are time-dependent rather than fixed. The FEIS model also yields an announcement effect of 0.10 pp for 2013.

Figure 2 shows the estimated total and direct SSM effects on the return on assets (see Table 6) along with 90% confidence intervals. In the FE model, the direct SSM effects are not much larger than the total SSM effects. In the FEIS model, the two effects are almost identical. This suggests that the SSM effects on the SSM banks' return on assets are mainly direct effects.

Next, we discuss the estimated SSM effects on the average risk weight of SSM banks (see Table 4). The average risk weight over the sample period is 55% for non-SSM banks and 45% for SSM banks. Both the DiD and FE models yield negative total SSM effects on the average risk weight of SSM banks of -2 pp to - 7 pp. The SSM effects in the FEIS model range from -1.6 pp to 2.8 pp and are also small but mostly positive. All three models find a negative announcement effect for 2013 of about -6.8 pp to -1.6 pp. Figure 3 displays the total and the direct SSM effects estimated with the FE and the FEIS models (see Table 6). In both models, the direct effects are slightly larger than the total effects, suggesting that SSM banks make adjustments to reduce the average risk weight.

As explained earlier, the return on risk-weighted assets captures the combined impact of the SSM on profitability and risk-taking. The mean return on risk-weighted assets over the sample period is 1.67% for non-SSM banks and 1.97% for SSM banks. The estimated total SSM effects on the return on risk-weighted assets range between 0.07 pp and 0.40 pp in the DiD and FE models and between 0.3 pp and 0.7 pp in the FEIS model (see Table 5). The effects are therefore substantial. The FE and FEIS models produce somewhat different results for the indirect SSM effects (see Figure 4). The FE model suggests that indirect effects are negligible, while the FEIS model suggests negative indirect SSM effects. The negative indirect effects in the FEIS model can be explained by the positive impact of the SSM on the average risk weight, which dampens the positive direct effect of the SSM on the return on risk-weighted

assets.

For completeness, we now briefly introduce the additional bank-specific and structural variables (see, Maudos and de Guevara, 2004; Athanasoglou et al., 2008; Maudos and Solis, 2009; Barakova and Palvia, 2014; Mariathasan and Merrouche, 2014; Ferri and Pesic, 2017; Beltratti and Paladino, 2016, among others) that we use in the FE and FEIS models to estimate direct SSM effects (see Table 6).

In the return on assets equations, we control for portfolio quality, the cost structure, the capital ratio, and the risk and return profile by including the loan loss reserve ratio, labor costs over total assets, the leverage ratio, the loan-to-deposit ratio, and the average risk weight. In the equations for the average risk weight, we use the same variables except for labor costs and average risk weights. To capture a bank's business strategy, the share of credit risk and the risk and return profile, we also include total asset growth, the gross loans to total assets ratio, and the return on assets before credit impairment and taxes. In addition, we include the 10-year government bond yield as a forward-looking determinant of the average risk weight and dummy variables to account for the different Basel risk-weight approaches.<sup>9</sup> In the equations for the return on risk-weighted assets, we use all control variables except risk weights, total assets growth, loans to total assets and return on assets, as these variables are part of the dependent variable and are therefore endogenous.

In the models for return on assets and return on risk-weighted assets, we also add structural variables to capture the economic environment of banks. These variables are the Herfindahl-Hirschman index to measure market concentration, a dummy variable ("Dummy neg. Euribor") for a negative 3M-Euribor to capture the negative interest rate environment in which banks have operated since mid-2014, 3M-Euribor rates, 10 year government bond yields and inflation rates to capture expected and realized inflation and GDP growth to measure demand growth.

<sup>&</sup>lt;sup>9</sup>As our sample starts in 2005, the first category is Basel I. Since the introduction of Basel II in 2007, banks can choose between the Standardized Approach (StA), the Foundation Internal Rating Based Approach (F-IRB), the Advanced Internal Rating Based Approach (A-IRB), and the Mixed Approach. Under Basel I and the StA approach, the risk weights are essentially fixed and depend on the type of risk and the portfolio structure. The F-IRB and A-IRB allow banks to estimate default probabilities. The A-IRB also allows banks to estimate the exposure at default and loss given default for portfolios that are subject to credit risk. The estimated parameters are then inserted in the capital requirement formula (BIS, 2005) to calculate capital requirements. Under the Mixed Approach, banks hold parts of their assets under different approaches. These risk weight approaches differ essentially for credit risk.

Table 3: Total SSM effects on return on assets.

	ROA DiD 1	ROA DiD 2	ROA FE 1	ROA FE 2	ROA FEIS 1	ROA FEIS 2
Intercept	1.4184***	1.4146***				
	(0.1010)	(0.1015)				
log(TA)	-0.0106	-0.0105	-0.0547	-0.0463	$-0.1923^{***}$	-0.1733***
	(0.0067)	(0.0067)	(0.0391)	(0.0395)	(0.0628)	(0.0611)
SSM bank	-0.0563	-0.0544	(,	(	(	(
	(0.0741)	(0.0765)				
SSM dummy	0.0655	(000100)	0.0701*		0.1456***	
boni daning	(0.0422)		(0.0359)		(0.0466)	
	(*** :==)		(0.00007)		(010100)	
SSM 2013		-0.0145		0.0033		0.0968**
		(0.0506)		(0.0417)		(0.0436)
SSM 2014		-0.0209		-0.0123		0.1810**
		(0.0583)		(0.0533)		(0.0621)
SSM 2015		0.0744		0.0751		0.2792**
		(0.0554)		(0.0485)		(0.0742)
SSM 2016		0.0518		0.0508		0.2062**
		(0.0519)		(0.0480)		(0.0926)
SSM 2017		0.0649		0.1118**		0.3285**
		(0.0597)		(0.0506)		(0.1110)
SSM 2018		0.1121*		0.1261**		0.3581**
		(0.0602)		(0.0512)		(0.1226)
SSM 2019		0.1068*		0.1093**		0.3522**
		(0.0590)		(0.0483)		(0.1318)
		. ,		. ,		. ,
Bank fixed effects	no	no	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	no	no
Individual time effects	no	no	no	no	yes	yes
R-squared	0.04	0.04	0.68	0.68	0.01	0.01
Adj. R-squared	0.04	0.04	0.63	0.63	0.01	0.01
Number of obs.	9,192	9,192	9,192	9,192	9,192	9,192
Number of groups	1,208	1,208	1,208	1,208	1,208	1,208
Average. Obs. group	8	8	8	8	8	8
Min. Obs. group	3	3	3	3	3	3
Max. Obs. Group	14	14	14	14	14	14

The dependent variable is the return on assets before credit impairment and taxes (ROA). SSM = 1 when the bank is an SSM bank and the SSM is active. SSM = 0 otherwise. The 2013–2019 SSM dummies take on the value 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and are 0 otherwise.  $g_i = 1$  when a bank is an SSM bank and  $g_i = 0$  otherwise. *t* denotes time. The bank-specific explanatory variable is the logarithm of total assets log(TA). \*\*\* p < 0.01; \*\*p < 0.05; \*p < 0.1. We use cluster robust standard errors with clustering at the bank level.

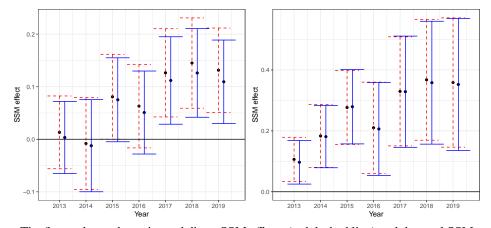


Figure 2: Direct and total SSM Effects on return on assets for the FE and the FEIS models.

The figure shows the estimated direct SSM effects (red dashed line) and the total SSM effects (blue solid line) together with 90% confidence intervals for the time period 2013-2019 from the FE model and the FEIS model.

Table 4:	Total	SSM	effects	on	the average	risk weight.

	RW DiD 1	RW DiD 2	RW FE 1	RW FE 2	RW FEIS 1	RW FEIS 2
Intercept	90.6280***	89.4636***				
	(3.9835)	(4.0427)				
log(TA)	-1.9631***	$-1.9420^{***}$	-8.8945***	-9.3465***	-11.7294***	-11.4240**
	(0.2550)	(0.2554)	(1.7354)	(1.7750)	(2.5186)	(2.6043)
SSM bank	-1.7877	-0.5214				
	(2.4415)	(2.5400)				
SSM dummy	-2.9154*		-2.8487**		0.2887	
,	(1.5015)		(1.1522)		(0.8007)	
SSM 2013		-6.7884***		-5.1226***		-1.6284**
		(1.6373)		(1.0637)		(0.7752)
SSM 2014		-3.2684**		-2.2708*		-0.6408
00112011		(1.5278)		(1.1650)		(1.0530)
SSM 2015		-2.6155		-2.9953**		0.2982
5511 2015		(1.7078)		(1.3521)		(1.2969)
SSM 2016		-3.9169**		-4.0429***		0.6845
5511 2010		(1.7998)		(1.4411)		(1.4857)
SSM 2017		-5.3618***		-4.3604***		1.4472
5511 2017		(2.0181)		(1.4428)		(1.6162)
SSM 2018		-4.1025**		-4.6380***		2.6143
55111 2010		(2.0473)		(1.5551)		(1.8811)
SSM 2019		-6.7855***		-7.3236***		2.7603
55WI 2017		(2.0840)		(1.6136)		(2.1507)
		(2.0840)		(1.0150)		(2.1307)
Bank fixed effects	no	no	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	no	no
Individual time effects	no	no	no	no	yes	yes
R-squared	0.12	0.12	0.86	0.86	0.05	0.05
Adj. R-squared	0.12	0.12	0.83	0.83	0.05	0.05
Number of obs.	8,337	8,337	8,337	8,337	8,337	8,337
Number of groups	1,166	1,166	1,166	1,166	1,166	1,166
Average. Obs. group	7.15	7.15	7.15	7.15	7.15	7.15
Min. Obs. group	3	3	3	3	3	3
Max. Obs. Group	14	14	14	14	14	14

The dependent variable is the average risk weight (RW). SSM = 1 when the bank is an SSM bank and the SSM is active. SSM = 0 otherwise. The 2013–2019 SSM dummies take on the value 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and are 0 otherwise.  $g_i = 1$  when a bank is an SSM bank and  $g_i = 0$  otherwise. *t* denotes time. The bank-specific explanatory variable is the logarithm of total assets log(TA). \*\*\* p < 0.01; \*\*p < 0.05; \*p < 0.1. We use cluster robust standard errors with clustering at the bank level.

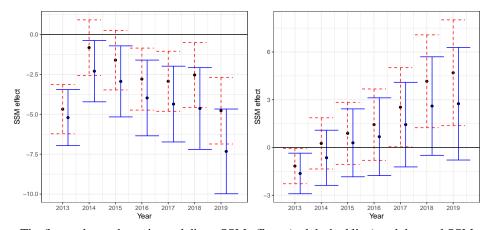


Figure 3: Direct and total SSM effects on the average risk weight from FE and the FEIS models.

The figure shows the estimated direct SSM effects (red dashed line) and the total SSM effects (blue solid line) together with 90% confidence intervals for the time period 2013–2019 from the FE model and the FEIS model.

Table 5: Total SSM	effects on the return	n on risk-weighted assets.

	RORWA DiD 1	RORWA DiD 2	RORWA FE 1	RORWA FE 2	RORWA FEIS 1	RORWA FEIS
Intercept	1.3837***	1.4055***				
	(0.2087)	(0.2100)				
log(TA)	0.0445***	0.0442***	0.1837*	0.2028**	-0.1580	-0.1384
	(0.0129)	(0.0130)	(0.1010)	(0.1024)	(0.1388)	(0.1384)
SSM bank	-0.0644	-0.0953				
	(0.1169)	(0.1175)				
SSM dummy	0.2221**		0.2359**		0.3241***	
2	(0.0899)		(0.0937)		(0.1091)	
SSM 2013		0.1872*		0.1754		0.3215***
		(0.1138)		(0.1113)		(0.1082)
SSM 2014		0.0732		0.0890		0.4277***
		(0.1270)		(0.1319)		(0.1398)
SSM 2015		0.3358**		0.3595***		0.6808***
		(0.1311)		(0.1315)		(0.1794)
SSM 2016		0.1239		0.1498		0.3163
		(0.1211)		(0.1326)		(0.2146)
SSM 2017		0.3070**		0.3793***		0.5925**
		(0.1311)		(0.1291)		(0.2430)
SSM 2018		0.3253***		0.3437***		0.5203*
		(0.1233)		(0.1256)		(0.2725)
SSM 2019		0.3979***		0.3810***		0.4840
		(0.1141)		(0.1153)		(0.2948)
Bank fixed effects	no	no	yes	ves	yes	yes
Time fixed effects	ves	ves	yes	yes	no	no
Individual time effects	no	no	no	no	yes	yes
R-squared	0.04	0.04	0.61	0.61	0.00	0.01
Adj. R-squared	0.04	0.04	0.55	0.55	0.00	0.01
Number of obs.	9,114	9,114	9,114	9,114	9,114	9,114
Number of groups	1,201	1,201	1,201	1,201	1,201	1,201
Average. Obs. group	8	8	8	8	8	8
Min. Obs. group	3	3	3	3	3	3
Max. Obs. Group	14	14	14	14	14	14

The dependent variable is return on risk-weighted assets (RORWA). SSM = 1 when the bank is an SSM bank and the SSM is active. SSM = 0 otherwise. The 2013–2019 SSM dummies take on the value 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and are 0 otherwise.  $g_i = 1$  when a bank is an SSM bank and  $g_i = 0$  otherwise. *t* denotes time. The bank-specific explanatory variable is the logarithm of total assets log(TA). \*\*\* p < 0.01; \*\* p < 0.05; \* p < 0.1. We use cluster robust standard errors with clustering at the bank level.

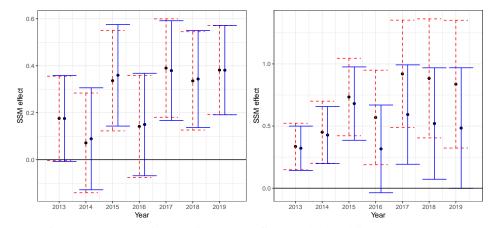


Figure 4: Direct and indirect SSM effects on the return on risk-weighted assets for the FE and the FEIS models.

The figure shows the estimated direct SSM effects (red dashed line) and the total SSM effects (blue solid line) together with 90% confidence intervals for the time period 2013–2019 from the FE model and the FEIS model.

Table 6: Direct SSM effects.

	FE ROA	FEIS ROA	FE RW	FEIS RW	FE RORWA	FEIS RORW
Intercept	1.8860***		70.9145***		2.6876*	
	(0.5997)		(18.2845)		(1.3825)	
log(TA)	$-0.0847^{**}$	$-0.1247^{*}$	-4.2672***	$-4.9862^{**}$	-0.0004	-0.1628
	(0.0430)	(0.0689)	(1.3547)	(2.2365)	(0.1068)	(0.1370)
SSM 2013	-0.0464	0.0957**	-4.6811***	-1.0780	0.0589	0.3355**
	(0.0391)	(0.0474)	(0.9386)	(0.6966)	(0.1079)	(0.1138)
SSM 2014	-0.0580	0.1676**	-0.8278	0.4396	0.0281	0.4505**
	(0.0534)	(0.0670)	(1.0586)	(1.0287)	(0.1314)	(0.1519)
SSM 2015	0.0269	0.2806***	-1.6083	1.1471	0.2286*	0.7336**
	(0.0463)	(0.0793)	(1.1339)	(1.2550)	(0.1309)	(0.1896)
SSM 2016	0.0269	0.2857***	-2.7958**	1.7287	0.1073	0.5691**
	(0.0449)	(0.0986)	(1.1805)	(1.4318)	(0.1336)	(0.2313)
SSM 2017	0.1293***	0.4354***	-2.9322**	2.8118*	0.4239***	0.9199**
	(0.0481)	(0.1167)	(1.1433)	(1.5602)	(0.1334)	(0.2628)
SSM 2018	0.1107**	0.4811***	-2.5384**	4.4565**	0.3066**	0.8836**
55141 2010	(0.0468)	(0.1295)	(1.2320)	(1.8162)	(0.1291)	(0.2911)
SSM 2019	0.0342	0.4521***	-4.7739***	5.0685**	0.2240**	0.8371**
55M 2019						
	(0.0434)	(0.1382)	(1.2693)	(2.0688)	(0.1115)	(0.3126)
Loan loss reserve ratio	0.0000	-0.0009	-0.0654	0.0499	0.0006	-0.0016
	(0.0014)	(0.0016)	(0.0729)	(0.1087)	(0.0029)	(0.0029)
Labor Costs over TA	-0.0733	-0.2341***			-0.2197	-0.5507**
	(0.0606)	(0.0815)			(0.1345)	(0.1613)
Leverage ratio (own)	0.0004	0.0304***	1.4790***	0.6772***	$-0.0258^{**}$	0.0403**
•	(0.0056)	(0.0077)	(0.1808)	(0.1922)	(0.0130)	(0.0164)
oan-to-deposit ratio	-0.0000	-0.0001	-0.0028	-0.0005	-0.0002	$-0.0005^{*}$
······································	(0.0001)	(0.0002)	(0.0022)	(0.0012)	(0.0003)	(0.0003)
RW	0.0028***	0.0022**	(,	(,	(,	(,
	(0.0008)	(0.0010)				
TA growth	(0.0000)	(0.0010)	0.0129	-0.0126		
IA glowin			(0.012)	(0.0187)		
Loans to TA			0.4135***	0.3387***		
Loans to TA						
NO.			(0.0383)	(0.0475)		
ROA			0.4681	-0.3331		
			(0.4139)	(0.3248)		
Basel I			4.9747**	1.6919	-0.0490	0.0504
			(2.1412)	(1.8120)	(0.3962)	(0.2843)
F-IRB			5.6771***	1.1981	-0.3789	-0.3293
			(1.5695)	(1.5326)	(0.3753)	(0.2737)
Mixed Approach			4.0666***	-1.2126	-0.2786	-0.1124
			(1.2357)	(1.3302)	(0.3853)	(0.2570)
StA Approach			10.1752***	3.2472**	-0.5452	-0.1918
**			(1.3289)	(1.4309)	(0.3881)	(0.2808)
Herfindahl index (ECB)	-0.0115***	0.0092*			-0.0322***	0.0232*
terminan much (ECD)	(0.0031)	(0.0055)			(0.0074)	(0.0116)
M E						
3M-Euribor	0.0509***	-0.0123			0.0206	-0.0527*
	(0.0093)	(0.0095)			(0.0220)	(0.0228)
Dummy neg. Euribor	-0.0246*	0.0258*			-0.0147	0.0975*
	(0.0149)	(0.0136)			(0.0338)	(0.0282)
Dummy neg. Euribor x Euribor	0.4113***	0.2149***			0.9548***	0.5523*
	(0.0485)	(0.0639)			(0.1196)	(0.1276)
10Y gov bond yield	$-0.0352^{***}$	-0.0227***	0.2958*	0.0912	$-0.0511^{***}$	-0.0181
	(0.0072)	(0.0070)	(0.1598)	(0.1008)	(0.0143)	(0.0131)
Dummy neg. Euribor x gov. bond yield	-0.0209	-0.0281**			-0.0091	-0.0680*
	(0.0144)	(0.0126)			(0.0323)	(0.0243)
GDP growth	0.0109***	0.0056**			0.0345***	0.0138**
- <i>o</i> · · · · ·	(0.0024)	(0.0025)			(0.0057)	(0.0053)
Inflation	-0.0086***	-0.0089***			-0.0230***	-0.0140*
million	(0.0025)	(0.0028)			(0.0055)	(0.0051)
Devil-775 and free devices		. ,	1	,		
Bank/Time fixed effects	yes/no	yes/no	yes/yes	yes/yes	yes/no	yes/no
Individual time effects	no	yes	no	yes	no	yes
	0.63	0.04	0.86	0.13	0.56	0.04
Adj. R-squared	0.05					
Adj. R-squared Number of obs.	9,192		8,341	8,341	9,114	9,114
		9, 192 1, 208		8,341 1,167	9,114 1,201	9,114 1,201

Source: Own calculations. SNL. ECB. World Bank. Bloomberg. Eurostat. \*\*\* p < 0.01; \*\* p < 0.05; \*p < 0.1. We use cluster robust standard errors with clustering at the bank level. In FE ROA and FEIS ROA the dependent variable is the return on assets. In FE RW and FEIS RW dependent variable is the risk weight. In FE RORWA and

FEIS RORWA the dependent variable is the return on risk-weighted assets. The 2013–2019 SSM dummies take on the value 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and are 0 otherwise. The bank-specific explanatory variables are the logarithm of total assets log(TA), the loan loss reserve ratio (loan loss reserves divided by total gross loans), Labor Costs over TA (labor costs divided by total assets), the leverage high ray, the loss reserve land (ball loss reserves under by lotal gloss loss), Labor Costs over 1A (how costs and costs and the ball of the labor costs and loss reserves under by lotal gloss loss), the reverge ratio (Tier 1 capital divided by total assets), the loss non-to-deposit ratio and the risk weight, total asset growth, loans to total assets and the return on assets. Basel I stands for the Basel I approach, StA for the Standardized Approach, F-IRB for the Foundation Internal Ratings Based Approach, and A-IRB denotes the Advanced IRB Approach. In the Mixed Approach banks use the StA, F-IRB and the A-IRB for different portfolios. The structural explanatory variables are the Herlindah index, the 3M-Euribor, Dummy neg. Euribor (a dummy which is 1 when the 3M-Euribor is negative and 0 otherwise, the interaction variable Dummy neg. Euribor, 10Y gov bond yield (10 year zero coupon government bond yield from Bloomberg), the interaction of the lot DDP.

the interaction Dummy neg. Euribor x gov. bond yield, GDP growth (year on year nominal GDP growth) and inflation (year on year growth of the consumer price index).

#### 5. Robustness Checks

In all three models, we find substantial positive SSM effects on the return on risk-weighted assets of SSM banks. We now present a number of robustness checks for our most flexible model, the FEIS model, where unobserved effects for each bank can change individually over time. The checks show that the results for the FEIS model are robust. The results for the DiD and FE models are also robust and available in the supplement to the paper.

# 5.1. Large Banks

Our panel dataset contains many smaller banks that contribute to the estimation of the parameters of the FEIS model. An objection might be that these smaller banks drive the results. Smaller banks should not pose a problem because we always control for bank size. Nevertheless, to see if the results are robust, we re-estimate the FEIS model with a much smaller sample that includes only the 200 largest banks based on total assets in 2013.<sup>10</sup> Of those banks, 80 are SSM banks.

The first column in Table 7 shows the results of the robustness check. As one would expect, the SSM effects are less precisely estimated in the much smaller sample. However, the effects are again quite large and qualitatively similar to the estimates from the full sample. The results also refute another objection, namely that all large banks, whether part of the SSM or not, would benefit from the SSM. Therefore, we conclude that smaller banks and large banks per se are not driving our results.

With the FEIS model, it is also possible to only include SSM banks in the sample. For this sample of only SSM banks the estimated SSM effects are very similar to the estimates with the 200 largest banks in the first column in Table 7. This shows that the estimated effects are indeed SSM effects and not just "large bank" effects.<sup>11</sup>

<sup>&</sup>lt;sup>10</sup>We include a bank only if all explanatory variables we use are available. For example, if the 168<sup>th</sup> largest bank did not report its loan loss reserve ratio, we would remove this bank and add the 201<sup>st</sup> biggest bank to our sample.

<sup>&</sup>lt;sup>11</sup>The results are available from the authors upon request and are provided in the supplementary materials.

#### 5.2. Core and Non-Core Countries

With regard to the level of non-performing loans, the European Commission categorizes the eurozone countries into core countries and peripheral countries (Mesnard et al., 2016). In this classification, the core countries are Austria, Belgium, Estonia, Germany, Finland, France, the Netherlands, and Slovakia, and the peripheral countries are Cyprus, Greece, Ireland, Italy, Malta, Portugal, Slovenia, and Spain. Avgeri et al. (2021) find positive and statistically significant SSM effects for peripheral countries and only small and statistically insignificant effects for core countries.

To check whether our estimates also differ for peripheral and core countries, we estimate the FEIS model for the return on risk-weighted assets separately for core and peripheral countries. We also find larger SSM effects for peripheral countries (second and third columns in Table 7), but the SSM effects in the core countries are also substantial.

#### 5.3. Self-Selection

The Economic and Financial Affairs Council of the European Union announced in December 2012 that a threshold of 30 billion Euro (ECOFIN, 2012) would be used to determine whether a bank would be subject to direct ECB supervision in the SSM. Ben-David et al. (2018) argue that after this announcement, some banks with assets around the threshold strategically reduced their assets in 2013 to avoid tighter ECB supervision in the future.

To examine whether this kind of strategic "self-selection" affects our results, we exclude all banks with total assets between 27 and 33 billion Euro in 2013 and re-estimate the FEIS model for the return on risk-weighted assets. We get almost identical SSM effects with this restricted sample (fourth column in Table 7). Therefore, we conclude that strategic behavior by banks to avoid ECB supervision has no discernible impact on our results.

## 5.4. Placebo Test

The SSM was announced in December 2012 and became effective in 2014. In a placebo test, we should therefore not find any SSM effects before 2012. In our placebo test, we use data up to 2011 and our fake treatment period is 2010–2011. As can be seen in the last column in Table 7, we do not find any statistically significant SSM effects in this fake treatment period.

# 5.5. Resampling

To ensure that our results are not affected by influential observations, we examine the stability of the estimated SSM effects using a resampling procedure similar to cross validation (Hastie et al., 2009). In the procedure, we first randomly divide the sample into 10 groups with approximately the same number of banks. After random assignment, we estimate a model 10 times, always dropping another group, and store the coefficients. We repeat the randomized group assignment 1,000 times. Thus, we estimate a model 10,000 times with a different combination of 90% of the banks in the sample.<sup>12</sup>

Using the resampling procedure, we check the stability of our FEIS estimates of the SSM effects on the return on risk-weighted assets. Table 8 summarizes the results. As we can easily see, the mean and median of the resampling distribution for the SSM effects virtually coincide with the SSM effects obtained with the original sample. Moreover, the narrow quantiles of the resampling distribution indicate that there is relatively little variation in the estimates. Therefore, the estimated SSM effects are very stable.

<sup>&</sup>lt;sup>12</sup>We emphasize that we do not stratify. Therefore, the nine groups used in estimating a model do not necessarily include all or a fixed number of SSM-banks. Moreover, we always drop different banks in each assignment. Our check is therefore tougher than a check that would in each run randomly drop 10% of all banks.

	FEIS Large Banks	FEIS Core Countries	FEIS Non-core Countries	FEIS Self-Selection	FEIS Placebo SSM Effects
log(TA)	-0.2859**	-0.3513**	0.2006	-0.1181	-0.4257
-	(0.1254)	(0.1496)	(0.3374)	(0.1433)	(0.3239)
SSM 2013	0.2167**	0.2813**	0.3715**	0.3252***	
	(0.1052)	(0.1361)	(0.1776)	(0.1088)	
SSM 2014	0.3213**	0.2728*	0.6128***	0.4794***	
	(0.1291)	(0.1585)	(0.2360)	(0.1322)	
SSM 2015	0.5274***	0.5774**	0.8360***	0.6581***	
	(0.1681)	(0.2356)	(0.2789)	(0.1791)	
SSM 2016	0.1409	0.3225	0.3832	0.3140	
	(0.1983)	(0.2844)	(0.3304)	(0.2163)	
SSM 2017	0.4968**	0.4604	0.8052**	0.6027**	
	(0.2194)	(0.3433)	(0.3494)	(0.2452)	
SSM 2018	0.3426	0.2340	0.9199**	0.5209*	
	(0.2457)	(0.3881)	(0.3829)	(0.2748)	
SSM 2019	0.2667	0.1692	0.9032**	0.4812	
	(0.2630)	(0.4310)	(0.3958)	(0.2973)	
Placebo SSM 2010					0.1105
					(0.0906)
Placebo SSM 2011					0.0252
					(0.0933)
Bank fixed effects	yes.	yes	yes	yes	yes
Time fixed effects	no	no	no	no	no
Individual time effects	yes	yes	yes	yes	yes
R-squared	0.03	0.01	0.02	0.01	0.01
Adj. R-squared	0.02	0.01	0.02	0.01	0.00
Number of obs.	2,279	7,450	1,664	8,801	2,144
Number of groups	200	968	233	1,162	549
Average. Obs. group	11	8	7	8	4
Min. Obs. group	3	3	3	3	3
Max. Obs. Group	15	14	14	14	7

Table 7: Return on risk-weighted assets: Robustness checks.

Source: Own calculation. SNL. \*\*\* p < 0.01; \*\* p < 0.05; \* p < 0.1. We use cluster robust standard errors at the bank level. The dependent variable is return on risk-weighted assets (RORWA). Log(TA) refers to the logarithm of total assets. The 2013–2019 SSM dummies take on the value 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and are 0 otherwise.

The Placebo SSM 2010 dummy takes the value of 1 when the bank is an SSM bank and the year is 2010 and 0 otherwise. The Placebo SSM 2011 dummy takes the value of 1 when the bank is an SSM bank and the year is 2011 and 0 otherwise. In the model "FEIS Large Banks", we only include the 200 largest banks based on their total assets in 2013.

In the model "FEIS Core Countries", we only include banks from the following core countries Austria, Belgium, Estonia, Germany, Finland, France, the

In the model "FEIS Non-core Countries", we only include banks from the following non-core countries Cyprus, Greece, Ireland, Italy, Malta, Portugal, Slovenia, and Spain.

In the model "FEIS Self-Selection", we exclude all banks that have total assets between 27 billion euros and 33 billion euros in 2013. In the model "FEIS Placebo SSM Effects", we restrict our dataset until the time period 2012 and assume that the SSM became active in 2011 for the SSM banks.

	Estimation	Q 0.05	Q 0.25	Mean	Median	Q 0.75	Q 0.95
log(TA)	-0.14	-0.21	-0.17	-0.14	-0.14	-0.11	-0.06
SSM 2013	0.32	0.26	0.30	0.32	0.32	0.35	0.38
SSM 2014	0.43	0.35	0.40	0.43	0.43	0.46	0.50
SSM 2015	0.68	0.58	0.64	0.68	0.68	0.72	0.78
SSM 2016	0.32	0.19	0.27	0.32	0.32	0.36	0.43
SSM 2017	0.59	0.45	0.54	0.59	0.60	0.65	0.72
SSM 2018	0.52	0.36	0.47	0.52	0.53	0.58	0.66
SSM 2019	0.48	0.31	0.42	0.48	0.49	0.55	0.63

Table 8: Resampling for the FEIS model for the return on risk-weighted assets.

The dependent variable is return on risk-weighted assets (RORWA). Log(TA) refers to the logarithm of total assets.

Resampling is performed for the model RORWA FEIS 2 in Table 5. The model is estimated 10,000 times.

Column Estimation shows the estimated SSM effects obtained with the original sample (see, Table 5). The columns Q 0.05, Q 0.25, Q 0.75 and Q 0.95 refer to the 5%, 25%, 75% and 95% quantiles based on 10,000 estimations with different subsets of 90% of the data.

The 2013–2019 SSM dummies take on the value 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and are 0 otherwise.

# 6. SSM Effects on the Components of the Return on Risk-Weighted Assets

We found that the SSM has a fairly strong positive direct impact on the return on risk-weighted assets. To shed more light on the nature of the SSM effects, we now turn to the question of which components of the return on risk-weighted assets are influenced by the SSM.

In Figure 5, we split the return on risk-weighted assets into four components: the income component (deposit rate, lending rate, net interest margin, the net non-interest income ratio), lending and deposits (net non-bank loan growth, non-bank deposit growth), the cost component (operating expenses ratio), and the risk component (loan loss reserve ratio, total security growth). Using the FEIS model, we estimate the total effects of the SSM on these components.

We begin with the impact of the SSM on income (Table 9). We find positive SSM effects for lending and deposit rates. The net effect is close to zero, however, as the SSM has virtually no effect on the net interest margin. In contrast, the SSM has a clear positive impact on the net non-interest income ratio. The granularity of the SNL data allows us to identify three non-interest income components, namely net fee and commission income, dividends from equity, and other non-interest income. From these subcomponents, the largest positive SSM effect comes from net fee and commission income.

Next we turn to lending and deposits. We find strong positive SSM effects on net non-bank loan and deposit growth (Table 10), and with an increase of up to 30 pp, the effect on loan growth is particularly pronounced. How can these strong effects be rationalized? Before 2014, net non-bank loan growth for SSM banks declined sharply, resulting in a negative growth rate of -3.56% in 2013. If this trend had continued at about -3 pp from 2014 to 2019, net non-bank loan growth would have declined to about -22% in 2019. However, the actual net non-bank loan growth rate for SSM banks in 2019 was 3.84%. The large positive SSM effects therefore indicate that the SSM has contributed to the reversal of the negative trend in bank lending.

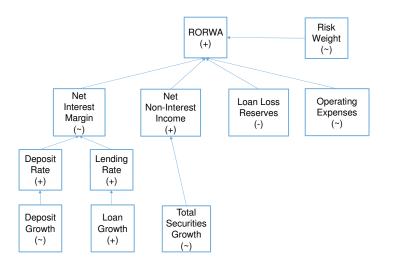
Direct supervision by the ECB is most likely stricter than supervision by national authorities. Therefore, SSM banks may need more (human) resources to fulfill risk management requirements and credit standards. In particular, SSM banks may need additional resources to support more extensive on-site examinations and to calibrate their internal ratings-based models to meet additional regulatory data requirements (e.g., for stress tests). Consistent with this conjecture, we find SSM effects on the operating expenses ratio of about 0.08 pp–0.15 pp from 2015 onward. Given that the average ratio of operating expenses to total assets is 1.40% for SSM banks, this implies an increase of about 10%.

The loan loss reserve ratio is the percentage reserve that a bank sets aside to cover estimated losses on its loan portfolio. The ratio thus indicates how much credit risk a bank has been taking. We find that the loan loss reserve ratio of SSM banks has declined since the launch of the SSM. There could be at least three reasons for this decline. The SSM could reduce the inflow into the loan loss reserve because SSM banks take lower risks and therefore need lower loan loss reserves. The supervisor may require SSM banks to reduce problem loans on their balance sheets. Or SSM banks may have improved their risk management in general.

We think that the empirical results point to the third possibility. The positive impact of the SSM on bank lending combined with the negative impact on loan loss reserves indicates that SSM banks are able to lend more without lending to riskier borrowers. This suggests that SSM banks have improved their risk management, thereby reducing information asymmetries between SSM banks and debtors, making it easier to identify good and bad borrowers (Akerlof, 1970). In addition, the negative SSM effects on total

security growth suggest a reduction in the search for yield.

Figure 5: Breakdown of RORWA: Total SSM Effects on the Components



The figure shows the breakdown of the RORWA. The main components of RORWA are the ROA which is mainly determined by the net interest margin, the net non-interest income ratio, the loan loss reserves and the operating expenses, and the RW. Below each component, we insert the total SSM effect. A (+) means positive SSM effects, a (-) means negative SSM effects and a ( $\sim$ ) means no significant SSM effects. These SSM effects are estimated in Table 9 and Table 10 for all components but the RW. The RW results can be found in Table 4.

#### Table 9: Total SSM effects: Income Components

	FEIS Deposit rate	FEIS Lending rate	FEIS Net interest margin	FEIS Net non-interest income ratio
log(TA)	0.2725	0.0091	-0.6149***	-0.2888***
U. V	(0.3322)	(0.2001)	(0.0605)	(0.0296)
SSM 2013	0.0145	0.1624	-0.0359	0.0734***
	(0.1467)	(0.1111)	(0.0444)	(0.0186)
SSM 2014	0.0584	0.3722**	0.0048	0.1248***
	(0.2091)	(0.1466)	(0.0570)	(0.0248)
SSM 2015	0.0216	0.3742**	-0.0033	0.1790***
	(0.2662)	(0.1715)	(0.0709)	(0.0304)
SSM 2016	0.1732	0.3955*	-0.0466	0.1871***
	(0.3333)	(0.2039)	(0.0894)	(0.0382)
SSM 2017	0.5702	0.7695***	-0.0415	0.2512***
	(0.4109)	(0.2423)	(0.1102)	(0.0465)
SSM 2018	0.9292*	1.0852***	-0.0406	0.2809***
	(0.4782)	(0.2823)	(0.1260)	(0.0516)
SSM 2019	1.5659***	1.4829***	-0.1079	0.3075***
	(0.5598)	(0.3266)	(0.1370)	(0.0557)
R-squared	0.06	0.03	0.09	0.14
Adj. R-squared	0.06	0.03	0.09	0.14
Number of obs.	8,364	8,364	8,364	8,364
Number of groups	1,165	1,165	1,165	1,165
Average. Obs. group	7	7	7	7
Min. Obs. group	3	3	3	3
Max. Obs. Group	14	14	14	14

Source: Own calculations. SNL. source: Own calculations. SNL. simple = 0.01;  $s^* p < 0.05$ ; p < 0.1. We use cluster robust standard errors at the bank level. In model "FEIS Deposit rate" the dependent variable is the bank-specific deposit rate for non-bank deposits. In model "FEIS Net interest margin" the dependent variable is the net interest margin, calculated as net interest income by total assets. In model "FEIS Net non-interest income ratio" the dependent variable is the net interest margin, calculated as net interest income by total assets. In model "FEIS Net non-interest income ratio" the dependent variable is the net non-interest income ratio which is defined as net non-interest income divided by total assets. The bank-specific explanatory variable is the logarithm of total assets log(TA). The 2013–2019 SSM dummies take on a value of 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and a value of 0 otherwise.  $G_i = 1$  when a bank is an SSM bank and  $G_i = 0$  otherwise. *t* denotes time.

#### Table 10: Total SSM effects: Non-bank Lending and Deposit Growth, Cost and Risk Components

	Lending an	nd Deposit	Cost Component	Risk Component		
	FEIS Net non-bank loan growth	FEIS Non-bank deposit growth	FEIS Operating expenses ratio	FEIS Loan loss reserve ratio	FEIS Total security growth	
log(TA)	4.9555**	10.1875***	-0.6849***	-2.6552***	21.1446***	
	(1.9621)	(1.5942)	(0.0693)	(0.6641)	(5.2300)	
SSM 2013	2.2509*	1.7383	0.0550*	0.8934**	-13.3890***	
	(1.1814)	(1.3039)	(0.0312)	(0.3831)	(3.9112)	
SSM 2014	10.1254***	4.9101***	0.0256	-0.0147	2.2006	
	(1.4067)	(1.5943)	(0.0377)	(0.4327)	(3.8706)	
SSM 2015	13.6286***	7.0122***	0.0843*	-0.7132	-13.1432***	
	(1.9024)	(1.8428)	(0.0485)	(0.6424)	(4.6217)	
SSM 2016	17.1886***	5.7082**	0.1468**	-1.6551*	-11.8594**	
	(2.2378)	(2.3573)	(0.0644)	(0.8781)	(5.1756)	
SSM 2017	20.5812***	9.6666****	0.1602**	-3.0877***	-15.2801**	
	(2.8046)	(2.5352)	(0.0683)	(1.0534)	(6.3488)	
SSM 2018	25.9338***	10.0898***	0.1358*	-4.8279***	-8.2835	
	(2.8304)	(2.9358)	(0.0785)	(1.2535)	(7.5548)	
SSM 2019	30.5709***	12.4168***	0.1541*	-6.6395***	-4.5136	
	(3.3368)	(3.1430)	(0.0916)	(1.3989)	(7.6456)	
R-squared	0.08	0.03	0.12	0.04	0.02	
Adj. R-squared	0.08	0.03	0.11	0.04	0.02	
Number of obs.	8,248	8,248	8,248	8,248	8,248	
Number of groups	1, 151	1,151	1,151	1,151	1,151	
Average. Obs. group	7	7	7	7	7	
Min. Obs. group	3	3	3	3	3	
Max. Obs. Group	14	14	14	14	14	

Source: Own calculations, SNL.

\*\*\*\* p < 0.01; \*\*\* p < 0.05; \* p < 0.1. We use cluster robust standard errors at the bank level.

p = 0.001, P = 0.002, p = 0.002, p = 0.002 and robust robust and errors at the bank total growth ratio. Non-bank loans include all loans but interbank loans In model "FEIS Non-bank deposit growth" the dependent variable is the non-bank deposit growth ratio.

In model "FEIS Operating expenses ratio", the dependent variable is the operating expenses ratio which is defined as operating expenses divided by total assets. Operating expenses are defined as the sum of all expenses except for interest expenses, amortization of intangibles and depreciation of property and plant equipment.

In model "FEIS Loan loss reserve ratio" the dependent variable is the loan loss reserve ratio which is defined as the loan loss reserves divided by non-hank gross loans.

FEIS Total security growth, the dependent variable is the total security growth. Total securities are the sum of total debt instruments, total equity instruments, derivative financial instruments, and other security investments.

The bank-specific explanatory variable is the logarithm of total assets log(TA).

The 2013–2019 SSM dummies take on a value of 1 when the bank is an SSM bank and the SSM is active (or anticipated) in the corresponding year and a value of 0 otherwise.  $G_i = 1$  when a bank is an SSM bank and  $G_i = 0$  otherwise. t denotes time.

# 7. Conclusion

Many large banks in the euro area were hit hard by the global financial crisis of 2007–2008 and the European sovereign debt crisis of 2009–2012. In response, the SSM was launched in 2014 and the supervision of more than 110 major euro area banks was transferred from national authorities to the ECB. In this study, we examined whether this major regulatory change helped to improve the performance and soundness of SSM banks.

Using three different econometric models, we consistently find positive SSM effects on the SSM banks' return on assets and only small effects on risk weights. More importantly, we find that the SSM has a strong positive impact on the return on risk-weighted assets – a measure that captures the combined impact of the SSM on profitability and risk weights. Furthermore, we find that the SSM mainly has a direct impact on SSM banks. Indirect SSM effects, resulting from adjustments of key bank-specific variables, play only a minor role.

To learn more about the likely sources of positive SSM effects, we examined which components of the return on risk-weighted assets are affected by the SSM. We find that the positive SSM effects on the return on risk-weighted assets mainly originate from an increase in income and a reduction in risk. Furthermore, we find that the SSM contributed to the reversal of a negative trend in the lending growth of SSM banks. In particular, the direct positive SSM effects on profitability and the negative SSM effects on risk-taking are consistent with increased confidence in the soundness of SSM banks and improved risk management.

In sum, our results support the hypothesis that the SSM has contributed to the recovery and stability of SSM banks by increasing confidence into the soundness of SSM banks. SSM banks have benefited from the shift to direct supervision by the ECB, as the higher costs of tougher supervision have been more than offset by the positive effects on profitability and risk-taking.

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# Appendix A. Summary Statistics of SSM and Non-SSM Banks

In this section, we provide separate summary statistics for SSM and non-SSM banks. For comparability, the summary statistics for the SSM banks in Table A.11 are computed over the entire sample period and not just for the period since 2014, when the SSM became active.

	Min.	1 <sup>st</sup> Qu.	Median	Mean	3 <sup>rd</sup> Qu.	Max	Data Cov.
Dependent variables							
ROA	-1.30	0.44	0.78	0.89	1.30	3.09	80.83
RW	1.45	28.95	44.00	45.26	59.97	110.79	78.90
RORWA	-2.80	1.23	1.93	1.97	2.63	5.82	76.80
Bank-specific variables							
log(TA)	11.23	17.25	17.93	18.07	19.01	21.51	82.13
Deposit rate	0.00	1.19	2.73	3.17	4.47	9.53	64.83
Lending rate	0.00	3.74	5.11	5.56	6.98	15.94	72.77
NIM	-0.72	0.72	1.26	1.34	1.83	4.10	81.17
Net non-interest income ratio	-0.23	0.26	0.56	0.61	0.90	2.11	80.32
Loan loss reserve ratio	0.00	1.08	2.30	3.77	4.31	33.94	77.08
Net loan growth to non-banks	-29.08	-3.54	2.09	2.90	8.17	36.65	69.99
Non-bank deposit growth	-24.96	-1.18	3.53	3.87	8.88	33.78	65.34
Operating expenses ratio	0.00	0.85	1.37	1.37	1.80	4.81	81.68
Total securities growth	-86.24	-11.57	-0.80	1.17	11.26	86.85	72.77
TA growth	-24.98	-3.84	1.72	1.97	7.26	31.37	71.58
Labor Costs over TA	0.00	0.42	0.71	0.70	0.91	2.47	81.62
Tier 1 capital ratio	4.29	9.62	12.86	13.84	16.20	44.02	77.65
Leverage ratio (own)	0.57	3.84	5.32	5.80	6.89	25.23	77.88
Loans to TA	0.00	44.79	60.84	56.58	70.91	89.46	76.12
Loan-to-deposit ratio	0.02	96.19	123.42	127.24	153.40	297.36	69.82
Basel I	0.00	0.00	0.00	0.10	0.00	1.00	100.00
StA Approach	0.00	0.00	0.00	0.46	1.00	1.00	100.00
Mixed Approach	0.00	0.00	0.00	0.41	1.00	1.00	100.00
F-IRB	0.00	0.00	0.00	0.03	0.00	1.00	100.00
A-IRB	0.00	0.00	0.00	0.01	0.00	1.00	100.00

Table A.11: Summary statistics for SSM banks.

All bank-specific variables are from SNL.

For all variables this table shows the minimum (Min.), first quantile (1<sup>st</sup> Qu.), median (Median), mean (Mean), third quantile (3<sup>rd</sup> Qu.), maximum (Max) and data coverage (Data Cov.), which refers to the percentage of available observations if the panel was balanced. The data are reported annually and cover over 2,600 banks over the period 2005–2019 for the euro area.

ROA is the return on assets. RW is the average risk weight computed as risk-weighted assets divided by total assets (TA). RORWA is the return on risk-weighted assets. All ratios and returns are in percentage terms (1 refers to 1%).

Log(TA) is the logarithm of total assets.

The deposit rate is defined as interest expenses to non-banks divided by non-bank deposits. The lending rate is defined as interest income from non-banks divided by total non-bank gross loans. NIM is the net interest rate margin, defined as interest income from non-banks minus interest rate expenses from non-banks divided by total assets. The net non-interest income ratio is net non-interest income divided by total assets.

Net loan growth to non-banks is the growth rate of non-bank loans net of loan loss reserves. The operating expenses ratio is the sum of labor costs, amortization of intangibles and other expenses divided by total assets. The loan loss reserve ratio is defined as the loan loss reserves on the balance sheet divided by total gross loans. Total security growth is the growth rate of total securities.

TA growth refers to total asset growth. Labor costs over TA refers to labor costs divided by total assets. The Tier 1 capital ratio is the Tier 1 capital divided by risk-weighted assets. Leverage ratio is the Tier 1 capital divided by total assets. Loans to TA is non-bank loans divided by total assets. The loan-to-deposit ratio is the ratio of non-bank loans to non-bank deposits. Basel I stands for the Basel I approach, StA for the Standardized Approach, F-IRB for the Foundation Internal Ratings Based Approach, and A-IRB denotes the Advanced IRB Approach. In the Mixed Approach, banks use the StA, F-IRB and the A-IRB for different portfolios.

	Min.	1 <sup>st</sup> Qu.	Median	Mean	3 <sup>rd</sup> Qu.	Max	Data Cov.	
Dependent variables								
ROA	-1.56	0.59	0.85	0.88	1.15	3.27	57.05	
RW	0.00	45.06	55.33	55.35	65.06	149.84	48.70	
RORWA	-2.80	1.09	1.54	1.67	2.11	5.99	46.80	
Bank-specific variables								
log(TA)	6.91	12.47	13.73	13.90	15.12	21.68	60.12	
Deposit rate	0.00	0.56	1.21	1.66	2.19	9.53	54.24	
Lending rate	0.00	3.42	4.53	4.98	6.01	15.97	45.28	
NIM	-1.50	1.42	1.87	1.82	2.26	5.41	58.25	
Net non-interest income ratio	-0.82	0.47	0.63	0.65	0.80	2.14	57.31	
Loan loss reserve ratio	0.00	0.72	1.57	3.07	3.12	99.92	26.26	
Net loan growth to non-banks	-29.57	-0.03	3.58	3.82	7.33	37.05	48.58	
Non-bank deposit growth	-25.68	0.91	3.98	4.40	7.36	34.06	47.26	
Operating expenses ratio	0.00	1.55	1.91	1.92	2.27	5.06	57.07	
Total securities growth	-89.19	-9.64	0.00	0.81	10.89	90.31	48.35	
TA growth	-25.21	-0.02	3.03	3.20	6.33	31.56	50.37	
Labor Costs over TA	0.00	0.82	1.09	1.07	1.31	3.17	57.30	
Tier 1 capital ratio	4.05	11.78	14.77	16.04	18.70	44.38	47.05	
Leverage ratio (own)	0.00	6.30	8.16	8.65	10.34	25.11	46.71	
Loans to TA	0.00	49.58	62.94	58.78	73.60	89.98	46.40	
Loan-to-deposit ratio	0.00	70.89	90.28	97.36	115.41	302.51	44.03	
Basel I	0.00	0.00	0.00	0.13	0.00	1.00	100.00	
StA Approach	0.00	1.00	1.00	0.81	1.00	1.00	100.00	
Mixed Approach	0.00	0.00	0.00	0.04	0.00	1.00	100.00	
F-IRB	0.00	0.00	0.00	0.01	0.00	1.00	100.00	
A-IRB	0.00	0.00	0.00	0.01	0.00	1.00	100.00	

Table A.12: Summary statistics for non-SSM banks.

All bank-specific variables are from SNL.

For all variables this table shows the minimum (Min.), first quantile (1<sup>st</sup> Qu.), median (Median), mean (Mean), third quantile (3<sup>rd</sup> Qu.), maximum (Max) and data coverage (Data Cov.), which refers to the percentage of available observations if the panel was balanced. The data are reported annually and cover over 2,600 banks over the period 2005–2019 for the euro area.

ROA is the return on assets. RW is the average risk weight computed as risk-weighted assets divided by total assets (TA). RORWA is the return on risk-weighted assets. All ratios and returns are in percentage terms (1 refers to 1%).

Log(TA) is the logarithm of total assets.

The deposit rate is defined as interest expenses to non-banks divided by non-bank deposits. The lending rate is defined as interest income from non-banks divided by total non-bank gross loans. NIM is the net interest rate margin, defined as interest income from non-banks minus interest rate expenses from non-banks divided by total assets. The net non-interest income ratio is net non-interest income divided by total assets.

Net loan growth to non-banks is the growth rate of non-bank loans net of loan loss reserves. The operating expenses ratio is the sum of labor costs, amortization of intangibles and other expenses divided by total assets. The loan loss reserve ratio is defined as the loan loss reserves on the balance sheet divided by total gross loans. Total security growth is the growth rate of total securities.

TA growth refers to total asset growth. Labor costs over TA refers to labor costs divided by total assets. The Tier 1 capital ratio is the Tier 1 capital divided by risk-weighted assets. Leverage ratio is the Tier 1 capital divided by total assets. Loans to TA is non-bank loans divided by total assets. The loan-to-deposit ratio is the ratio of non-bank loans to non-bank deposits. Basel I stands for the Basel I approach, StA for the Standardized Approach, F-IRB for the Foundation Internal Ratings Based Approach, and A-IRB denotes the Advanced IRB Approach. In the Mixed Approach, banks use the StA, F-IRB and the A-IRB for different portfolios.