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Getting better? The effect of the Single Supervisory Mechanism on banks' loan loss reporting and loan loss reserves

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Abstract

The recent financial crises have brought into focus questions regarding the quality of banks' assets. We study the patterns in banks reserving for and reporting of loan losses in the EU before and after implementation of the Single Supervisory Mechanism (SSM). We find that banks that 1) have less tier 1 capital, 2) are smaller, 3) are less liquid and 4) have smaller net interest margins either report relatively smaller loan loss reserves or less loan losses, even after including various controls. This supports the hypothesis that financially weaker banks may have a larger incentive to engage in balance sheet window dressing. We further find that the SSM has reduced but not eliminated the under-reserving and under-reporting bias. In addition, there has been a separate positive effect on the overall proportion of nonperforming loans (NPLs) that are realised as losses among the banks that have been under direct supervision by the SSM since implementation of the SSM.

Keywords: balance sheet cosmetics, loan losses, loan loss reserves, SSM, Euro area, Difference-in-differences

JEL: G18, G21, G28

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1. Introduction

Since the recent financial crises and the recession that followed the high ratio of non-performing loans (NPLs) to total loans in the European banking system has become a central concern to financial authorities. The total amount of NPLs was close to 1 trillion euros - over 5% of all loans - in the EU banking sector in the end of 2016 (ESRB, 2017). The development of NPLs has raised questions whether the reported values describing the quality of banks assets were accurate and trustworthy even during the time preceding the crises. Also in the US, e.g., Wall (2017) has characterized such concerns by saying that the adjustments to loan loss reserves - that are meant to equal the amount of expected loan losses - were 'too little, too late'.

In this study we investigate the possible under-reporting behaviour in the Euro area banking system in the form of under-reserving for loan losses and under-reporting of loan losses with a special focus on the effect that the implementation of the Single Supervisory Mechanism (SSM) has had on these practices. As a response to the financial crises, the European Banking Union was established. As part of it, the SSM started in November 2014 with responsibility to directly oversee and supervise the largest and most significant financial institutions and also being the ultimate supervisory authority for all banks in the countries belonging to the Banking Union¹. As

¹The president of the ECB Mario Draghi (Draghi, 2017) said that *what is clear is that European supervision has been instrumental in building a stronger and more resilient banking sector. The country in which a bank is located has also become a less important factor in how its credit risk is perceived. ...Currently the most important issue here is tackling non-performing loans (NPLs).*

multiple national supervisors have been replaced by a common supervisor, it would be expected that possible heterogeneous reserving and reporting practices, possibly partly arising from distorted incentives, would be in better control.

We control for the process generating NPLs, loan loss reserves and finally loan losses that depends on the macroeconomic environment and banks' ability to screen borrowers. Using data covering around 50% of the banks in the Euro area and including information on banks' entire loan portfolio instead of just loans for firms, we find that financially weaker banks in terms of lower tier 1 capital ratios, smaller amounts of assets and less liquidity tend to set less loan loss reserves relative to other banks. In addition, banks that have less assets and smaller net interest margins report smaller amounts of loan losses given the same NPLs to total loans ratios and equal macroeconomic conditions. These results are in line with similar evidence of loan loss under-reporting in Portuguese banks provided by Blattner et al. (2017)². The implementation of the SSM has increased the amount of realised loan losses among the Euro area banks, but it has also reduced the proportion of NPLs value that is covered with loan loss reserves. However, the results suggest that the under-reserving and under-reporting practises by banks with specific characteristics remain. Further the results suggest that the share of NPLs that is realised as losses has increased among the significant banks that are directly supervised by the SSM. We also find that there is a country specific effect on loan loss reporting and reserving, which indicates

²Blattner et al. (2017) show that higher capital requirements for a subset of banks in Portugal increased under-reporting of loan losses in this bank group.

vulnerabilities to a banking system with a common banking supervisor³.

The rest of this paper is as follows. Section 2 provides a review of the related literature. Section 3 introduces the research hypotheses and the empirical methodology used to test them. The data is described in Section 4, where we also validate our macroeconomic control variables and conduct some preliminary analysis regarding NPLs, loan losses and loan loss reserves in the EU. Our main results are presented in Section 5. Finally, Section 6 concludes.

2. Literature review

Banks' incentives to under-report and under-reserve for loan losses relate strongly to the fundamental problems of banking regarding asymmetric information. These incentive problems - that have been a popular topic in economic research for multiple decades - can arise from asymmetric information between borrowers and bank managers (Stiglitz and Weiss, 1983), between bank managers and bank owners (Holmstrom, 1999) and also between managers and regulators/supervisors (Aghion et al., 1999). Rajan (1994) presents a theory to explain fluctuations in bank credit policies. His model implies that a rational bank manager wants to maximize earnings and that the manager also cares about her reputation. As markets can only observe current bank earnings and not the quality of a specific borrower or the exact contents of the loan portfolio, managers have an incentive to influence market's view on current earnings by hiding losses. Also Lindgren et al.

³Loan loss reserves are meant to signal the current quality of banks' loan portfolio to investors, supervisors, public etc. Differing reserving practises across countries make it more difficult to compare financial conditions of banks located in different countries.

(1996) argue that *Owners and managers of unsound banks have incentives to show loans as performing in order not to lose their bank.*

Aghion et al. (1999) show that a tough bank closure policy and bank manager's information advantage over the bank regulator on the quality of loans creates an incentive for the bank to hide losses. They also argue that a softer bailout policy - were the recapitalization of banks is performed by buying out NPLs - is a better option than injecting capital into the bank by buying subordinated bonds. The problem of healthier banks over-reporting NPLs can be solved by using a nonlinear transfer price mechanism for NPLs. Similarly Mitchell (2001) models the situation where bank regulators are not going to close a troubled bank during a banking crisis and there are information asymmetries between borrowers, bank managers and regulators. The model indicates that due to information asymmetries and the fear of losing their jobs, bank managers have an incentive to roll over loans and regulators choice of policy on cleaning banks' balance sheet has an effect on these incentives. In addition, Calveras (2003) argues that banker's incentive to manipulate information for the regulator increases with tighter capital requirements.

The literature has identified two ways how a bank can in practise hide its losses: 1) rolling over a loan by extending the maturity of the loan and capitalizing the interest that was not paid or 2) by admitting a new loan used to repay borrower's original loan. Niinimaki (2012) has shown that the latter option is more profitable for the bank, because in addition to the gain of not having to realise losses, the bank will also get repayment income, which does not occur when the loan is rolled over. Furthermore, Niinimaki (2007) has shown that balance sheet window dressing occurs especially when bank supervision and bank transparency are weak.

The loan loss provisioning literature has studied mainly three different actions by managers: income smoothing, capital management and signalling banks financial strength. In the first case banks set more (less) provisions when earnings are high (low) to smooth their earnings. This kind of relationship between provisions and earnings has been found in numerous studies (see e.g. Collins et al. (1995), Perez et al. (2006) and Shrieves and Dahl (2003)). The second action, capital management, closely relates to our study. This action means that banks with smaller amounts of capital do not want to make provisions in the same manner as well capitalized banks, because provisions reduce capital through retained earnings. According to Cummings and Durrani (2016), the reasons why a bank may want to manage capital via loan loss provisions are the high cost of raising new capital and owners preferences to pay earnings as dividends. The last action refers to bank signalling its financial strength to investors by showing that the bank is strong enough that it can make additional provisions to absorb upcoming losses (Liu et al., 1997).

This study also relates to the empirical papers investigating *zombie lending* or *evergreening*. These terms refer to the kind of lending behaviour where banks provide additional loans to weak firms that are already de facto insolvent so that these firms can continue to fulfill their scheduled payments and banks do not have to write off these loans as loan losses. The existing literature has analysed zombie lending by linking firm - bank lending relationships and then identifying zombie firms by specific criterion⁴. In their

⁴For example Storz et al. (2017) used a definition where firms with negative returns, negative investments, and debt servicing capacity below 5 % for at least two consecutive years were labelled as zombie firms.

seminal paper Peek and Rosengren (2005) show that the weakest Japanese firms are more likely to get additional loans and this kind of lending is more common among banks that have capital ratios close to the regulatory minimum. More recently Acharya et al. (2017) find that the launching of the Outright Monetary Transactions (OMT) Program has increased loans mostly to low-quality private borrowers in Europe, which is partially due to evergreening of weakly capitalized banks⁵. This paper differs from the mentioned literature as we focus more broadly on possible under-reporting and not just on zombie lending. We do not identify zombie firms or bank - firm lending relationships, but instead try to identify possible under-reporting by distinguishing bank characteristics that should affect loan loss reporting and reserving practices only through balance sheet cosmetics incentives.

3. Empirical methodology and research hypotheses

We investigate banks' possible under-reporting from two different perspectives with a focus on the possible effects that the implementation of the SSM has had on these practices. The sequence of bank operations that we are interested in is the following: bank reports NPLs, bank estimates the amount of NPLs that will end up as loan losses, bank sets loan loss reserves accordingly to equal the amount of expected loan losses, and finally realises (writes off) loan losses. During this sequence of actions banks can under-report NPLs, set the loan loss reserves lower than the expected amount of losses and under-report loan losses. In this paper we do not restrict the lending to only firms that may be insolvent, but identify possible

⁵For more empirical research on zombie lending see e.g. Caballero et al. (2008), Giannetti and Simonov (2013) and Andrews and Petroulakis (2017).

under-reporting in a general level from the lenders side by studying banks decisions on setting loan loss reserves and writing off loans given the process generating loan losses. This way we are accounting for all loans including loans to firms and consumers. We focus on the loan loss reserves instead of the provisions (additions or subtractions to these reserves), because we want to utilize the fact that the level of loan loss reserves should in principle equal the amount of expected loan losses. Possible under-reporting of NPLs is not analysed as we want to use this variable to control for banks' loan screening ability.

Given the amount of NPLs (bank's ability to screen borrowers), country specific practises and the macroeconomic environment affecting borrowers' loan repayment capability (Figure 1), one would expect to get a precise estimate of the amount of loan losses and loan loss reserves that a bank will report. In addition to these variables, the idea is to introduce bank specific variables that should not affect the level of loan losses or loan loss reserves, but describe banks possible incentives to under-report loan losses and under-reserve for these losses. Our first testable hypothesis relies on theoretical results (Rajan (2005), Lindgren et al. (1996), Mitchell (2001) and Calveras (2003)) indicating that weaker banks are more likely to engage in balance sheet window dressing. Our main variable indicating bank weakness is the tier 1 capital ratio that describes bank's ability to withstand unexpected losses. We expect that the coefficient for this variable is positive, meaning that the less a bank has capital the less it is willing to realize losses and make provisions to loan loss reserves. As loan losses and provisions to loan loss reserves reduce earnings and capital, a bank that is close to the regulatory minimum capital ratio level does not want to fall below that level by making more provisions to reserves or by charging off more loans when compared to

a situation where the bank is well capitalized.

Hypothesis 1. *Financially weaker banks have a larger incentive to under-report and under-reserve for loan losses.*

Hypothesis 2. *The implementation of the SSM has strengthened banking supervision in that it has reduced under-reserving and under-reporting of loan losses in the Euro area.*

In addition, we include liquidity and size as a measure of weakness and expect the coefficients of these variables also to be positive and significant. Niinimäki (2007) argued that during weak financial supervision bank's poor liquidity uncovers the possible window dressing behaviour, which strengthens our beliefs even more about the possible sign of this variable's coefficient. A large bank knows that it is more relevant for the economy, financial stability and more over to banking supervisors, which is why it would have a larger incentive not to engage in under-reserving or under-reporting practices. Variables for profitability and efficiency are also included in the analysis, but the direction of their effect on the level of loan losses and reserves is not that certain. As these variables in principle imply the current state of bank's financial strength, the theory indicates that this profitability and efficiency might in fact be a results of window dressing. This implies that efficiency and profitability might have a positive or a negative effect on loan loss reporting and reserving. Nevertheless, these characteristics should not have a significant effect on these variables except via incentives to under-reserve or under-report losses. Niinimäki (2007) argues that a bank that is already hiding losses may choose to 'gamble for resurrection' by increasing lending excessively and in the process accepting a higher deposits rate to get funding. Motivated by this theoretical result, we also include bank's

net interest margin in the analysis. A bank with a less profitable lending business indicated by low net interest margin might have a higher incentive to engage in balance sheet window dressing.

Hypothesis 3. *The implementation of the SSM has had a stronger effect on the reporting and reserving practises among the significant banks that are directly supervised by the SSM.*

Our second research hypothesis is derived from the theoretical argument by Niinimäki (2007), where he stated that during weak bank supervision and poor transparency banks have a higher incentive to hide losses and affect the general view of bank's financial condition. As the implementation of the SSM can be seen as a clear attempt to unify and improve bank supervision, we have a natural experiment on the implications of the mentioned theoretical arguments. In practise, this means that we will test whether there has been a significant increase in loan losses to total loans and loan loss reserves to NPLs ratios after the implementation of the SSM in November 2014. We will also analyse, if the SSM has affected the possible relationships between the bank characteristics affecting the incentives to engage in window dressing. Although the SSM has the final responsibility for all banks in the Euro area, it directly supervises only the most significant financial intermediaries labelled as significant supervised entities and groups (SSEs). Our final research hypothesis states that the supervision of SSEs⁶ might

⁶The ECB labels a bank as a SSE when a bank fulfils atleast one of the following criteria: size (the total value of its assets exceeds 30 billion euros), economic importance (for the specific country or the EU economy as a whole), cross-border activities (the total value of its assets exceeds 5 billion euros and the ratio of its cross-border assets/liabilities in more than one other participating Member State to its total assets/liabilities is above

have been improved significantly more relatively to the banks that are less significant and are still directly supervised by the national supervisors.

We test hypotheses 1 in the following panel regression framework

$$Y_{i,j,t} = \alpha_1 \omega^{(j)} + \alpha_2 \mu^{(t)} + \beta_1 X_{i,j,t-1} + \theta Z_{j,t} + Sav_{i,j,t} + Coop_{i,j,t} + \epsilon_{i,j,t} \quad (1)$$

$$Y_{i,j,t} = \alpha_1 \omega^{(j)} + \alpha_2 \mu^{(t)} + \lambda_1 NPL_{i,j,t-1} + \beta_1 X_{i,j,t-1} + \theta Z_{j,t} + Sav_{i,j,t} + Coop_{i,j,t} + \epsilon_{i,j,t}, \quad (2)$$

where i , j and t refer to the bank, country and year. The dependent variable Y is either the ratio of loan loss reserves to NPLs (Eq. 1) or gross loan losses to total loans (Eq. 2). The former variable describes how much of the value of bank's NPLs is covered by reserves and the latter indicates how much of bank's loan portfolio is realised as losses at period t . Matrix X holds the lagged values of the bank specific variables that describe bank's financial strength and incentive to under-report or under-reserve. These variables are lagged due to obvious endogeneity problems arising from the contemporaneous relation between Y and X by definition e.g. increases to loan loss reserves reduces tier 1 capital. When Y equals the ratio of loan losses to total loans, the lagged value of NPLs to total loans is included as an explanatory variable to control for the quality of bank's loan portfolio and bank's loan screening ability. The part of NPLs that end up as loan losses

20%), direct public financial assistance (it has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility) or if it is one of the three most significant banks established in a particular country.

should be significantly less dependent on bank's management abilities as the part of total loans that end up as NPLs. The reasoning here is that when a loan is revealed as a bad loan and it is labelled as a NPL, the screening is already done and the NPL to total loans ratio includes the information how well the bank has originally screened the borrowers. The proportion of NPLs that end up as loan losses - when bad loans end up as even worse - depends mostly on macroeconomic factors and banks loan loss reporting practices.

Sorge and Virolainen (2006) used Real GDP growth, real interest rate and lagged 'excess' indebtedness⁷ to predict corporate default rates. These three macroeconomic factors have been shown to explain fluctuations in loan loss to total loans ratios surprisingly well in an aggregate country level (Jokivuolle et al., 2015), which is why we also include them together with inflation in matrix Z to control for the macroeconomic environment generating loan repayment problems. In addition, dummy variables for cooperative and savings banks, and both country and year fixed effects are included in every model specification to account for differences across bank owner/business types and to control for possible country and time heterogeneity in reporting practises. Bank fixed effects are not included in the model, because these effects might absorb some important variation from the bank characteristics variables due to our relatively short sample of six years⁸ and the time invariant nature of bank balance sheet variables e.g. bank size doesn't vary

⁷We calculate the 'excess' indebtedness by using the method by Hamilton (2017), who uses the past values of the variables to predict the current values after which the prediction error is used as the deviation from trend component of the variable.

⁸There is on average around 3.7 annual observations for each bank. The sample also includes banks for which there are only one or two observations available.

much during our 6 year sample period.

To test Hypothesis 2, we will expand the panel regression to a difference-in-differences (DD) regression by including a treatment dummy variable for the SSM that is equal to 1 for Euro area banks after the implementation of the SSM⁹ and 0 otherwise. The control group consists of EU banks that are not located in the Euro area and are not under the supervision of the SSM. Two different model specifications are used in the analysis. First, the SSM is assumed to have an effect only on general reserves to NPLs ratios (Eq. 3) and to the proportion of NPLs that is realized as losses (Eq. 4). In model 3, the fixed country effects control for the time-invariant country specific reserving practises (α_1), year fixed effects control for year specific changes in reserving practises (α_2) and the difference-in-differences estimator (α_3) reveals the SSMs possible effect on loan loss reserving in the EU. In model 4, λ_1 indicates the general proportion of NPLs that banks in the EU realize as losses. The coefficients λ_2 and λ_3 present the country and year specific changes in this ratio and the DD estimator λ_4 indicates SSMs effect on loan loss reporting given the level of bad loans.

$$Y_{i,j,t} = \alpha_0 + \alpha_1\omega^{(j)} + \alpha_2\mu^{(t)} + \alpha_3SSM_{i,j,t} + \beta_1X_{i,j,t-1} + \theta Z_{j,t} + Sav_{i,j,t} + Coop_{i,j,t} + \epsilon_{i,j,t} \quad (3)$$

⁹The SSM was implemented in November 2014. Due to annual data, the SSM dummy variable is equal to one for the years 2015 and 2016.

$$\begin{aligned}
Y_{i,j,t} = & \alpha_0 + \alpha_1\omega^{(j)} + \alpha_2\mu^{(t)} + \alpha_3SSM_{i,j,t} + \beta_1X_{i,j,t-1} + \theta Z_{j,t} \\
& + \lambda_1NPL_{i,j,t-1} + \lambda_2(\omega^{(j)} \times NPL_{i,j,t-1}) + \lambda_3(\mu^{(t)} \times NPL_{i,j,t-1}) \\
& + \lambda_4(SSM_{i,j,t} \times NPL_{i,j,t-1}) + Sav_{i,j,t} + Coop_{i,j,t} + \epsilon_{i,j,t} \quad (4)
\end{aligned}$$

In the second model specification (Eq.5 and Eq.6), the SSM is assumed to have an effect also to the relationship between the dependent variable Y and the variables X describing bank's incentive to under-report or under-reserve for losses. Coefficients β_2 and β_3 represent the time invariant country specific characteristics and the year specific changes in this relationship. The coefficient of interest is again the DD estimator (β_4), which reveals the possible change in the relationship between X and Y caused by the SSM - possible amplification or reduction of balance sheet window dressing. We will use the same models (Eq.3 and Eq.6) to answer whether the SSM has had a significant reducing effect on possible under-reporting and under-reserving only in the banks that are directly supervised by the SSM. The difference in this analysis is that the sample is reduced to include only banks in the Euro area and that the SSM treatment dummy is equal to 1 for SSEs that have been directly supervised by the SSM since 2014. To test Hypothesis 3 more robustly, we will in addition repeat the same analysis with the whole EU sample so that the control group includes all non-SSE banks in the EU and also the significant banks in non-Euro area EU countries¹⁰.

¹⁰This is in principle the difference-in-difference-in-differences regression with multiple countries and periods.

$$\begin{aligned}
Y_{i,j,t} = & \alpha_0 + \alpha_1 \omega^{(j)} + \alpha_2 \mu^{(t)} + \alpha_3 SSM_{i,j,t} + \theta Z_{j,t} + \beta_1 X_{i,j,t-1} + \beta_2 (\omega^{(j)} \times X_{i,j,t-1}) \\
& + \beta_3 (\mu^{(t)} \times X_{i,j,t-1}) + \beta_4 (SSM_{i,j,t} \times X_{i,j,t-1}) + Sav_{i,j,t} + Coop_{i,j,t} + \epsilon_{i,j,t}
\end{aligned} \tag{5}$$

$$\begin{aligned}
Y_{i,j,t} = & \alpha_0 + \alpha_1 \omega^{(j)} + \alpha_2 \mu^{(t)} + \alpha_3 SSM_{i,j,t} + \theta Z_{j,t} + \lambda_1 NPL_{i,j,t-1} \\
& + \lambda_2 (\omega^{(j)} \times NPL_{i,j,t-1}) + \lambda_3 (\mu^{(t)} \times NPL_{i,j,t-1}) + \lambda_4 (SSM_{i,j,t} \times NPL_{i,j,t-1}) \\
& + \beta_1 X_{i,j,t-1} + \beta_2 (\omega^{(j)} \times X_{i,j,t-1}) + \beta_3 (\mu^{(t)} \times X_{i,j,t-1}) + \beta_4 (SSM_{i,j,t} \times X_{i,j,t-1}) \\
& + Sav_{i,j,t} + Coop_{i,j,t} + \epsilon_{i,j,t}
\end{aligned} \tag{6}$$

The models are estimated with OLS and the standard errors are clustered by country and not by bank, as it is common in the literature to cluster by the more general cluster when the clusters are nested. It is also quite likely that the errors are correlated within a country and the fixed country effects cannot capture all of the heterogeneity. We do not cluster the standard errors by year as there is data for only six years, so that the amount of clusters would be very small and the asymptotic results would not be valid.

4. Data, validation of controls and preliminary analysis

We use annual bank balance sheet data from Orbis bank focus database by Bureau Van Dijk. The final panel used in the main analysis includes balance sheet data from up to 2387 commercial, cooperative and savings banks from 24 EU countries including Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Malta, Netherlands, Poland, Portugal, Romania,

Slovenia, Spain, Sweden, and United Kingdom. The classification of banks to SSEs and non-SSEs was done by using the ECBs list of SSEs reported in September 2014¹¹. Around 7.4% of the banks in the sample are SSEs and the timespan covered is from 2011 to 2016. In addition to the variables of interest summarised in Table 1 such as nonperforming loans, gross loan losses and loan loss reserves, we will include variables that measure banks financial strength, size, liquidity, profitability and efficiency. Bank's financial strength to withstand unexpected losses is measured with the tier 1 capital ratio, bank size by the logarithm of total assets, liquidity by liquid assets to short-term funding and deposits. Banks profitability to its owners is measured by the return of average equity (ROAE) and the profitability of banks lending business is measured by the net interest margin. The return of average assets (ROAA) and cost-to-income are meant to measure banks efficiency to accumulate returns. In addition to bank balance sheet variables we include annual country level macro variables from the World Bank such as the real interest rate, real GDP growth, credit-to-GDP ratio and inflation. We formulate an "excess" indebtedness variable from the credit-to-GDP ratio by using the method by Hamilton (2017), which has been shown to be a better alternative to the usual deviation from trend variable¹². High indebtedness combined with rising interest rates, high inflation and declining economic growth are the main macroeconomic conditions increasing loan repayment problems, which is why we use them as controls in our analysis.

¹¹<https://www.ecb.europa.eu/pub/pdf/other/ssm-listofsupervisedentities1409en.pdf>

¹²Hamilton (2017) uses the lags of the variables to predict the future values with some specific horizon and then uses the prediction error as the deviation from a trend variable. We use four lags of the credit-to-GDP and the forecast horizon is two years.

To see that the country level variables can sufficiently capture and control the macroeconomic part of the process that generates loan losses, we will estimate a similar model as Sorge and Virolainen (2006) and Jokivuolle et al. (2015). Instead of estimating the model with data from just 16 countries or less as has been done in previous literature, we will use data from the World Bank Financial Development Database covering 115 countries from the time interval 1999-2015. The dependent variable will be the ratio of NPLs to total loans instead of loan losses to total loans, because data on the latter variable is very hard to come by in an aggregate country level with a sufficient amount of observations. We do not see this as a major problem as both NPLs and loan losses represent 'bad loans' - loan losses represent the worst quality NPLs. The point is that the data generating process behind the two is somewhat nested. As mentioned earlier the simple three factor model has been able to explain the variation in the share of loan losses quite well in previous studies - R^2 -values are between 0.8 and 0.9. With our global dataset the fit is similar with a R^2 -value of 0.87. Although our country coverage is over seven times larger relative to previous studies, the simple three factor model still prevails and captures majority of the variation in country aggregate NPL ratios. This result is sufficient proof for us to use these factors in the upcoming analysis on under-reporting and under-reserving to control for the macroeconomic environment that affect to the levels of loan losses and hopefully loan loss reserves. In addition to this validation exercise, the three factor model can give some information about the country heterogeneity of NPL reporting practices. Figure 2 plots the country fixed effects for the EU countries, which represent the part of the variation in NPL ratios that cannot be explained by the changes in countries' macroeconomic environment. The majority of the countries with a

large positive fixed effect has had significant problems with their banking sectors and are currently in the center of attention in the EU regarding their high levels of NPLs. As these differences do not depend on macroeconomic factors, a possible explanation might be differences in NPL reporting practises and the quality distribution of borrowers e.g. banks in some specific country may have a more lenient borrower screening process in general.

As a preliminary analysis for possible under-reporting in the Euro area, we plot the relative densities of the NPLs to total loans ratio and the loan loss reserves to NPLs ratio before and after the implementation of the SSM. From Figure 3 it can be seen that the SSM has not had a significant effect on the amount of reserves banks set for a given amount of NPLs in the banks of the Euro area, when GIIPSC countries (Greece, Italy, Ireland, Portugal, Spain and Cyprus) are excluded. On the other hand, the mean of the distribution of reserves to NPLs ratios for banks in the GIIPSC countries has increased dramatically from a pre-SSM mean of 42.6% to a post-SSM mean of 55.8%. This statistically significant increase of 13.2 percentage points could imply that the SSM has had an effect on the loan loss reserving practises of banks in countries whose banking sectors have had problems the most. We can also speculate that perhaps the loan loss reserving practises might have been looser in these countries and the SSM forced those practises to equal or at least converge towards the practises in the other Euro area countries. Similar implication can be drawn from Figures 4 and 5. In the former the relative density distributions of NPLs to total loans ratios indicate that during the SSM the share of NPLs has increased 2.5 percentage points in GIIPSC countries and has somewhat declined in the other Euro countries. This doesn't necessarily mean that the implementation of the SSM has 'drawn out' the under-reported bad loans, but it can also mean

that after 2014 the macroeconomic environment part of the process that generates NPLs has worsened. To verify that the reason for the rise in the level of NPLs is in fact due to a shift in supervision, we will have to control for the changes in other factors affecting the level of NPLs. Figure 5 gives a more exhaustive view on the evolution of average gross loan losses, NPLs and loan loss reserves from 2011 onwards. The relationships between the three variables has stayed relatively stable during the particular time window in the EU. Furthermore, there has been a clear rising trend in both the level of NPLs and the level of loan loss reserves in the GIIPSC countries. This is what we should observe as the expected amount of loan losses rise along with the NPL ratio and this higher level of expected losses should be covered by additional loan loss reserves. A rising trend in these two variables should also imply a rise in the level of gross loan losses, but surprisingly we do not see that. Although, a small increase in the level of gross loan losses can be seen in the graph, it seems rather modest relative to the explosion in the amount of NPLs banks possess.

Figure 6 plots the country means of net and gross loan losses relative to the amount of NPLs in the EU. Almost all of the country means are in a 45 degree straight line indicating an almost one-to-one positive relationship between the two variables. This implies that the mean of recoveries from past loan losses is close to zero and that gross and net loan losses are equal in the long run. A majority of the countries that have experienced financial difficulties since the GFC can be clearly separated from the rest as their mean net loan losses seem to be much smaller with same ratios of gross loan losses to NPLs. This implies that the recoveries from past losses systematically exceeded current period gross loan losses during this time window and that the reporting of gross loan losses has been systematically

inaccurate. Altogether, these figures cannot be regarded as a general proof of under-reporting or under-reserving, but they certainly give a reason to analyse the issue further. In the next section we will report the main results of the paper regarding possible under-reporting and under-reserving for loan losses in the EU.

5. Main results

5.1. Under-reserving for loan losses

The results regarding general loan loss reserving practises in the EU are reported in Table 2. The model (Eq.1) is estimated with four different data samples: EU, Euro area, GIIPSC and also separately for systemically important banks (SIBs)¹³. The model is estimated with both data from years prior to the SSM and with the whole time sample of 2011-2016. Our model seems to explain a large portion of the variation in our dependent variable as the R^2 -value is between 86.1% and 89.2% for all eight estimation samples. As the 7 lagged balance sheet variables ($T1CR$, $ROAE$, NIM , $Size$, $CTIR$, $ROAA$ and LIQ) of the model should only affect bank's loan loss reserves to NPLs ratio via the window dressing incentive channel, we interpret a significant and theory proposed coefficient as evidence of this kind of behaviour in the given sample.

The positive and significant coefficient for tier 1 capital ratio confirms Hypothesis 1 of weaker banks having a tendency to relatively under-reserve

¹³We use the term SIB, because this sample also includes significant banks from non-Euro area countries. The ECB has not made a separate list of SSEs in these countries, which is why we are using this broader definition of a significant bank. SIBs include Euro area SSEs, non-Euro area D-SIBs and G-SIBs.

for loan losses. This result holds in the whole EU, but the effect is even stronger in the problem countries indicated by somewhat larger coefficients. Interestingly, the relationship between bank's tier 1 capital and its reserves to NPLs ratio is negative for SIBs. The more a systemically important bank has tier 1 capital, the less it sets reserves for the amount of NPLs it possesses. Bank's profitability does not seem to matter as the coefficients of *ROAE* and *NIM* are not statistically significant. Only exception is the model estimated with GIIPSC banks prior to the SSM for which the coefficient is positive and highly significant indicating that less profitable banks have had less reserves relative to more profitable banks for similar amounts of bad loans in their balance sheets. Bank's size has a significant and expected effect on loan loss reserving only in the GIIPSC countries - smaller banks under-reserve for losses relative to larger banks. In addition, bank's liquidity seems to have the expected and significant positive coefficient for all of the samples with Euro area banks. This again confirms Hypothesis 1 as weak banks in terms of less liquidity having a higher incentive to under-reserve for losses. The results regarding the relationship between bank's efficiency and reserves are not that clear. It seems, that more efficient (smaller cost-to-income ratios) banks in the GIIPSC countries under-reserve relative to less efficient banks. We have an analogous result in the same sample prior to the SSM when we look at bank efficiency in terms of return on average assets. As there is clear evidence of relative under-reserving by banks in the EU with some specific characteristic (e.g. less tier 1 capital and liquidity), it would also be interesting to compare the differences in reserving practises across countries. Figure 7 plots the fixed country effects of the basic model (Eq.1) prior to the SSM and for the entire 6 year time period estimated with the whole EU sample. We can think of a country's fixed effect as a mean of reserves to

NPLs ratios for banks in that particular country for which every value of our control variables is equal to 0. From Figure 7 it can be seen that the country means vary across countries and in every country there has been an increase in the mean since the implementation of the SSM.

The results regarding the difference-in-differences (DD) analysis (Eq. 3 and 5) are reported in Table 3. The most critical assumption for this analysis is the parallel trend assumption (PTA), which implies that the difference in the dependent variable between treatment and control groups is constant over time. In our study we cannot simply plot the dependent variables and check the trends prior to the treatment, because the macroeconomic environment, country specific practises, and other control variables should be taken into account before making any inference on the group trends. We solve this issue by comparing the coefficient estimates and the R^2 -values of the models (Eq. 1) estimated prior to the SSM with all countries and just the treatment group. If the coefficients are similar and both models explain equal proportion of the variation in the dependent variable, then the parallel trend assumption holds. The results in Table 2 confirm this assumption as the significant coefficients of the variables and the R^2 -values are roughly the same for the EU and Euro area samples. Only the coefficient of liquidity seems to be much larger in the treatment sample compared to the control sample. Another key assumption of the DD model is that the allocation of banks to the treatment group was not determined by the outcome variables - reserves to NPLs ratio and gross loan losses to total loans ratio. It can be quite easily argued that the loan loss reserving or loan loss reporting practises in the Euro area countries relative to the whole EU were not the reasons why the SSM was implemented to the former group, but rather due to being a member of the European Monetary Union (EMU). If we want to

use the banks in the GIIPSC countries alone and exclude other Euro area banks from the treatment group, then the PTA would not hold as most of the coefficients are very different between the model estimated with the whole EU sample and only with the GIIPSC sample. Nevertheless, we will report these results as well.

The model in the first column of Table 3 assumes that the SSM can only have an effect on the general level of reserves to NPLs ratio and not on its relationship between the bank characteristics variables. The models in the second and third column of Table 3 assume that the SSM can also have an effect on these relationships. In the latter model the country and year specific unobserved parts of these relations are also controlled¹⁴. It seems realistic to assume that better supervision would also have an effect on the magnitude of the incentive to under-serve (relationship between X and Y) for a given level of financial weakness e.g. during better banking supervision a bank with a tier 1 capital ratio of only 6.5%, might still have an incentive to under-serve, but due to better supervision the bank takes into account the higher likelihood of being caught by the bank supervisor and the bank will under-serve less relative to the times with weaker supervision. For a proper DD analysis we will also have to control for country and bank specific characteristics in this relationship, which is why we will regard the results in column 3 of Table 3 as our main evidence.

The coefficient of the SSM treatment dummy variable indicates some

¹⁴Only the model in the third column can be regarded as a DD analysis of the SSMs causal effect on the relationship between the dependent variable and the bank characteristics variables. The other two are DD analysis on SSMs effect on general levels of reserves to NPLs ratios.

weak evidence that there has been smaller reserves to NPLs ratios due to the SSM in the Euro area banks. This result is more significant and much larger in the GIIPSC countries. Bank's tier 1 capital, net interest margin, ROAA and liquidity have the expected and significant relationship to under-reserving practises as with the earlier much simpler model specifications in Table 2. On the other hand, the coefficients of bank size and profitability (ROAE) have the opposite sign as before - larger and more profitable banks set less reserves for the same amount of NPLs in their loan portfolio. The SSM has significantly reduced the under-reserving incentive of large, more profitable and less efficient banks in the EU, but the significant relationship between small tier 1 capital ratio, small net interest margin and lower reserves to NPLs ratio remains throughout the sample. When the DD analysis is done so that the non-GIIPSC Euro area banks are excluded (columns 4, 5 and 6 of Table 3), the results are somewhat different. Tier 1 capital, profitability and ROAA do not seem to incentivise to under-reserve in the GIIPSC countries, but high cost-to-income ratios, poor liquidity and bank size seem to matter significantly. The SSM has similarly improved the situation in this sample as the efficiency and size incentive factors have either diminished completely or come down to half of the size compared to the coefficient prior to the SSM. On the other hand, the SSM has not had any effect on the fact that less liquid banks have smaller reserves to NPLs ratios.

5.2. Under-reporting of loan losses

The results on loan loss reporting practises are reported in Table 4. The coefficients of the first row for the NPLs to total loans ratio reveal that a percentage point increase in the NPLs to total loans ratio will imply a 0.016 percentage point increase in the the loan loss to total loans ratio of

the upcoming year in the EU prior to the SSM. In other words 1.6% of new NPLs will be realized as losses in the future. This estimate is larger, when the SSM years are also included in the sample - around 2.8%. There is not much variation in this estimate across bank samples, but for the SIBs this coefficient is not significant implying that a rise in NPLs does not imply a rise in loan losses for these banks. Bank size and net interest margin seem to have a significant effect on the level of realised losses across different bank and time samples. Both have the expected sign implying that smaller and less profitable banks report less losses, when both the macroeconomic environment and the NPLs ratio are controlled. Prior to the SSM banks in the EU with higher efficiency (ROAA) and banks in the GIIPSC countries with higher profitability (ROAE) have also realised less losses. The amount of tier 1 capital has had a negative relationship between realised losses in the GIIPSC countries for the whole time period and prior to the SSM in the EU sample. The bank characteristics that seem to stimulate under-reporting of loan losses only in the GIIPSC countries are low cost-to-income ratios and high liquidity. The results of Table 4 confirm Hypothesis 1 from the perspective of bank size and net interest margin - smaller banks and banks that have less profitable lending businesses report relatively less loan losses when we control for other aspects affecting the reported values of loan losses.

We have the same model specifications as in the previous section for the purpose of testing Hypothesis 2 from the perspective of loan loss reporting. Again, we argue that the crucial parallel trend assumption holds as the coefficients of the variables and the R^2 -values in Table 4 are very much the same for the models estimated prior to the SSM with the whole EU bank sample and only with the treatment group (Euro area banks). This time the coefficients of the model estimated with the GIIPSC country sample do

not deviate significantly from the ones of the model estimated with the EU sample, which implies that the PTA holds also in this case. This enables us to analyse the differences in the treatment effect between the banks in the crisis stricken countries and other banks in the Euro area. We argue with the same reasoning as in the previous analysis on under-reserving, that the assumption of the allocation of banks into treatment and control groups does not depend on banks' loan loss reporting practises. Similarly, we make our inference on banks' loan loss reporting practises from the models in columns 3 and 6 of Table 5, which assume that the SSM can have an effect to both the general level of reported losses, incentives to under-report and to the magnitude of these incentives. In addition, these two model specifications control for possible time and country specific differences in the incentives as well and not only in the general levels of realised losses.

The coefficients of interest in Table 5 are the ones of the interaction terms between different bank characteristics and the SSM treatment dummy. These coefficients are the DD estimates of the SSMs effect on banks' incentives to under-report losses. In both samples - Euro area and GIIPSC - the SSM has amplified the incentive to under-report losses by banks with smaller net interest margins and by banks that are more efficient in terms of a higher ROAA. In the larger sample, there is also evidence of an amplifying effect on the under-reporting incentive of less efficient banks in terms of larger cost-to-income ratios. We cannot confirm Hypothesis 2 from the perspective of under-reporting of losses, but on the contrary the SSM seems to have had an unexpected negative effect on loan loss reporting practises. A possible reason for this might be that the banks have tried to accumulate larger capital buffers at least partly due to stricter supervision and that this has been done to some extent by under-reporting losses.

As the macroeconomic environment and the ratio of bad loans in banks' balance sheet have been controlled in the basic model (Eq.2), we can make some inference on the country specific loans loss reporting practises from the size of the country fixed effects plotted in Figure 8. The fixed effects vary greatly in magnitude and also the sign of the effect differs across countries. It might be argued that in the countries with the largest positive country fixed effects a larger portion of loans end up as losses in general. This might be due to overall poorer loan screening in these countries so that even the quality distribution of banks' NPLs is more skewed towards the worst borrowers relative to the distributions in other countries. A stricter banking supervision relative to other countries could be another reason for this effect. A very large negative fixed effect might be similarly explained by an overall better loan screening across banks in a country relative to other EU countries or with a weaker banking supervision and a general practise of relative under-reporting of loan losses. Furthermore, a large positive change in the country effect could suggest that the explanation to a prior large negative fixed effect is in fact systemic under-reporting that the common and stronger banking supervision has reduced significantly. Although majority of the samples countries have a relatively small fixed effect, the existence of multiple relatively large fixed effects implies that there exist heterogeneity in loan loss reporting practises across EU countries.

5.3. Effect of the direct supervision by the SSM

Despite of the fact that the SSM is the ultimate supervisor of all banks in the Euro area since the implementation of the SSM, it directly supervises only the largest and most significant banks labelled as significant supervised entities (SSEs). Our previous analysis has assumed that if the SSM has

had an effect to the balance sheet window dressing incentives, then this effect has been common for all Euro area banks. Although the non-SSE banks of the Euro area are also indirectly supervised by the SSM, it can still be argued that a possible effect on window dressing incentives is seen only or at least mostly among the SSEs. To test whether there has been a significant effect from the direct supervision by the SSM (Hypothesis 3), we conduct a DD analysis where the SSEs serve as the treatment group and the control group consist of the other banks in the Euro area. To get even more robust results on direct supervision's causal effect, we also estimate a difference-in-difference-in-differences (DDD) regression, where the treatment group remains the same, but the control group includes the whole set of EU banks including the significant banks of the EU countries that are not part of the Euro area. This way we can control for a possible common trend in reporting and reserving practises among significant banks. As the ECB has not made a list of SSEs outside of the Euro area, we use the domestically (D-SIBs) and globally systemic important banks (G-SIBs) as a reference group for SSEs in the EU that are not located in the Eurozone.

The models estimated prior to the SSM represented in Tables 2 and 4 can again be used to test the parallel trend assumption. Although the R^2 -values are almost equal for the Euro and the SIB sample models in Table 2, the variable coefficients vary greatly between the two models. The same does not apply for the models for loan losses in Table 4, as the coefficients that are significant in either of the models have at least the same sign and do not differ that much in size. For the PTA not to hold, it would be required that the SSEs and the non-SSE banks have a different trend in reserving and loss reporting practises given the macroeconomic environment, bank's ratio of NPLs and other bank characteristics. It is plausible that there might be a

level difference between the two groups, but a different trend in reporting practises is hard to see from an economic theory perspective. Despite of this argument, we report the results for both the model explaining loan loss reserves and the one explaining loan losses, but we do not consider the coefficients of the former model as sufficient evidence to reject or confirm our hypothesis due to the possible violation of the PTA assumption. In addition to the models using EU (DDD) and Euro samples (DD), we will also estimate a DD model with only the banks from the GIIPSC countries included in the sample. This way we can see whether the direct supervision’s possible effect has been different among the problem countries when compared to the rest of the Euro area. In this case, the SSEs of the GIIPSC countries serve as the treatment group and the other banks in the same countries as the control group. We also argue that the allocation of banks to treatment (SSEs) and to control groups (non-SSE banks) did not depend on banks’ loan loss reserving or loss reporting practises. The reasons for a bank being labelled as an SSE is its significance to the financial system and not its reporting and reserving practises.

Columns 1-3 of Table 6 report the results from the DD analysis regarding the possible causal effect of the direct supervision by the SSM on loan loss reserving practises. The coefficient of the treatment dummy variable *Direct* is the DD estimator for the general effect on loan loss reserves to NPLs ratios. Similarly, the coefficients of the interaction terms between bank characteristics and the treatment dummy are the DD estimators of the corresponding effect on window dressing incentives. The coefficients in the first row of Table 6 reveal that due to the direct supervision, the SSEs have had smaller reserves to NPLs ratios since the implementation of the SSM when compared to other banks. The DDD estimator in the third column

confirms this result with an even more negative coefficient. Surprisingly, the corresponding coefficient for the GIIPSC sample model is only one third of the DDD coefficient (-18.9% vs. -59.8%) and it is not statistically significant. A possible explanation for this results might be again that the stronger banking supervision has emphasized and forced banks to accumulate more tier 1 capital and in the process banks have neglected loan loss reserving as more reserves means less tier 1 capital. The DD estimators of the bank characteristics interaction terms imply that if there has been a reduction in the incentives to under-reserve due to the SSM, then the SSM's direct supervision has not made any difference as majority of the coefficients are not significant. Only the "size incentive" channel has had a separate effect from the direct supervision. The effect has been amplifying so that smaller SSEs have had an even larger incentive to under-reserve relative to larger SSEs. Although the SSM directly supervises all of the SSEs, the main focus might be on the largest ones and this then shows as higher coverage ratios within this subgroup relative to other SSEs. The DDD regression results again confirm this result. In the GIIPSC countries, the direct supervision has not affected the "size incentive", but rather on the "efficiency incentive". The SSEs of GIIPSC countries that have relatively higher cost-to-income ratios and ROAA values have reserved less since the implementation of the SSM even after controlling for various other factors. These results should be inferred with caution due to the possible violation of the PTA. The DDD model controls for the difference in trends between significant banks and the normal banks in the EU, but a violation of the PTA in this model specification would be a difference in the trends between significant banks in the Euro area (SSEs) and non-Euro area (D-SIBs and G-SIBs). A level difference between the groups could be plausible, but it is hard to argue a

robust explanation for a difference in the trends as the sample consists of EU banks. A difference in group trends would have to relate to a monetary union specific factor affecting only to the reserving/reporting practises of the significant banks - like the direct supervision by the SSM.

The results regarding direct supervision's possible effect on loan loss reporting can be seen in columns 4-6 of Table 6. The coefficients for the interaction term between the treatment dummy variable and the NPL ratio indicate that the direct supervision has increased the ratio of realised losses given the ratio of NPLs the bank holds. This increase is 10 percentage points in the Euro area in general and 6.9 percentage points in the GIIPSC countries. As the results from Section 4.2 showed that the SSM has had an overall raising effect on the amount of realised losses given the amount of NPLs, the results in this section imply that this positive effect has in fact been stronger for banks supervised directly by the SSM. From the perspective of the incentives to under-report losses, the direct supervision has not had any separate effect in the Euro area in general. Surprisingly, there has been a significant causal effect to the "capital incentive" channel in the SSEs of the GIIPSC countries. The effect has been amplifying so that the banks with less tier 1 capital have reported even less losses after the change in supervision. Although the increase in the amount of NPLs that are realised as losses has been a general phenomenon among the significant banks of the Euro area, the weakly capitalized SSEs in the GIIPSC countries have not realised losses in the same manner relative to well capitalized banks. This implies that the direct supervision has possibly made the significant banks of the problem countries to accumulate larger capital buffers and the hiding of loan losses has been a negative spillover from this action. To summarise the results regarding the causal effect of SSM's direct supervision, Hypothesis

3 can be confirmed partly from the point of view of loan loss reporting as there has been a significant increase in the amount of losses that is realised from a given quantity of bad loans, but there has been a negative spillover to the GIIPSC SSEs via an amplified "capital incentive" to hide losses.

6. Conclusions

We have analysed banks' possible under-reporting of loan losses and under-reserving for loan losses in the EU before and after the introduction of the SSM. In line with our hypothesis of financially weaker banks being more prone to these practises, we show that banks with less tier 1 capital, banks that are smaller and banks that are less liquid tend to set less loan loss reserves for a given level of NPLs in their balance sheet, even when the macroeconomic environment affecting borrowers loan repayment capability is controlled. The SSM has reduced some of the estimated under-reserving, but it has not had any effect on the relationship between bank's tier 1 capital, liquidity and loan loss reserves. Furthermore, the share of NPLs that is covered with loan loss reserves has significantly declined since the implementation of the SSM.

In addition, we show that there are large differences across countries and banks in practises regarding reserving for loan losses and also writing off 'bad loans'. Our empirical evidence suggests that the countries where banks have smaller reserves to NPLs ratios include many of the countries that have experienced difficulties in their financial sectors since the global financial crisis. In a transparent financial system that is supervised by a single banking authority, these large country specific time invariant differences should be as small as possible. We find that smaller banks and banks that

have smaller net interest margins report less losses given the same quantity of bad loans in their portfolio and equal macroeconomic environment. The implementation of the SSM has not improved the situation as the 'net interest margin incentive' to under-report has rather been amplified due to the change in supervision. Furthermore, our analysis shows that the direct supervision by the SSM did not have a separate positive effect on Euro areas significant banks' (SSEs) window dressing incentives, but in fact may have amplified some of these practises. SSEs may have been more interested in accumulating larger capital buffers due to the enhanced supervisions, which could explain this result. However, the direct supervision has had an additional increasing effect to the proportion of NPLs that is realised as losses among the significant banks of the Euro area.

From the perspective of a banking supervisor or a macroprudential policy maker, it is essential that loan loss reserves and loan losses are reported correctly, timely and accurately to describe bank's current financial condition. Our results indicate possible under-reporting of loan losses among the banks in the Euro area and we also find evidence of possible under-reserving for loan losses. Our results have the following policy implications: 1) the supervisors and regulators should continue efforts to unify the practises on setting loan loss reserves and realising losses across countries and further on across banks ; 2) much of the attention should be put on banks that have less tier 1 capital, are smaller, have less assets and smaller net interest margins.

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Figures and Tables

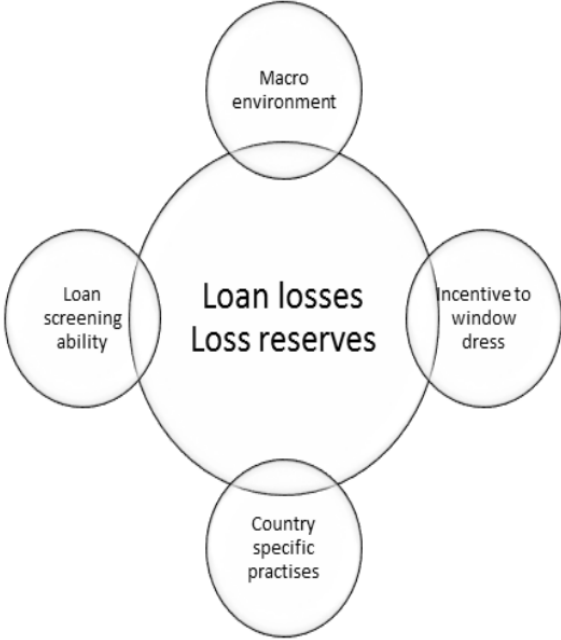


Figure 1: Determinants of reported loan losses and loss reserves.

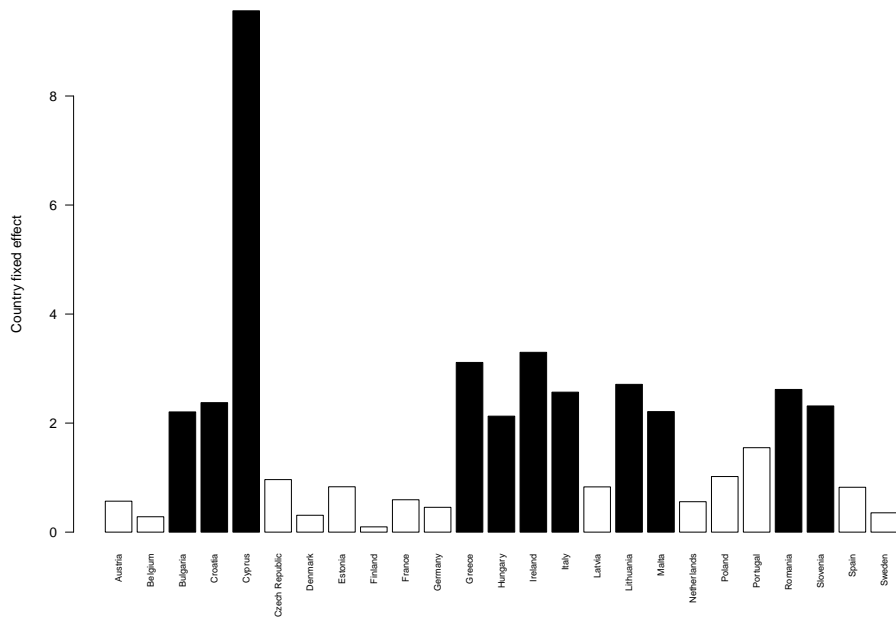
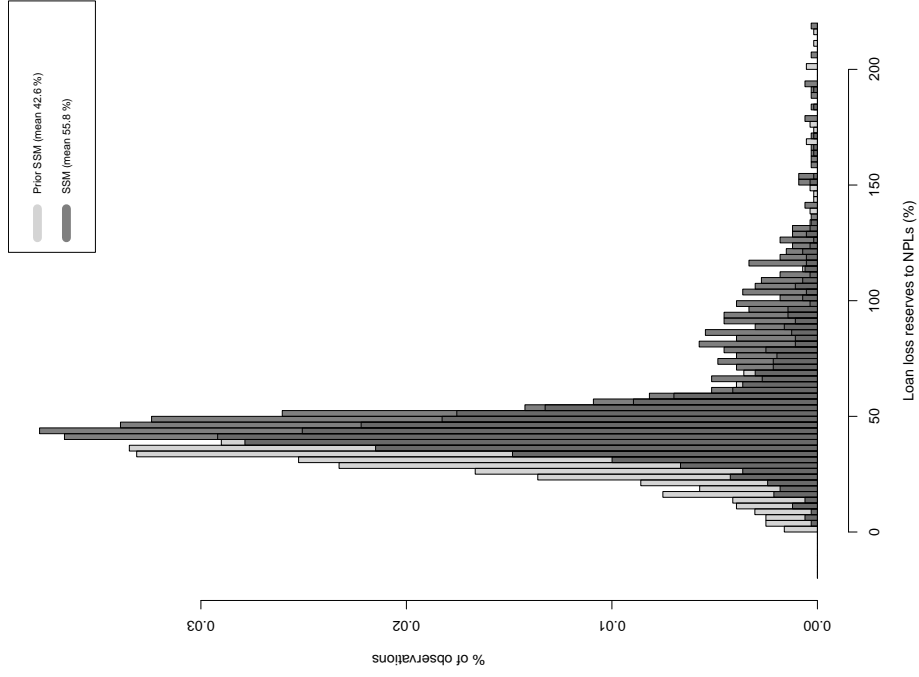
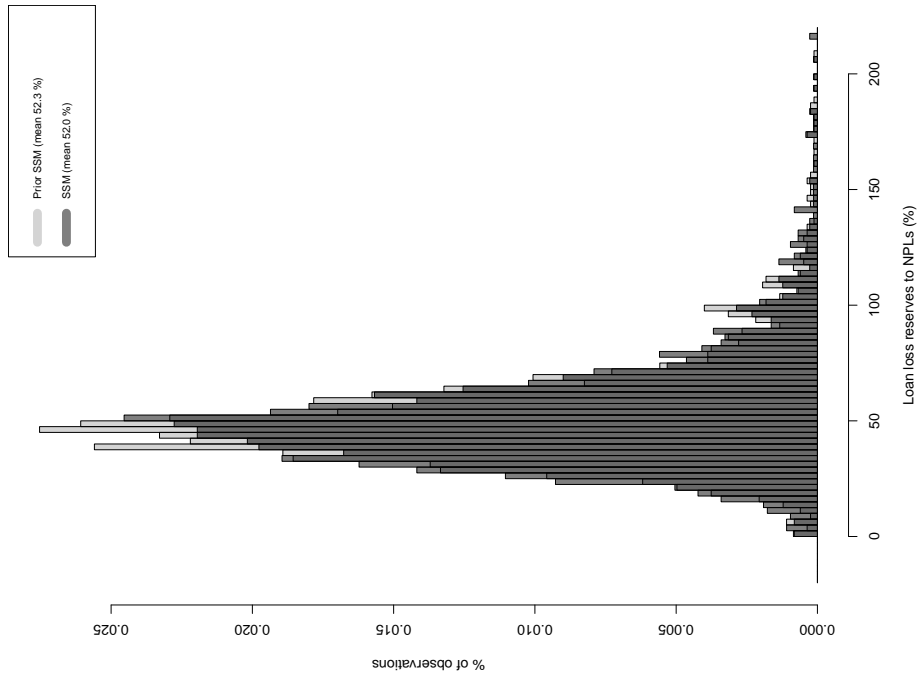


Figure 2: Country fixed effects from NPL prediction model. SV model (real GDP growth, real interest rate and excess indebtedness with no lag and a hamilton trend) with aggregate data and SE clustered by year. MSE=6.5, R-squared=0.87, 115 countries, T = 1999-2015, N=1305. All coefficients have the expected sign and are significant except the coefficient of excess indebtedness. Top 6 largest significant country effects are for *Cyprus, Ireland, Greece, Lithuania, Romania and Italy*.

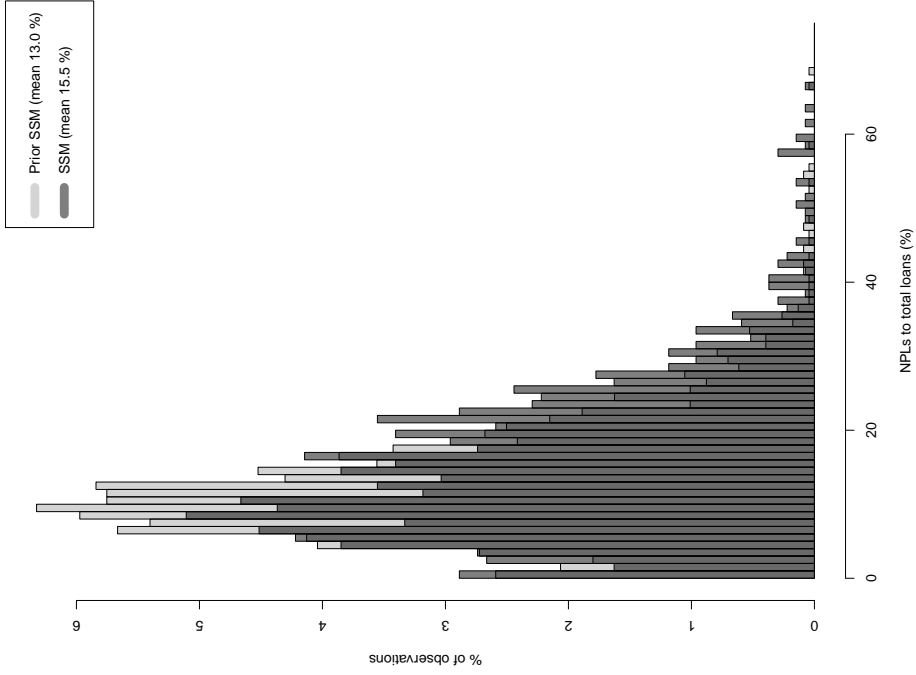


(a) Euro area (non-GIIPSC)

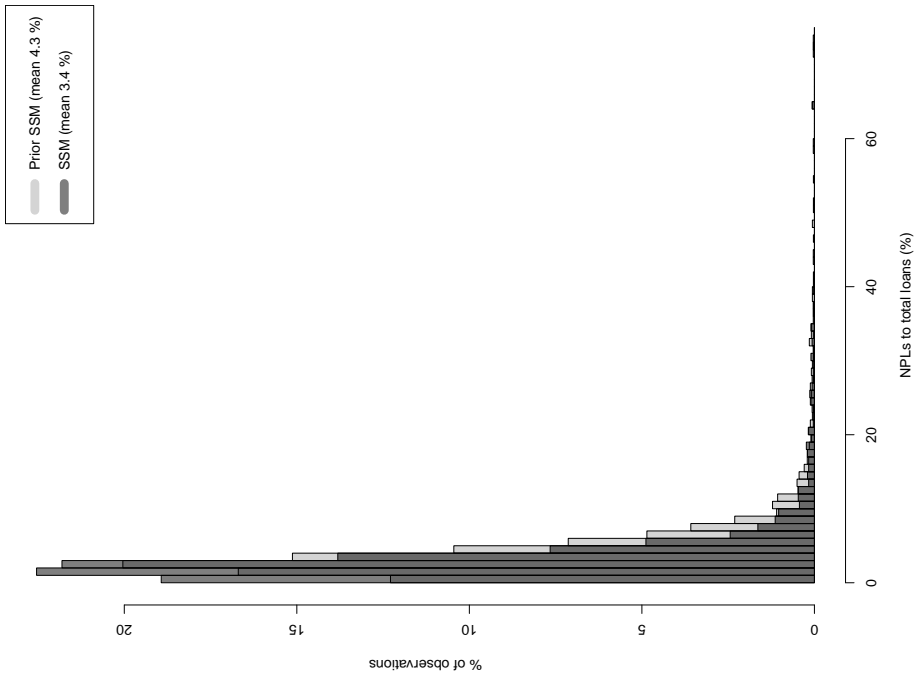


(b) GIIPSC countries

Figure 3: Loan loss reserves to NPLs ratio distribution in Euro area before and after the SSM.

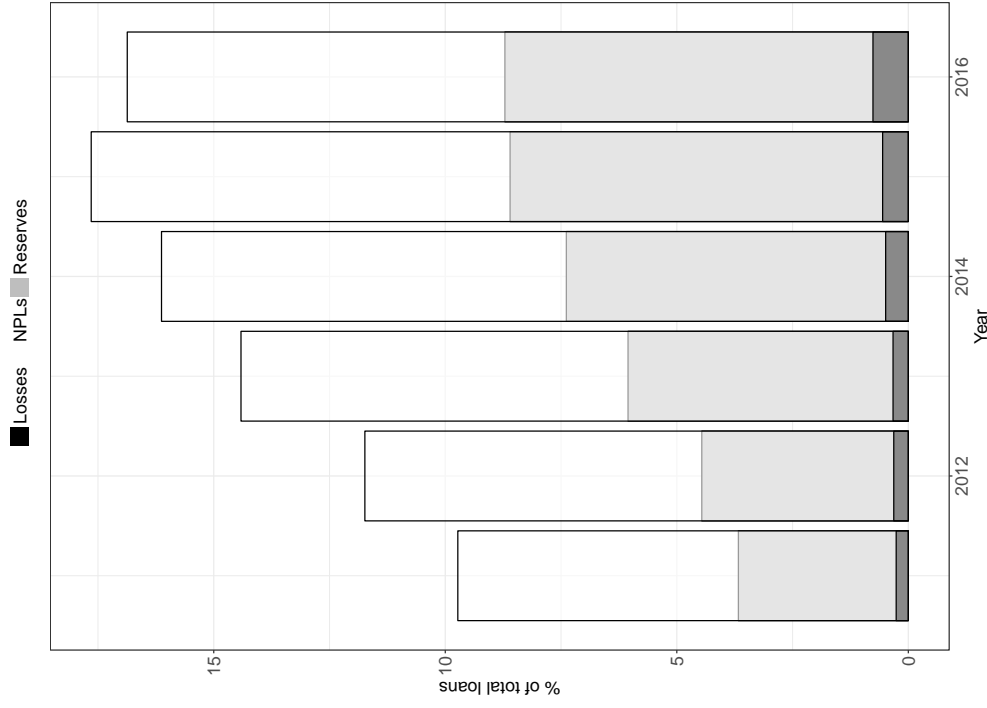


(a) Euro area (non-GIIPSC)

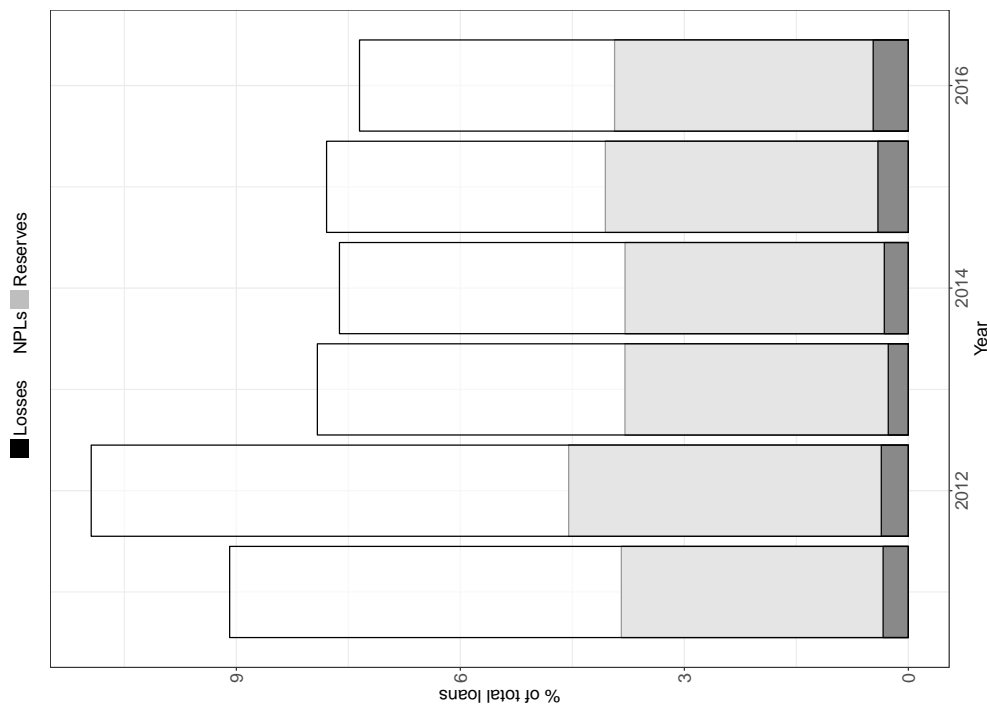


(b) GIIPSC countries

Figure 4: NPLs to total loans ratio distribution in Euro area before and after the SSM.



(a) EU (non GIIPSC)



(b) GIIPSC countries

Figure 5: Mean level of NPLs, loan loss reserves and loan losses with respect to total loans in the EU from 2011 to 2016.

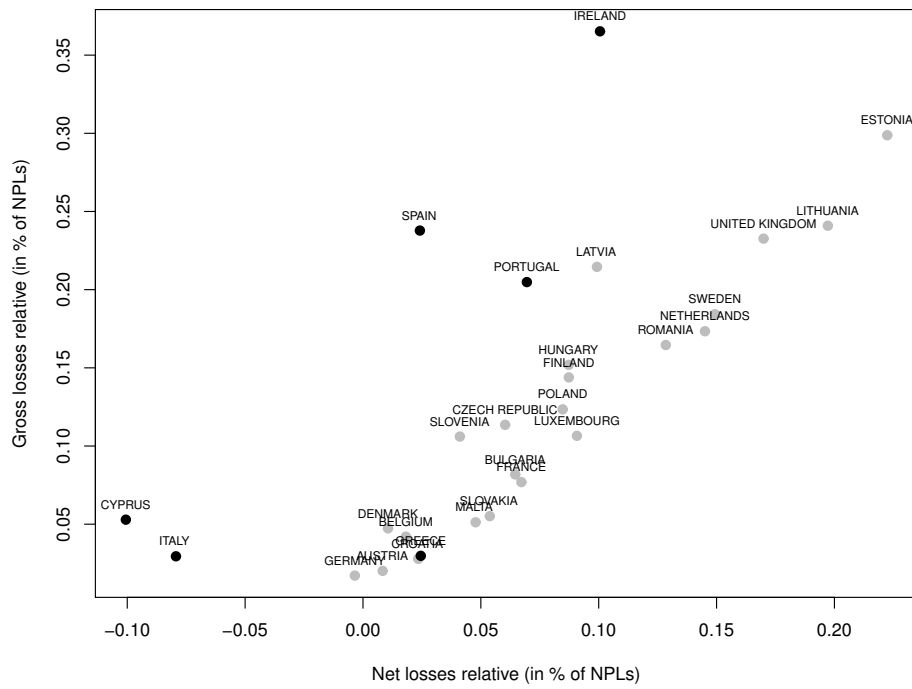


Figure 6: Country means of net and gross loan losses in the EU.

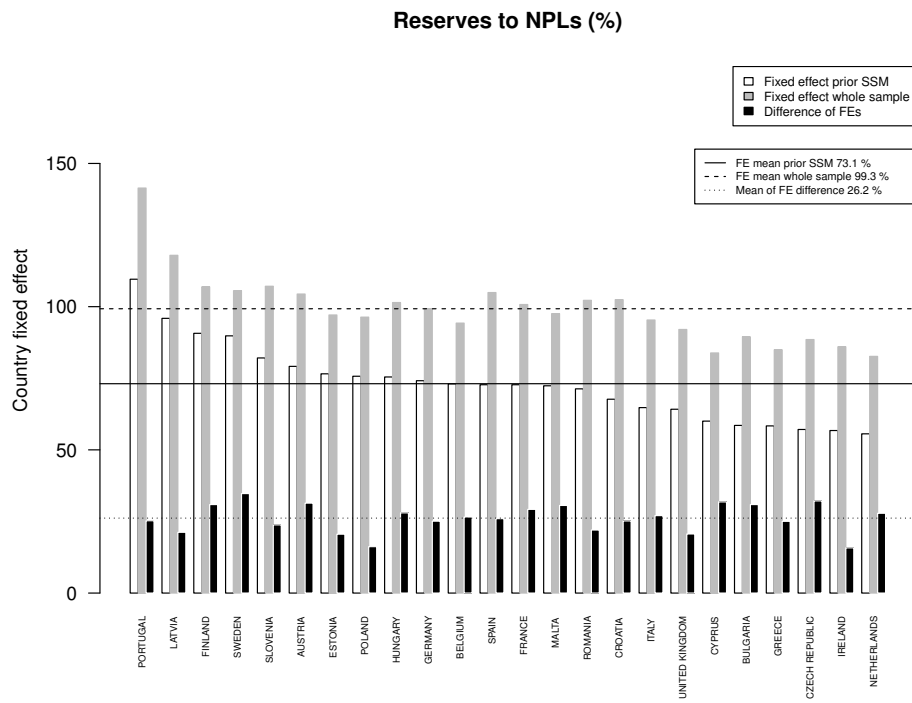


Figure 7: Country fixed effects of basic model for loan loss reserves to NPLs ratio (Eq. 1) estimated with both data prior to SSM and data covering the whole sample.

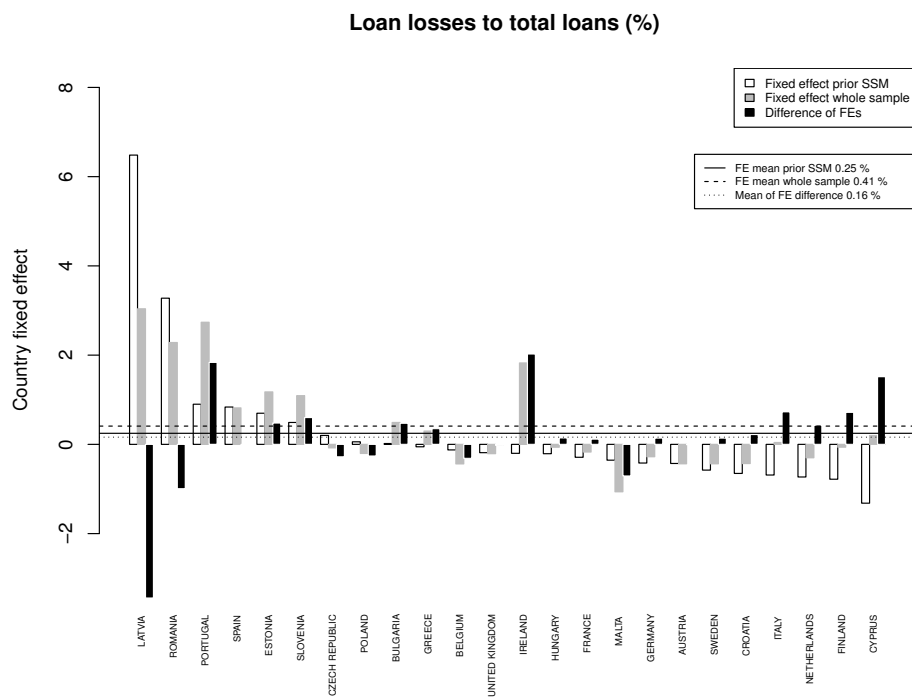


Figure 8: Country fixed effects of basic model for loan losses (Eq. 2) estimated with both data prior to SSM and data covering the whole sample.

Table 1: Summary of loan loss reserves, NPLs and gross loan losses by country in the time interval 2011-2016.

Country	Loan loss reserves to total loans (%)				NPLs to total loans ² (%)				Gross loan losses to NPLs (%)			
	N	Mean	Median	s.d.	N	Mean	Median	s.d.	N	Mean	Median	s.d.
AUSTRIA	194	4.5	3.3	7.4	128	8.2	4.7	12.5	79	2	0.6	5.5
BELGIUM	49	2.3	1.7	2.2	59	5.1	2.7	5.7	21	4.2	3.9	3
BULGARIA	104	5.7	6.9	24.2	73	21.3	18.9	15.4	59	8.2	3.6	12.1
CROATIA	149	11.4	9.5	8.7	119	18.6	16.4	11.2	95	2.8	0.8	5.3
CYPRUS	97	11	7.3	9.1	99	21	14.5	18.9	47	5.3	1	8.4
CZECH REPUBLIC	88	4.2	2.9	3.8	88	9.6	5.2	11.5	66	11.4	7	16.8
DENMARK	313	8.8	6.8	8.4	300	14	12	9.6	122	4.7	1.6	9.8
ESTONIA	30	3.4	1.4	4.7	32	5.8	2.6	7.3	23	29.9	23.8	24.8
FINLAND	85	1.3	0.6	4.9	78	1.3	1	0.8	39	14.4	11.3	10.9
FRANCE	729	4.4	2.7	8	754	6.3	3.5	9.9	702	7.5	5.4	10.5
GERMANY	5,224	1.6	1.1	4.6	4,962	3.1	2.5	3.5	4,288	1.6	0.6	4.5
GREECE	38	16.3	14.7	9.1	35	34.1	31.6	15.4	31	3	1.9	3.7
HUNGARY	56	13.8	12.7	6.6	44	20.4	19.4	8.4	23	15.2	8.1	19
IRELAND	41	9.1	7	8.9	41	16.8	15	16.3	18	15.4	3.6	23.7
ITALY	2,909	6.3	5.4	4.5	2,903	14.3	13	8.1	2,866	2.9	1	6
LATVIA	62	13.6	7.6	20	56	21.5	13.2	22.6	28	21.5	12.8	25.2
LITHUANIA	17	5.1	4	3.8	16	12.1	10.9	7.7	12	24.1	20	20.2
LUXEMBOURG	100	2.2	1.4	2.7	62	8.2	2.2	21.1	18	10.7	8.9	11.9
MALTA	38	3.1	2.1	2.8	31	8.1	4.9	8.6	19	5.1	2	7.3
NETHERLANDS	105	3.1	1.4	5.6	90	4.8	2.9	8.5	71	17.3	11.3	20
POLAND	127	5.3	4.5	3	129	8.6	7.7	5.1	87	12.3	9.5	12.6
PORTUGAL	291	11.4	7.4	15.3	281	10.8	6.9	15	22	20.5	13.6	18.6
ROMANIA	94	11.6	10	7.8	91	22.4	17.4	16.7	64	16.5	11.2	19.7
SLOVAKIA	55	4.9	4.4	2.6	55	13.2	9.1	20.4	38	5.5	3.7	4.8
SLOVENIA	68	13.5	10.2	10.8	68	23.7	17.3	19.4	52	10.6	4.9	15.1
SPAIN	279	5.7	5.2	3.9	275	10	9.1	6.3	94	22.9	19.8	21.4
SWEDEN	295	1.4	0.6	2.5	287	2.1	1.1	3.6	268	18.1	11.5	19.4
UNITED KINGDOM	399	4.9	1.4	11.7	325	7.9	2.8	14.2	188	21.9	17.2	19.6

¹ Loan loss reserves are meant to equal the amount of expected loan losses.

² A loan is labelled as a nonperforming loan (NPL) when the borrower has not made his scheduled payments for 90 days.

³ A loan is usually written completely off when the borrower has not made his scheduled payments for 180 days.

Table 2: Under-reserving for loan losses in the EU. The estimated model is shown in Equation 1. Sample includes years 2011-2016, 24 EU countries (16 Euro area members), 2387 banks and 174 significant banks (SSEs, D-SIBs and G-SIBs). The coefficients for the macroeconomic control variables, the bank owner type dummy variables and the fixed effects are omitted from the regression results.

	<i>Dependent variable: Reserves to NPLs (%)</i>							
	Prior SSM				Whole sample			
	EU	EURO	GIIPSC	SIBs	EU	EURO	GIIPSC	SIBs
$T1CR_{t-1}$	0.375*** (0.110)	0.354*** (0.105)	0.408*** (0.081)	-0.205* (0.123)	0.148* (0.081)	0.130 (0.082)	0.283*** (0.073)	-0.332** (0.167)
$ROAE_{t-1}$	0.018 (0.012)	0.019 (0.012)	0.009 (0.015)	0.012 (0.012)	0.020 (0.018)	0.023 (0.017)	0.028 (0.022)	0.009 (0.012)
NIM_{t-1}	0.316 (0.969)	0.875 (0.918)	1.879*** (0.703)	2.876 (2.246)	0.111 (0.482)	0.273 (0.409)	0.530 (0.332)	2.337 (2.480)
$Size_{t-1}$	0.811 (0.526)	0.915* (0.538)	1.783*** (0.193)	-1.923 (1.502)	0.436 (0.299)	0.373 (0.295)	0.891*** (0.300)	-1.097 (0.801)
$CTIR_{t-1}$	0.037 (0.023)	0.044** (0.020)	0.077*** (0.009)	-0.011 (0.034)	0.010 (0.023)	0.010 (0.025)	0.058*** (0.007)	-0.023 (0.023)
$ROAA_{t-1}$	0.027 (0.525)	-0.143 (0.504)	-0.533** (0.261)	0.974* (0.557)	0.584* (0.304)	0.363 (0.230)	0.319 (0.218)	0.645 (0.401)
LIQ_{t-1}	0.060 (0.103)	0.169** (0.067)	0.249*** (0.040)	0.313* (0.183)	0.046 (0.051)	0.089** (0.038)	0.151*** (0.027)	0.236 (0.189)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,911	2,761	1,396	330	6,743	6,328	2,504	604
R ²	0.863	0.867	0.882	0.871	0.861	0.862	0.892	0.884

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 3: Difference-in-differences analysis of SSMs effect on under-reserving for loan losses in the EU. Control group is the EU banks that are not located in the Euro area member states. For the model specification with SSEs as the treatment group, the control group consists of the significant banks located in non-Euro area member states of the EU.

Treatment group	Dependent variable: Reserves to NPLs (%)					
	EURO			GIIPSC		
<i>SSM</i>	3.395 (3.349)	23.686** (10.753)	-31.999* (16.923)	-7.020 (7.886)	-2.221 (29.987)	-260.246** (101.303)
<i>T1CR_{t-1}</i>	0.148* (0.081)	0.341** (0.134)	0.522*** (0.167)	0.861 (0.687)	1.476 (1.321)	-1.077 (0.878)
<i>ROAE_{t-1}</i>	0.020 (0.017)	0.016 (0.011)	-1.351*** (0.444)	-0.078 (0.153)	-0.077 (0.154)	0.491 (2.047)
<i>NIM_{t-1}</i>	0.119 (0.484)	0.350 (0.890)	5.563*** (2.085)	-0.917 (2.500)	-0.874 (3.435)	-0.011 (1.397)
<i>Size_{t-1}</i>	0.430 (0.297)	0.890* (0.487)	-2.065*** (0.567)	-2.481 (3.630)	-2.756 (4.380)	-19.255*** (5.727)
<i>CTIR_{t-1}</i>	0.011 (0.023)	0.039* (0.023)	-0.186 (0.215)	-0.012 (0.085)	-0.062 (0.141)	-1.292** (0.547)
<i>ROAA_{t-1}</i>	0.570* (0.303)	0.283 (0.477)	20.782*** (4.351)	7.083 (7.953)	8.535 (10.063)	-10.849 (14.113)
<i>LIQ_{t-1}</i>	0.046 (0.051)	0.051 (0.088)	0.369*** (0.143)	-0.233 (0.332)	-0.296 (0.367)	0.511** (0.223)
<i>T1CR_{t-1} × SSM</i>		-0.239** (0.102)	-0.259 (0.158)		-1.264 (1.350)	-0.401 (1.513)
<i>ROAE_{t-1} × SSM</i>		0.097 (0.138)	1.115*** (0.419)		0.240 (0.214)	-0.168 (2.532)
<i>NIM_{t-1} × SSM</i>		-0.460 (1.110)	0.408 (1.747)		-1.877 (2.350)	6.816 (10.288)
<i>Size_{t-1} × SSM</i>		-0.786 (0.500)	1.575*** (0.558)		0.904 (2.400)	11.370*** (4.286)
<i>CTIR_{t-1} × SSM</i>		-0.061** (0.029)	0.211 (0.204)		0.080 (0.136)	1.174*** (0.428)
<i>ROAA_{t-1} × SSM</i>		0.141 (1.126)	-8.476** (3.795)		-8.074 (9.917)	-11.678 (32.560)
<i>LIQ_{t-1} × SSM</i>		-0.005 (0.082)	-0.040 (0.146)		0.269 (0.285)	0.163 (0.490)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes
Year × X effects	No	No	Yes	No	No	Yes
Country × X effects	No	No	Yes	No	No	Yes
Observations	6,743	6,743	486,743	2,928	2,928	2,928
R ²	0.861	0.198	0.252	0.136	0.042	0.298

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 4: Under reporting of loan losses in the EU. The estimated model is shown in equation 2. Sample includes years 2012-2016, 24 EU countries (16 Euro area members), 2124 banks and 154 significant banks (SSEs, D-SIBs and G-SIBs). The coefficients for the macro control variables, the bank owner type dummy variables and the fixed effects are omitted from the regression results.

<i>Dependent variable: Loan losses to total loans (%)</i>								
	Prior SSM				Whole sample			
	EU	EURO	GIIPSC	SIBs	EU	EURO	GIIPSC	SIBs
<i>NPL ratio</i> _{<i>t</i>-1}	0.016*** (0.004)	0.014*** (0.002)	0.012*** (0.002)	-0.008 (0.006)	0.028*** (0.007)	0.025*** (0.006)	0.028*** (0.010)	0.044 (0.027)
<i>T1CR</i> _{<i>t</i>-1}	-0.002** (0.001)	-0.002*** (0.001)	-0.002* (0.001)	-0.008 (0.010)	-0.002 (0.003)	-0.002 (0.003)	-0.003*** (0.001)	0.010 (0.013)
<i>ROAE</i> _{<i>t</i>-1}	-0.001 (0.001)	-0.001 (0.001)	-0.002** (0.001)	-0.002* (0.001)	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.003)	0.0004 (0.001)
<i>NIM</i> _{<i>t</i>-1}	0.188*** (0.055)	0.192*** (0.068)	0.205*** (0.072)	0.487*** (0.122)	0.193* (0.117)	0.227 (0.152)	0.137** (0.057)	0.366*** (0.095)
<i>Size</i> _{<i>t</i>-1}	0.045*** (0.015)	0.051*** (0.014)	0.056*** (0.007)	0.028 (0.060)	0.064*** (0.016)	0.079*** (0.019)	0.071*** (0.008)	0.091*** (0.033)
<i>CTIR</i> _{<i>t</i>-1}	-0.00001 (0.0005)	0.0001 (0.0005)	0.0004 (0.001)	0.002 (0.001)	0.003 (0.002)	0.003 (0.003)	0.006*** (0.001)	-0.0002 (0.002)
<i>ROAA</i> _{<i>t</i>-1}	-0.057** (0.028)	-0.043* (0.025)	-0.025 (0.024)	-0.047 (0.048)	0.035 (0.050)	0.056 (0.053)	0.102 (0.090)	0.164 (0.129)
<i>LIQ</i> _{<i>t</i>-1}	0.001 (0.001)	0.001 (0.001)	0.00003 (0.001)	0.003 (0.004)	-0.001 (0.001)	-0.001 (0.002)	-0.002** (0.001)	0.004 (0.003)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,671	2,543	1,372	306	6,049	5,685	2,350	536
R ²	0.437	0.399	0.386	0.795	0.190	0.156	0.250	0.588

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 5: Difference-in-differences analysis of SSMs effect on under-reporting of loan losses in the EU. Control group is the EU banks that are not located in the Euro area member states. For the model specification with SSEs as the treatment group, the control group consists of the significant banks located in non-Euro area member states of the EU.

Treatment group	<i>Dependent variable: Loan losses to total loans (%)</i>					
	EURO			GIIPSC		
<i>SSM</i>	0.194 (0.240)	-1.595** (0.783)	2.067 (2.227)	0.182 (0.321)	-2.091* (1.123)	2.267 (2.418)
<i>NPL ratio</i> _{t-1}	0.028*** (0.009)	0.047*** (0.016)	0.136** (0.069)	0.030** (0.012)	0.112*** (0.011)	0.171*** (0.041)
<i>T1CR</i> _{t-1}	-0.002 (0.003)	-0.004* (0.002)	-0.006 (0.037)	-0.003* (0.002)	-0.005 (0.004)	0.236*** (0.016)
<i>ROAE</i> _{t-1}	-0.002 (0.002)	-0.001 (0.001)	0.016 (0.077)	-0.002 (0.002)	-0.002 (0.001)	0.163 (0.111)
<i>NIM</i> _{t-1}	0.195 (0.120)	0.091 (0.060)	-0.694*** (0.229)	0.126*** (0.038)	0.161*** (0.045)	-0.053 (0.137)
<i>Size</i> _{t-1}	0.064*** (0.016)	0.020 (0.027)	-0.063 (0.087)	0.055*** (0.021)	0.033 (0.028)	0.541*** (0.194)
<i>CTIR</i> _{t-1}	0.003 (0.002)	0.001 (0.001)	0.057** (0.026)	0.005*** (0.001)	0.002 (0.001)	0.041 (0.033)
<i>ROAA</i> _{t-1}	0.034 (0.049)	0.019 (0.033)	1.417** (0.560)	0.067 (0.062)	0.033 (0.046)	-0.827* (0.435)
<i>LIQ</i> _{t-1}	-0.001 (0.001)	0.0005 (0.001)	0.004 (0.012)	-0.001** (0.0005)	0.0004 (0.001)	-0.031*** (0.011)
<i>NPL ratio</i> _{t-1} × <i>SSM</i>	0.001 (0.008)	-0.024 (0.017)	-0.111* (0.066)	0.003 (0.011)	-0.018 (0.028)	-0.110 (0.067)
<i>T1CR</i> _{t-1} × <i>SSM</i>		0.004 (0.003)	-0.028 (0.022)		0.002 (0.004)	-0.022 (0.020)
<i>ROAE</i> _{t-1} × <i>SSM</i>		-0.042*** (0.014)	-0.066 (0.072)		-0.045** (0.018)	-0.061 (0.075)
<i>NIM</i> _{t-1} × <i>SSM</i>		0.043 (0.147)	0.524** (0.230)		-0.065 (0.084)	0.403* (0.224)
<i>Size</i> _{t-1} × <i>SSM</i>		0.082*** (0.028)	0.110 (0.089)		0.089* (0.046)	0.091 (0.089)
<i>CTIR</i> _{t-1} × <i>SSM</i>		0.006 (0.006)	-0.043* (0.026)		0.016*** (0.003)	-0.039 (0.028)
<i>ROAA</i> _{t-1} × <i>SSM</i>		0.539** (0.238)	-0.960* (0.536)		0.693** (0.338)	-0.919* (0.552)
<i>LIQ</i> _{t-1} × <i>SSM</i>		-0.003 (0.002)	-0.002 (0.012)		-0.003 (0.003)	-0.004 (0.012)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes	Yes	Yes
Year × X effects	No	No	Yes	No	No	Yes
Country × X effects	No	No	Yes	No	No	Yes
Observations	6,049	6,049	6,049	2,714	2,714	2,714
R ²	0.155	0.199	0.296	0.203	0.284	0.447

Note:

*p<0.1; **p<0.05; ***p<0.01

Table 6: Difference-in-differences analysis of SSM's direct supervision's effect on loan loss reserving and reporting practises in the EU. The estimated models are the ones in Equations 5 and 6. Only the DD and DDD estimators are reported in the table and the coefficients for the control variables are omitted.

Sample	<i>Reserves to NPLs (%)</i>			<i>Losses to total loans (%)</i>		
	Euro	GIIPSC	EU	Euro	GIIPSC	EU
<i>Direct_t</i>	-47.904*** (15.948)	-18.905 (14.963)	-59.809*** (18.239)	0.226 (1.669)	-3.450 (2.324)	0.448 (1.964)
<i>NPL ratio_{t-1} × Direct_t</i>				0.100*** (0.038)	0.069** (0.033)	0.080** (0.038)
<i>T1CR_{t-1} × Direct_t</i>	0.420 (0.364)	0.104 (0.080)	0.441 (0.349)	0.020 (0.038)	0.122** (0.048)	0.015 (0.039)
<i>ROAE_{t-1} × Direct_t</i>	0.055 (0.241)	0.108 (0.156)	0.198 (0.178)	-0.021 (0.051)	-0.088 (0.058)	-0.023 (0.046)
<i>NIM_{t-1} × Direct_t</i>	1.032 (1.599)	1.917 (2.666)	1.219 (1.461)	-0.425 (0.289)	0.069 (0.234)	-0.204 (0.269)
<i>Size_{t-1} × Direct_t</i>	2.004** (0.843)	0.691 (1.054)	2.887*** (0.983)	-0.057 (0.078)	0.110 (0.114)	-0.067 (0.096)
<i>CTIR_{t-1} × Direct_t</i>	-0.020 (0.087)	-0.090* (0.051)	-0.012 (0.071)	0.001 (0.008)	-0.012 (0.012)	0.001 (0.006)
<i>ROAA_{t-1} × Direct_t</i>	-2.405 (3.012)	-6.236*** (2.344)	-3.428 (2.511)	1.180 (1.108)	1.845 (1.198)	1.066 (1.009)
<i>LIQ_{t-1} × Direct_t</i>	0.141 (0.135)	0.028 (0.082)	-0.021 (0.124)	0.003 (0.010)	0.002 (0.011)	0.005 (0.010)
Method	DD	DD	DDD	DD	DD	DDD
Treatment	Euro SSEs	GIIPSC SSEs	Euro SSEs	Euro SSEs	GIIPSC SSEs	Euro SSEs
Control	Euro other	GIIPSC other	EU other	Euro other	GIIPSC other	EU other
Observations	6,328	2,504	6,743	5,685	2,350	6,049
R ²	0.213	0.463	0.211	0.167	0.273	0.190

Note:

*p<0.1; **p<0.05; ***p<0.01

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