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THE SINGLE SUPERVISORY MECHANISM AND ITS IMPLICATIONS FOR THE PROFITABILITY OF EUROPEAN BANKS

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Abstract

The scope of this paper is to examine if and how the establishment of the Single Supervisory Mechanism (SSM) influenced the profitability of European banks. To do so, we employ the returns on assets and equity as alternative indicators for profitability. Using data for 344 European banks in 2011-2017 we apply the difference-in-differences methodology combined with matching techniques. Our main findings indicate a statistically significant and positive effect on profitability for the directly supervised banks, especially banks located in the periphery of the euro area, implying that institutional improvements introduced by the SSM were beneficial not only for strengthening stability and increasing credibility but also for improving performance and enhancing integration.

Keywords: European Banking Union; SSM; Bank profitability; policy evaluation.

JEL Classification: C23, C51, G21

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1. Introduction

The financial and sovereign debt crises experienced in the European Union in 2008 and 2010 revealed the existence of strong links between national banking sectors and their sovereigns, a destabilizing phenomenon known as the doom-loop (European Commission 2017). The institutional response towards a more resilient European financial sector was the creation of the European Banking Union (EBU), based on common supervision, crisis management and deposit insurance. The basis of this framework comprises three inseparable pillars, namely, a Single Supervisory Mechanism (SSM), a Single Resolution Mechanism (SRM) and a common deposit-guarantee scheme. The SSM has already been established and within its framework all systemic banks in the EU are supervised according to the same standards, with all significant banks in the euro area being centrally supervised by the European Central Bank (ECB).

The related proposal for its establishment was published by the European Commission in September 2012 and the European Council legally adopted the regulation creating the SSM on 15 October 2013.¹ The supervisory role of the first pillar of the EBU officially started on 4 November 2014.

The development and implementation of the SSM covered a considerable time period before its introduction in 2014. A significant preparatory step before the SSM launch was a 12-month Comprehensive Assessment (CA) of the European banking system. It was conducted on 130 banks of the EU and consisted of an Asset Quality Review (AQR) and a stress test exercise. Its results were published in October 2014. Therefore, the new institutional regime was known and anticipated. This could have led the European banks to adjust their behavior and modify their activities in anticipation of the SSM, which subsequently could affect bank efficiency and performance.

The scope of this study is to examine whether the evolution of banks' profitability indices, and, in particular, the Return on Assets (ROA) and the Return on Equity (ROE), were significantly altered by the introduction of the SSM. Specifically, focusing on the pool of European banks that are directly supervised by the ECB (treated banks) and the non-systemic banks that are supervised by the National

¹ European Council (2013)

Supervisory Authorities (untreated banks), we study the net effect of the SSM on profitability, controlling for other important determinants related to the macro-environment, and some bank-specific characteristics.

One way that profitability may have been affected is through the expectations of increased credibility of the treated banks as a result of the announcement and preparation before implementing the central supervision by the ECB. Increased credibility leads to lower borrowing costs as markets expect lower yields from safer institutions.

In addition, Fiordelisi et al. (2017) provided evidence that banks which expected to be directly supervised by the ECB adjusted their lending activity, which in turn affected their equity capital ratios. Both lending behavior and capitalization are related to bank profitability. Hence, we expect an indirect effect on profitability due to the reactions of the banks involved in anticipation of the SSM.

The main findings on bank profitability indicate that the establishment of the SSM, as a sound prudential regulation mechanism, had a positive effect for the directly supervised group of European banks. For a comprehensive image of the years before and after the introduction of the SSM we extend our analysis to the period 2013-2017. The year-by-year estimates provide evidence that the profitability of the treated banks was initially affected (2014) but in the following years profitability appeared to be more resilient to institutional changes.

Questioning whether this positive effect on profitability is homogeneous across the EU member states we find that banks in countries of the European periphery have benefited most, compared to banks of the European core countries for which we find an insignificant impact on ROA and ROE.

To assess the validity of our main results we employ various robustness checks. First, we perform our analysis using both ROA and ROE as alternative profitability indicators. Our results indicate a positive effect of the SSM on bank profitability irrespective of the indicator used. Second, we use as a filtering criterion the size of the directly supervised banks, matching the two groups according to their size. This way we focus on the larger banks of the control sample to ensure that our findings are not affected by the ECB selection criteria. Third, we combine the difference-in-differences methodology with propensity score matching to correct for any

imbalances among the observed characteristics we control for, when evaluating the impact of the SSM on the performance of the banks under examination. Fourth, we explore whether there are differences between the treated and untreated banks during the pre-treatment period (2012-2013), by incorrectly assuming that the introduction of the SSM was established in 2013. This placebo test should in principle be able to reveal essential profitability differentiations across the two groups considered. Moreover, it can reveal increased efforts of treated banks for improved performance after the announcement and during the preparation of the SSM launch. Finally, it provides evidence of possible effects on profitability during the pre-treatment period, caused by the reaction of the treated banks in anticipation of the SSM. Fifth, we apply the ECB selection criteria to banks that belong to European countries outside the European Monetary Union (EMU) and we find no evidence of factors other than the SSM, which even though they could affect profitability are not being accounted for and thus could have been captured by our policy variable.

The implemented reforms have already started to deliver results, but there are further improvements and measures to be taken, while moving towards a more integrated European financial sector. After the introduction of the SRM in 2016, the third pillar to be introduced is a single European Deposit Insurance Scheme, which will provide uniform insurance coverage to all depositors in the EU. Finally, a remaining challenge is the reduction of the high levels of non-performing loans (NPLs) in the European banking sector (European Commission 2017; ECB 2017, Ari et al., 2020). Since the banking union is a work in progress, it is important to analyze further how it has affected in practice the banking sector so far. Our analysis will contribute to the banking union related literature, as it focuses on the evolution of the profitability of European banks, by means of a methodological approach, which, to the best of our knowledge, has not been deployed enough by the ongoing research on the recent EU institutional reforms.

The rest of this paper is structured in the following way: Section 2 presents the review of the relevant literature. Section 3 describes the data, the variables and the methodology used. Section 4 provides the results of the econometric analysis and Section 5 concludes.

2. Literature review

Even though the European banking union builds on the foundations set by the European Commission's initiatives on banking regulation and supervision in the 1960s and early 1970s, the establishment of its first pillars is still considered to be at an early stage. Therefore, there have not been many studies related to its implications for the banks involved.

A significant stream of literature explores the way in which regulation and supervision affect bank performance and overall efficiency. Barth et al. (2013), examine approximately 4050 banks' observations in 72 countries during 1999-2007. They use data envelopment analysis (DEA) to obtain operational efficiency scores, the determinants of which are estimated with maximum likelihood estimation. Their findings indicate that regulatory restrictions on bank activities impede efficiency, while stricter capital requirements foster it. Furthermore, they find that strengthening supervisory power has positive effects on efficiency in countries where supervisory authorities are more independent. Finally, their findings suggest a positive relation between market monitoring and bank efficiency.

Ongena et al. (2013) explore the way that bank regulation and supervision affect lending standards abroad. They analyze business lending by 155 banks to 9613 firms across 16 countries. Their findings indicate that lower entry barriers, tighter restrictions on bank activities and higher minimum capital requirements in domestic markets are associated with lower bank lending standards abroad.

Focusing on the inter-temporal relation between bank efficiency, risk and capital, Fiordelisi et al. (2011) applied Granger-causality methods on a dataset of 1987 bank observations from 26 EU countries during the period 1995-2007. The results of their research indicate that lower bank efficiency can cause higher bank risk, while increases in bank capital can lead to improved cost efficiency.

The relationship between risk-taking, bank ownership structure and national bank regulation has been explored by Laeven and Levine (2009). They used mainly ordinary least squares and instrumental variable estimation methods and their sample consists of 296 banks across 48 countries during the period 1996-2001. Their findings suggest that ownership concentration affects the relationship between risk-taking and bank regulations, such as deposit insurance, capital requirements and restrictions on

bank activities. These results imply that the effect of regulation on risk will be different for banks with different corporate governance structures.

Demirguc-Kunt et al. (2004) examine how bank regulation, banking sector concentration and institutional development affect bank efficiency and specifically the cost of financial intermediation. They use generalized least-squares estimation and their dataset comprises 1400 banks from 72 countries over the period 1995-1999. They find evidence that, besides individual bank characteristics, regulatory restrictions increase the cost of financial intermediation. Bank regulation however cannot be viewed in isolation from the overall institutional structure. Finally, they find mixed evidence on the relation between concentration and efficiency.

The role of financial structure in bank performance, measured by bank profitability and bank interest margins, was analyzed by Demirguc-Kunt and Huizinga (2000). Applying simple means tests and regression analysis on a dataset that includes bank observations from 44 countries, during the period 1990-1997, they find indications that the degree of development of the financial systems affects bank performance.

Another stream of literature examines the stress tests performed by supervisory authorities and their implications. For the case of the SSM, the related studies focus on the implications of the preparation before the SSM introduction, i.e. the Comprehensive Assessment (CA) of the European banking system.

An interesting question examined by Fiordelisi et al. (2017) is how the lending behavior and capitalization of the European banks has been affected during the period of the SSM launch. Employing a sample of 336 banks and using difference-in-differences estimation, they find evidence that the treated banks reduced their lending activities more than the group of untreated banks. Splitting total loans into reserves for loan losses and net loans, their results indicate that the treated banks reduced both these variables in anticipation of the SSM launch. Regarding banks' capitalization, their findings indicate a positive effect on equity capital ratios without a similar statistically significant effect on equity capital levels.

Abad et al. (2020) investigated how stock market returns were affected by the main steps during the SSM development and implementation. They also studied the impact on systemic risk, overall risk of the EU market and the interdependence across

countries. They used a regulatory event study by estimating a dummy-extended seemingly unrelated regression (SUR) model and they collected data on daily stock price indexes from 27 European countries over the period 2008-2014. Their results indicate negative return responses and increased risk, reactions that differ among the different steps of the process of the SSM development and establishment. In addition, these reactions were heterogeneous across EU countries.

In order to examine how the stress tests performed during the CA affected the correlation between stock returns and CDS spreads, Covi and Ambrosini (2016) performed an event study and panel data analysis on a sample of 40 banks. After the announcement of the stress test's results, the usual negative correlation between stock prices and default probabilities, measured by CDS spreads was not observed. A possible explanation is that the announcement of the stress test's results decreased information asymmetries and increased banks' balance sheet transparency and credibility without decreasing their value. Examining the reaction of financial markets to the CA regarding stock returns and CDS spreads and using an event study methodology, Sahin and De Haan (2016) found no indication that the publication of the CA results affected stock returns and CDS spreads, probably because markets had already discounted the outcome. Finally, Acharya and Steffen (2014) focus on the stress tests performed during the CA. Using four stressed capital shortfall measures for a sample of 109 banks that were stress-tested under the CA in 2014, they provide a set of capital shortfall estimates as benchmark estimates against which the CA stress tests could be evaluated.

The existing literature indicates that bank performance is affected by the institutional framework and that the banking sector had to adapt to the introduction of the SSM. Markets also reacted accordingly as transparency and credibility were enhanced. Therefore, in spite of the fact that the improvement of profitability is not among the main objectives of the establishment of the SSM, we expect that the profitability of supervised banks will be affected in an indirect and possibly unintended way by the institutional restructuring.

3. Data, econometric model and empirical methodology

3.1 Data

We use bank-specific and macroeconomic annual data for the period 2011-2017 from 16 member countries of the euro area². Our dataset comprises 344 banks, with 81 of them belonging to the treated group. These are the banks that in 2014 were classified as significant and their supervision was directly transferred to the ECB. The comparison group is composed of 263 commercial and savings banks that have been classified as less significant and are still supervised by their national supervisory authorities. For a bank to be categorized as significant it needs to fulfill one of the following criteria:³

1. The total value of its assets exceeds €30 billion.
2. The ratio of the bank's total assets to GDP of the member state, in which it is located, exceeds 20%, unless the total value of its assets is below €5 billion.
3. The bank is one of the three most significant financial institutions of the member state in which it is located.

The source for the bank-specific data is the BankFocus database provided by Bureau van Dijk. Macroeconomic data are collected from the World Bank, the ECB Statistical Data Warehouse and the AMECO database. Table 1 presents all the variables included in our analysis and Table 2 presents the summary statistics.

3.2 Econometric model

For our empirical analysis the specification to be estimated can be written as follows:

$$Y_{i,c,t} = \beta_0 + \beta_1 post_t + \beta_2 treated_i + \beta_3 post_t \times treated_i + \beta_4 X_{i,t-1} + \beta_5 M_{c,t-1} + A_c + \varepsilon_{i,c,t} \quad (1)$$

We define by $Y_{i,c,t}$ the profitability indicator for bank i , in country c , in period t . The main dependent variable is the Return on Assets (ROA) and alternatively, as a robustness check the Return on Equity (ROE) is used.

² We examine banks from Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. We excluded Latvia and Lithuania since they joined the euro area in 2014 and 2015 respectively. This constitutes a significant change of their financial environment and as it coincides with the establishment of the SSM, including them could yield misleading results. We also excluded banks from Luxembourg because they have a different business model than the banks located in other euro area countries.

³ECB (2014).

The time period dummy variable $post_t$ is equal to 1 after the introduction of the SSM (from 2014 onwards) and 0 otherwise. It captures the aggregate factors that could affect the dependent variable as time moves, irrespective of the policy change. The dummy variable $treated_i$ equals 1 if a bank is directly supervised by the ECB and 0 otherwise. It captures the differences between the two groups during the pre-treatment period. The policy variable of interest is the dummy variable $post_t \times treated_i$. It takes the value 1 for the case of a treated bank after the introduction of the SSM (from 2014 onwards) and 0 otherwise. The coefficient of $post_t \times treated_i$ measures the effect of the SSM.

The vector of bank-specific variables, $X_{i,t-1}$, comprises the natural logarithm of total assets as an indicator of bank size, the ratio of equity to total assets as a proxy for bank's capital, the ratio of loan loss reserves to gross loans as an indicator of bank's risk and asset quality and the cost to income ratio as an indicator of operational efficiency.

The vector of macroeconomic variables, $M_{c,t-1}$, includes the growth rate of each country's real Gross Domestic Product (GDP), the profit tax ratio (corporate taxes paid as a percentage of corporate profits), the Herfindahl-Hirschman Index of market concentration and the Government Effectiveness Index as an institutional quality indicator⁴. Along with the observed macroeconomic variables, we added country fixed effects to control for other macroeconomic characteristics that remained constant over the period of interest and are common across all banks for a given country (A_c). The reported standard errors account for clustering across banks.⁵

3.3 Empirical methodology

We first evaluate the effect of the introduction of the SSM using the difference-in-differences estimation framework. This allows us to study the effects of policy interventions on certain outcome variables in two subpopulations, where one is subject to the intervention and the other is not.⁶ The way supervision by the ECB was

⁴ According to the definition of Kaufmann et al. (2010), it represents the quality of public services, the quality of civil service and its level of independence from political pressure. It also indicates the government's credibility since it shows the quality of policy formulation and the commitment to implementing such policies.

⁵ Abadie et al. (2017)

⁶ For more information about difference-in-differences estimation and program evaluation see Bertrand, Duflo and Mullainathan (2004), Donald and Lang (2007), Imbens and Wooldridge (2007, 2009).

imposed, formed two groups of European banks, one composed of directly and one of indirectly supervised banks. This naturally creates a treatment/comparison group setting. The policy intervention of interest is the establishment of the SSM, which took place in 2014.

The difference-in-differences approach will allow us to perform valid statistical inference when essential assumptions, such as the conditional parallel trend assumption are effective. The first possible reason for this assumption to be violated could result from the treated banks' reaction in anticipation of the SSM introduction. Second, since the assignment of direct supervision is not random, imbalances between the treatment and comparison groups may occur. The variety of approaches employed and the falsification tests performed deal with these potential sources of bias.

Valid estimation requires the differential trend between the profitability of the two groups during the pre-treatment period to be limited. However, since the treatment assignment by the ECB was based on specific selection criteria, comparing the average difference between the two group's profitability indicators (Figure 1) may render the findings of our estimation unreliable. To deal with this issue we introduce in our analysis a vector of bank specific variables, a vector of macroeconomic variables and a set of country dummies. By including these control variables, the parallel trend assumption becomes more plausible. Following the approach of Ashenfelter et al. (2013), we estimate equation (2) with our two groups of data (treated and control groups) using OLS estimation.

$$Y_{i,c,t} = \beta_1 X_{i,t-1} + \beta_2 Year_t + \beta_3 M_{c,t-1} + A_c + \varepsilon_{i,c,t} \quad (2)$$

The dependent $Y_{i,c,t}$ is the profitability indicator for bank i , in country c , in period t . $X_{i,t-1}$ is the vector of the bank specific variables, $Year_t$ are the year dummies, $M_{c,t-1}$ is the vector of the macroeconomic variables and A_c are the country dummies. Then, we focus on the estimated coefficients of the year dummies which account for annual fixed effects conditional on the banks' observable characteristics and macroeconomic variables. In Figure 2 we plot the estimated coefficients $\hat{\beta}_2$ against the corresponding year for the group of treated and untreated banks for ROA and ROE. Inspection of the year dummies estimated coefficients, indicates that when we account for the set of regressors in $X_{i,t-1}$ and $M_{c,t-1}$ the parallel trend assumption seems plausible enough. This suggests that estimation within the difference-in-

differences framework is reliable. Further supporting evidence about the parallel trend assumption is given in section 4.4.

To make our results robust and in accordance with the recent literature on policy evaluation we adopt a combined difference-in-differences and propensity score matching method.⁷ Consequently we align the distribution of the observed characteristics in the control sample with that of the treated sample. Matching mimics the feature of randomization according to which the distributions of the observed characteristics of the two populations are the same (Heckman et al., 1997). To deal with the practical difficulty of matching on high dimensional $X_{i,t-1}$, we used the result derived by Rosenbaum and Rubin (1983) according to which it is sufficient to match on the propensity score.

In order to estimate the propensity score we use a logit model aligned with the observed bank specific characteristics (Stuart and Rubin 2007) and we perform sequential matching with replacement. Each bank in the treated group is matched to the nearest neighbor in the comparison group. The number of nearest neighbors from the comparison group that can be matched to each one of the treated banks is set at one. To avoid substantial distance between the estimated propensity score of a treated bank and its nearest neighbor in the control sample, we impose a pre-specified tolerance level. Matching is performed if the absolute distance of the estimated propensity scores of the matched banks does not exceed this tolerance level.

Following the above selection process, before employing the difference-in-differences estimation, ensures that the treated and untreated banks have comparable characteristics. This in principle should result in more reliable inference of the net effect of SSM on bank profitability.

4. Empirical results

4.1 The effect of the SSM on bank profitability

In this section we examine the effect of the SSM on the evolution of bank profitability. Focusing on a narrow interval around the policy initiation will allow us

⁷ Rosenbaum and Rubin (1983, 1985), Heckman Ichimura and Todd (1997), Lee M-J (2005), Stuart and Rubin (2007), Abadie and Imbens(2012). An application of difference-in-differences estimation combined with propensity score matching is provided by Blundell et al. (2004).

to further isolate other events or policies that might have affected profitability. To this end, we first focus on the year before (2013) and the year after (2015) the policy introduction. Table 3 presents the main estimates of the policy impact on European banks' ROA (column 1) and ROE (column 4), applying the difference-in-differences methodology on the full available sample of banks.

Regarding ROA, our results indicate that as we move from 2013 to 2015 the establishment of the SSM, causes a direct positive and significant (at 5% level) effect on the ROA of directly supervised banks, controlling for other determinants of profitability. Our findings indicate that, because of the SSM introduction, the expected mean effect on the treated banks was an additional 0.58 increase in ROA.

Similarly, there is evidence that differences in the evolution of ROE between the two groups can be attributed to the new institutional regime. The corresponding coefficient (β_3) is again positive and statistically significant at the 5% level. The introduction of the SSM causes an additional 0.93 increase in the expected mean effect of ROE for the treated banks.

A possible explanation for the positive effect of the SSM on profitability can be found in the way in which the directly supervised banks responded to its introduction. An improvement of the quality of the banks' lending portfolios and capital adequacy is positively related to bank profitability. Indications of such interactions are provided in the studies of Fiordelisi et al. (2017) and Demirguc-Kunt and Huizinga (1999). Finally, informed markets improved borrowing conditions to treated banks as transparency and credibility were enhanced.⁸

The control variables included allow us to control for the parallel trend assumption, which is necessary for valid statistical inference of the policy effect. These are also frequently used in the literature pertaining to the determinants of bank profitability (e.g. Molyneux and Thornton 1992; Berger and Hannan 1998; Demirguc-Kunt and Huizinga 1999, 2000; Athanasoglou et al. 2008; Kosmidou and Passiouras 2007; Dietrich and Wanzenried 2011; Barth et al. 2013; Tan 2016; Batten and Vo 2019). Their signs, when statistically different from zero, are in accordance with the findings of the relevant literature. In some cases, however, our results indicate that certain determinants of bank profitability are not statistically significant. This can be

⁸ ECB (2020)

attributed to the fact that we focus our analysis on the SSM and the years before and after its introduction (2013 and 2015), as this enables us to isolate further incidences that might have affected profitability.

4.2 Construction of the comparison group using matching according to bank size

In this section, we further examine the strength of our results by exploiting the effect of different comparison groups on the significance level of our estimates. For the construction of the comparison group we use as a threshold the minimum size of the banks of the treated group in the year before the introduction of the SSM (2013), and include in the comparison group only banks whose size is above this threshold.⁹ This data selection mechanism provides further support on the parallel trend assumption among the two groups, and in principle should provide additional evidence on the SSM effect on profitability.

Table 3 (columns 2 and 5) reports the difference-in-differences estimation for this sample. The results provide further support for a positive and significant effect on profitability after the establishment of the SSM. For ROA (column 2), our findings indicate that as we move from the period before (2013) to the period after (2015) the establishment of the SSM, there is a direct positive effect on the ROA of directly supervised banks, controlling for other determinants of profitability. The estimated coefficient of the policy variable indicates an additional 0.55 increase in ROA of the treated banks which can be attributed to the SSM implementation.

Similarly, there is evidence that the difference in the evolution of ROE (column 5) between the two groups gives rise to an additional 0.97 increase in the ROE of the treated banks due to the SSM. Comparing these estimates with our full sample results presented in section 4.1, shows that they are in agreement in terms of statistical significance and approximate level. Thus, further support for our main conclusion of the SSM effect on profitability is provided.

4.3 Construction of the comparison group using propensity score matching

As an additional evidence of the SSM effect on profitability we apply on our sample the propensity score matching method, aligned with the difference-in-

⁹ A similar approach in order to enhance group comparability has been applied in Blundell et al. (2004) using age as a threshold.

differences approach. This will allow us to enhance the comparability of the characteristics among the two groups and possibly provide more robust estimates. For the calculation of the propensity score we use all of the bank-specific variables included in this analysis for the year 2013, namely total assets, equity to total assets, cost to income ratio and the ratio of loan loss reserves to gross loans, following the approach presented in Stuart and Rubin (2007), according to which it is important for the matching process to include variables related to the treatment assignment and the outcome.

The quality of the matching is related to the number of potential controls available. Figure 3 depicts the density of the estimated probability of direct supervision for the full sample. We observe a rather wide overlap region throughout the range of propensity scores between the two groups, which provides a large pool of potential controls and therefore better matches.¹⁰ In Figure 4 we see a more balanced density of the estimated probability of participation for the matched samples when the dependent variable is ROA and ROE.

Table 3 (columns 3 and 6) reports the difference-in-differences estimation for the matched sample. The estimated coefficients reinforce the findings of our previous exercises. In particular, for the case of ROA (column 3) the estimated coefficient of the policy variable indicates that as we move from 2013 to 2015, the establishment of the SSM causes a statistically significant positive effect on the ROA of the directly supervised banks, controlling for other determinants of profitability. We observe a 0.77 increase in the effect of ROA for the treated banks, related with the introduction of the SSM. Similarly, for ROE (column 6) there is evidence of a positive and statistically significant effect. The estimated coefficient of the policy variable indicates a 1.24 increase in ROE for the treated banks of the matched sample.

In all cases examined, and for both measures of profitability (ROE and ROA), the effect of the SSM on profitability is positive and significant. Small differences among the magnitude of the effect across our exercises are observed, which do not alter our main conclusion. This can be verified further by the fact that all point estimates of each exercise lie inside the 95% confidence interval of each estimate.

¹⁰ Stuart and Rubin (2007).

4.4 The placebo test: changing the year of the implemented reform

This section completes the inspection of whether the underlying assumptions of the difference-in-differences estimation hold. The results of this part are obtained by estimating model (1) before the establishment of the SSM, treating 2013 as the year during which a fictitious event is supposed to have taken place. We can consider as a fictitious event, the possible anticipation of the SSM establishment for the treated banks. This would probably lead them to adjust their behavior (e.g. in management and/or lending activity) as a consequence of the forthcoming regime. As Table 4 reports, there is no evidence of statistically significant effects on ROA or ROE resulting from any event (fictitious or not) that took place as we focus on years 2012 to 2014. It seems that the treated banks' reaction to the announcement and preparation of the SSM implementation did not have a significant direct effect on profitability then. A possible explanation for this could be that changes in factors that affect profitability do not have an immediate impact on its evolution, something that reinforces our initial hypothesis that profitability would be affected by the SSM in an indirect way.

Similarly, for the cases of the matched sample based on the bank size (columns 2 and 5) and the matched sample according to the estimated propensity score (columns 3 and 6), the placebo test reveals no evidence of factors that could have affected profitability during the years prior to the SSM launch. This is a further indication that the evolution of the profitability of the two groups would have been the same in the absence of the examined reform, which makes the essential parallel trend assumption even more credible.

For a complete overview of the pre- and post-treatment period we include in our analysis the years that followed the introduction of the SSM, i.e. 2015-2017. Table 5 reports the year-by-year estimated effect of significant events on bank profitability during 2013-2017. Apparently, the only statistically significant policy effect that we are able to extract from this procedure is the effect of the SSM, in 2014. This result reinforces our assumption, according to which we expected an indirect effect on the profitability of the banks involved, during the period of the SSM introduction, an effect that gradually faded, making profitability less sensitive to changes in the banks' institutional environment. This could indicate that, after the rather unintended positive effect on profitability, the SSM rendered the profitability of European banks more

resilient to institutional changes. The policy variables of 2015 and 2016 could have captured the impact of other significant events (e.g. the quantitative easing in 2015, the introduction of the SRM in 2016). We see however, that the related estimated effects are not statistically significant. This result could indicate that after the establishment of the SSM, bank profitability is driven mostly by the banks' financial activities and is less affected by changes in their environment. Therefore, one can infer that institutional changes introduced by the SSM were beneficial for the stability of the performance of European financial sector.

4.5 Countries outside the European Monetary Union (EMU)

In this section we examine if there are other factors that could have affected the profitability of European banks in 2014, apart from the introduction of the SSM. To do so, we focus on banks located in European countries outside the EMU, for which it is optional to participate to this new institutional framework, and examine if there is a significant effect for these banks in 2014.

For the purpose of this falsification test we applied the aforementioned ECB selection criteria (see section 3.1) to a set of European banks not supervised by the SSM, in order to identify which of these banks would have been treated if the institutional reform was implemented in the countries they are located in. Thus, we ended up with two artificial groups, one of treated and one of untreated banks. The banks of this section are located in Bulgaria, Croatia, the Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the United Kingdom and the sample comprises 126 banks, of which 42 are in the treated group and 84 are in the comparison group. We focus on the year before (2013) and the year after (2015) the SSM introduction.

In Table 6 we see that there is no evidence of factors that could have affected the evolution of ROA and ROE of the treated banks differently in comparison to the untreated ones. As there is no indication of a statistically significant effect of the policy variable in 2014, our assumption that there are no other factors, that could have affected profitability but have not been accounted for, becomes more credible. Hence, this can be considered as further evidence that the significant and positive effect reported in sections 4.1-4.3 could be attributed to the establishment of the SSM.

4.6 Core and periphery fragmentation

For a more thorough examination of the observed positive effect that the introduction of the SSM had on bank profitability, we continue our analysis focusing on whether this effect concerns all treated banks or whether some are more affected than others. We investigate the existence of possible differences between banks located in core and periphery countries with respect to how they were affected by the policy change. One of the objectives of the European Union has been strengthening financial integration (Baele et al., 2004) and many of its initiatives aimed at promoting it. Nonetheless, financial fragmentation is still observed in different European markets and its level and implications have been examined in various studies (e.g. Anastasiou et al. 2019; Zaghini 2016; Mayordomo et al. 2015; Bijsterbosch and Falagiarda 2015; Ehrmann and Fratzscher 2015). The reason why this part of the current study is a matter of interest is because it will indicate if the implementation of SSM, which was a step towards a more integrated EU financial sector, affected the countries involved in a differentiated way.

For the categorization into the groups of core and periphery countries we followed the European Commission's identification of distinct groups of EU Member States, with respect to their levels of NPLs, as presented in Magnus et al. (2017). The group of core countries is composed of Austria, Belgium, Estonia, Germany, Finland, France, Netherlands and Slovakia and the group of periphery countries is composed of Cyprus, Greece, Ireland, Italy, Malta, Portugal, Slovenia and Spain.

A dummy variable "core" is added which takes the value 1 if a bank is located in a euro area core country and 0 otherwise. Our aim is to create, within the group of treated banks, a comparison between the effect of the SSM on treated banks located in core countries and treated banks located in periphery countries. This leads us to a three-group comparison, i.e. untreated banks, treated banks located in core countries, treated banks located in periphery countries.

In Table 7 we see the estimated effect of the SSM on the evolution of profitability for banks located in core and periphery countries, represented by the variables $post_t \times treated_{i_{core}}$ and $post_t \times treated_{i_{periphery}}$ respectively. As we see, the estimated effect is positive and significant only for treated banks located in periphery countries, both for ROA and ROE. The effect of the SSM on treated banks

located in the core countries is smaller and not statistically significant, which indicates that the positive effect of the SSM on the treated banks was less apparent in the core countries. The different way in which the introduction of the SSM affected the profitability of banks located in core and periphery countries may imply that the SSM reduced fragmentation between core and periphery, as it enhances the profitability of periphery banks which are the weaker ones and the ones most affected by the crisis. This may happen because banks in the periphery enjoy lower borrowing cost as markets understand the institutional improvements. Another reason could be that banks in the periphery have improved their loan portfolios and lending behavior according to the new supervisory standards.

5. Concluding remarks

The introduction of the SSM in 2014, as the first pillar of the European Banking Union, shifted banking supervision from the national level to the ECB. As with every institutional change, it poses the question of other implications that could possibly arise, besides its main objectives. In this paper we examined how the SSM affected the performance of the banks which fell within the remit of the new supervisory regime. Focusing on profitability, for our empirical examination we employed the difference-in-differences estimation and for the assessment of our results we conducted a series of robustness tests. We used two alternative profitability indicators, ROA and ROE, and along with the full sample of banks, we examined a sample resulting from matching according to bank size and a sample constructed using propensity score matching, in order to ensure that our results are not affected by the ECB selection criteria. Two additional tests, one focusing on the pre- and post-treatment periods and the other on the non-EMU banks, further support our conclusions.

The main findings of this study supported by the robustness test performed provide evidence that the SSM had a positive effect on the profitability of the directly supervised banks. As we extended our analysis, we found indications of the existence of differentiation regarding the intensity of the positive effect of the SSM introduction in core and periphery countries. According to these results, banks located in periphery countries were more intensely affected by the SSM in comparison to banks located in

core countries, a finding that supports another unintended consequence of the SSM, which is the reduction of fragmentation.

Although profitability was not among the main objectives of the SSM, the emergence of unintentional implications after an institutional restructuring is not an unusual phenomenon. Our study highlights a positive effect, which further justifies the role of the SSM as far as efficiency and stability of the EU financial sector is concerned. In addition, the stronger effect on periphery banks indicates an improvement in financial integration and provides information to be considered by regulators while developing the steps towards the completion of the Banking Union.

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Table 1
Variables used in the models for profitability

| Variable | Definition | Source |
|--------------|---|---|
| ROA | Return on assets | BankFocus |
| ROE | Return on equity | BankFocus |
| ta | Total assets (ln) | BankFocus |
| eqta | Equity to total assets | BankFocus |
| llrgl | Loan loss reserves to gross loans | BankFocus |
| cinc | Cost to income ratio | BankFocus |
| growth | Growth rate of real GDP | AMECO |
| prft | Profit tax | World Development Indicators of the World Bank |
| hhi | Herfindahl-Hirschman Index | ECB Statistical Data Warehouse |
| ge | Government effectiveness | Worldwide Governance Indicators of the World Bank |
| post | Dummy variable which indicates the period before and after the establishment of SSM (post=0 and post=1 respectively) | ECB |
| treated | Dummy variable which indicates whether a bank is directly supervised or not (treated=1 and treated=0 respectively) | ECB |
| post×treated | Dummy variable which takes the value 1 for the case of a treated bank after the introduction of the SSM and 0 otherwise | |

Table 2
Summary statistics

| Variable | mean | std. dev. | min | max |
|----------|-----------|-----------|---------|----------|
| ROA | 0.19295 | 1.192709 | -13.52 | 8.91 |
| ROE | 2.381299 | 27.73761 | -596.31 | 341.17 |
| ta | 1.14e+08 | 3.01e+08 | 31845 | 2.16e+09 |
| eqta | 8.099223 | 4.536898 | -3.93 | 54.86 |
| llrgl | 4.280829 | 4.876432 | 0 | 36.4 |
| cinc | 70.71019 | 27.19356 | 11.12 | 587.41 |
| growth | 1.140711 | 2.180055 | -9.12 | 25.08 |
| prft | 17.65525 | 6.982324 | -0.2 | 32.4 |
| hhi | 0.0726864 | 0.065221 | 0.025 | 0.388 |
| ge | 84.03052 | 11.27828 | 62.5 | 100 |

Table 3
Difference-in-differences estimation
Threshold year: 2014 (SSM introduction)

| Variables | ROA | | | ROE | | |
|--------------|----------------------|-----------------------|-----------------------------------|---------------------|-----------------------|-----------------------------------|
| | Full sample | Matched sample (size) | Matched sample (propensity score) | Full sample | Matched sample (size) | Matched sample (propensity score) |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| post×treated | 0.579* (0.296) | 0.549** (0.260) | 0.770* (0.397) | 0.930** (0.447) | 0.976*** (0.368) | 1.241** (0.615) |
| post | -0.050 (0.263) | 0.016 (0.253) | -0.226 (0.487) | -0.065 (0.409) | 0.171 (0.386) | -0.195 (0.795) |
| treated | -0.233 (0.251) | -0.345 (0.213) | -0.146 (0.287) | -0.483 (0.423) | -0.849** (0.360) | -0.661 (0.506) |
| ta | 0.012 (0.040) | 0.005 (0.044) | 0.055 (0.066) | 0.034 (0.060) | 0.061 (0.072) | 0.077 (0.110) |
| eqta | 0.036 (0.023) | 0.074* (0.038) | 0.118*** (0.044) | 0.020 (0.028) | 0.052 (0.059) | 0.069 (0.076) |
| llrgl | -0.038 (0.033) | 0.008 (0.032) | 0.012 (0.055) | -0.076 (0.052) | 0.006 (0.046) | -0.020 (0.088) |
| cinc | -0.016 (0.694) | -0.901** (0.349) | -1.105 (0.693) | -0.040 (0.997) | -1.489*** (0.567) | -2.060* (1.154) |
| growth | 0.302** (0.153) | 0.208 (0.156) | 0.266 (0.218) | 0.374* (0.214) | 0.180 (0.195) | 0.249 (0.292) |
| hhi | -0.594*** (0.193) | -0.548** (0.234) | -0.781*** (0.288) | -0.532* (0.317) | -0.500 (0.370) | -0.585 (0.456) |
| prft | -0.030* (0.0169) | -0.023 (0.019) | -0.019 (0.022) | -0.058** (0.026) | -0.046 (0.029) | -0.058 (0.037) |
| ge | -0.303*** (0.107) | -0.273** (0.113) | -0.281* (0.150) | -0.407** (0.183) | -0.397** (0.196) | -0.384 (0.262) |
| Constant | 30.84*** (9.924) | 28.09*** (10.34) | 28.20** (13.48) | 40.70** (16.87) | 39.39** (17.92) | 38.70 (23.40) |
| Sample size | 482 | 344 | 226 | 482 | 344 | 226 |
| \bar{R}^2 | 0.393 | 0.496 | 0.449 | 0.336 | 0.388 | 0.303 |

Note: Standard errors adjusted for clustering by bank in parentheses.

Statistical significance: *, ** and *** at the 10%, 5% and 1% level respectively.

Table 4
Difference-in-differences estimation

| Variables | Threshold year: 2013 (Placebo test) | | | | | |
|--------------|-------------------------------------|-----------------------|-----------------------------------|--------------------|-----------------------|-----------------------------------|
| | ROA | | | ROE | | |
| | Full sample | Matched sample (size) | Matched sample (propensity score) | Full sample | Matched sample (size) | Matched sample (propensity score) |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| post×treated | -0.177 (0.323) | -0.219 (0.345) | -0.772 (0.566) | -1.878 (1.377) | -2.031 (1.548) | -4.251 (2.583) |
| post | 0.316 (0.341) | 0.299 (0.429) | 0.325 (0.495) | 1.691 (1.135) | 2.069 (1.637) | 2.778 (1.975) |
| treated | 0.551* (0.331) | 0.471 (0.389) | 0.952* (0.541) | 2.969 (1.864) | 3.380 (2.310) | 5.202 (3.214) |
| ta | -0.127*** (0.042) | -0.112** (0.057) | -0.111** (0.053) | -0.384* (0.207) | -0.556 (0.356) | -0.551 (0.375) |
| eqta | 0.002 (0.020) | 0.031 (0.027) | 0.096*** (0.034) | -0.042 (0.033) | 0.035 (0.094) | 0.135 (0.120) |
| llrgl | -0.031 (0.032) | -0.026 (0.029) | -0.055 (0.041) | -0.045 (0.056) | -0.074 (0.074) | -0.055 (0.0768) |
| cinc | 0.004 (0.355) | 0.139 (0.244) | 0.484** (0.208) | 0.158 (0.502) | 0.358 (0.549) | 0.581 (0.469) |
| growth | 0.056 (0.142) | 0.052 (0.168) | -0.117 (0.176) | 0.230 (0.403) | 0.365 (0.545) | -0.129 (0.524) |
| hhi | 0.154 (0.147) | 0.104 (0.165) | 0.193 (0.189) | 0.614 (0.394) | 0.567 (0.465) | 0.748 (0.521) |
| prft | 0.111* (0.060) | 0.125** (0.063) | 0.145** (0.068) | 0.490* (0.277) | 0.517* (0.291) | 0.576* (0.312) |
| ge | -0.055 (0.052) | -0.066 (0.061) | 0.0504 (0.076) | -0.225 (0.140) | -0.318 (0.210) | -0.030 (0.243) |
| Constant | 4.922 (4.982) | 5.428 (5.373) | -6.724 (7.334) | 16.12 (13.01) | 26.40 (18.35) | -3.735 (22.94) |
| Sample size | 450 | 328 | 198 | 450 | 328 | 198 |
| \bar{R}^2 | 0.365 | 0.346 | 0.450 | 0.230 | 0.200 | 0.209 |

Note: Standard errors adjusted for clustering by bank in parentheses.

Statistical significance: *, ** and *** at the 10%, 5% and 1% level respectively.

Table 5
Year-by-year estimates

| Variables | ROA | | | ROE | | |
|---|-------------------|-----------------------|-----------------------------------|--------------------|-----------------------|-----------------------------------|
| | Full sample | Matched sample (size) | Matched sample (propensity score) | Full sample | Matched sample (size) | Matched sample (propensity score) |
| Threshold year: 2013 (Placebo test) | | | | | | |
| post×treated | -0.177 (0.323) | -0.219 (0.345) | -0.772 (0.566) | -1.878 (1.377) | -2.031 (1.548) | -4.251 (2.583) |
| Sample size | 450 | 328 | 198 | 450 | 328 | 198 |
| \bar{R}^2 | 0.365 | 0.346 | 0.450 | 0.230 | 0.200 | 0.209 |
| Threshold year: 2014 (SSM Introduction) | | | | | | |
| post×treated | 0.579* (0.296) | 0.549** (0.260) | 0.770* (0.397) | 0.930** (0.447) | 0.976*** (0.368) | 1.241** (0.615) |
| Sample size | 482 | 344 | 226 | 482 | 344 | 226 |
| \bar{R}^2 | 0.393 | 0.496 | 0.294 | 0.336 | 0.388 | 0.303 |
| Threshold year: 2015 | | | | | | |
| post×treated | -0.175 (0.111) | -0.123 (0.115) | -0.212 (0.228) | -0.001 (0.152) | -0.018 (0.163) | -0.140 (0.224) |
| Sample size | 688 | 568 | 258 | 688 | 568 | 258 |
| \bar{R}^2 | 0.262 | 0.208 | 0.258 | 0.122 | 0.175 | 0.153 |
| Threshold year: 2016 | | | | | | |
| post×treated | -0.093 (0.135) | -0.186 (0.145) | 0.055 (0.141) | -0.184 (0.160) | -0.262 (0.178) | -0.030 (0.190) |
| Sample size | 688 | 568 | 272 | 688 | 568 | 272 |
| \bar{R}^2 | 0.234 | 0.263 | 0.567 | 0.133 | 0.151 | 0.177 |

Note: Standard errors adjusted for clustering by bank in parentheses.

Statistical significance: *, ** and *** at the 10%, 5% and 1% level respectively.

Table 6
Difference-in-differences estimation: non-EMU countries

| Variables | Threshold year: 2014 (SSM Introduction) | | | | | |
|--------------|---|-----------------------|-----------------------------------|----------------------|-----------------------|-----------------------------------|
| | ROA | | | ROE | | |
| | Full sample | Matched sample (size) | Matched sample (propensity score) | Full sample | Matched sample (size) | Matched sample (propensity score) |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| post×treated | -0.173 (0.412) | -0.073 (0.319) | -0.505 (1.094) | 0.198 (0.442) | -0.181 (0.369) | -0.576 (1.150) |
| post | 0.417 (0.651) | -0.496 (0.459) | 0.159 (1.475) | 0.032 (0.801) | -0.736 (0.619) | -0.262 (1.681) |
| treated | 0.621 (0.569) | 0.358 (0.509) | 0.405 (1.186) | 0.189 (0.733) | 0.119 (0.632) | 0.427 (1.281) |
| ta | -0.151 (0.116) | -0.081 (0.114) | 0.472 (0.427) | -0.195 (0.140) | -0.123 (0.162) | 0.273 (0.513) |
| eqta | 0.0401 (0.041) | 0.154*** (0.044) | 0.037 (0.090) | -0.037 (0.034) | 0.077 (0.068) | -0.018 (0.110) |
| llrgl | -0.052 (0.062) | -0.116* (0.061) | -0.097 (0.139) | 0.001 (0.075) | -0.168** (0.077) | -0.150 (0.155) |
| cinc | -1.377*** (0.300) | -0.758** (0.319) | -2.249*** (0.561) | -1.021*** (0.377) | -1.641** (0.634) | -3.912*** (0.847) |
| growth | 0.041 (0.254) | 0.284 (0.172) | 0.183 (0.247) | 0.093 (0.351) | 0.414** (0.202) | 0.291 (0.311) |
| hhi | -0.448 (0.347) | -0.169 (0.318) | -0.382 (0.575) | -0.283 (0.380) | -0.186 (0.387) | -0.145 (0.621) |
| prft | 0.018 (0.363) | -0.060 (0.285) | -0.281 (0.416) | 0.123 (0.443) | -0.250 (0.335) | -0.718 (0.475) |
| ge | -0.090 (0.063) | 0.111* (0.063) | 0.060 (0.149) | -0.098 (0.066) | 0.104 (0.067) | 0.104 (0.148) |
| Constant | 11.78*** (4.285) | -2.815 (3.639) | -3.581 (10.23) | 12.16** (5.133) | 1.146 (5.608) | -1.084 (12.62) |
| Sample size | 252 | 124 | 72 | 252 | 124 | 72 |
| \bar{R}^2 | 0.214 | 0.489 | 0.374 | 0.041 | 0.425 | 0.375 |

Note: Standard errors adjusted for clustering by bank in parentheses.

Statistical significance: *, ** and *** at the 10%, 5% and 1% level respectively.

Table 7
Difference-in-differences estimation: banks located in core and periphery countries
Threshold year: 2014 (SSM Introduction)

| Variables | ROA | | | ROE | | |
|-----------------------------------|----------------------|-----------------------|-----------------------------------|---------------------|-----------------------|-----------------------------------|
| | Full sample | Matched sample (size) | Matched sample (propensity score) | Full sample | Matched sample (size) | Matched sample (propensity score) |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| post×treated _{periphery} | 1.684** (0.655) | 1.832*** (0.598) | 2.206*** (0.668) | 2.318** (0.988) | 2.900*** (0.835) | 3.247*** (0.991) |
| post×treated _{core} | -0.078 (0.189) | -0.095 (0.193) | -0.006 (0.332) | 0.107 (0.371) | 0.011 (0.381) | 0.151 (0.622) |
| post | 0.288 (0.236) | 0.423** (0.209) | 0.402 (0.425) | 0.359 (0.442) | 0.782* (0.404) | 0.691 (0.785) |
| ta | 0.011 (0.039) | 0.0006 (0.040) | 0.062 (0.066) | 0.033 (0.059) | 0.054 (0.067) | 0.090 (0.110) |
| eqta | 0.035 (0.022) | 0.085** (0.037) | 0.120*** (0.044) | 0.019 (0.027) | 0.068 (0.056) | 0.075 (0.075) |
| llrgl | -0.045 (0.032) | -0.003 (0.029) | 0.004 (0.056) | -0.084* (0.051) | -0.010 (0.040) | -0.029 (0.084) |
| cinc | -0.033 (0.736) | -0.934*** (0.318) | -1.424* (0.743) | -0.06 (1.061) | -1.541*** (0.530) | -2.520** (1.214) |
| growth | 0.148 (0.145) | 0.003 (0.117) | -0.044 (0.208) | 0.180 (0.237) | -0.128 (0.178) | -0.187 (0.304) |
| hhi | -0.620*** (0.182) | -0.613*** (0.230) | -0.780*** (0.261) | -0.563* (0.304) | -0.598* (0.355) | -0.589 (0.420) |
| prft | -0.045** (0.021) | -0.035 (0.022) | -0.030 (0.023) | -0.076** (0.031) | -0.064** (0.031) | -0.073** (0.037) |
| ge | -0.285*** (0.098) | -0.242** (0.098) | -0.232* (0.126) | -0.385** (0.172) | -0.350** (0.172) | -0.315 (0.223) |
| Constant | 29.55*** (9.093) | 25.61*** (9.067) | 23.91** (11.52) | 39.08** (15.96) | 35.68** (15.92) | 32.48 (20.21) |
| Sample size | 482 | 344 | 226 | 482 | 344 | 226 |
| \bar{R}^2 | 0.563 | 0.819 | 0.749 | 0.551 | 0.672 | 0.605 |

Note: Standard errors adjusted for clustering by bank in parentheses.

Statistical significance: *, ** and *** at the 10%, 5% and 1% level respectively

Figure 1
Average ROA and average ROE before the SSM introduction

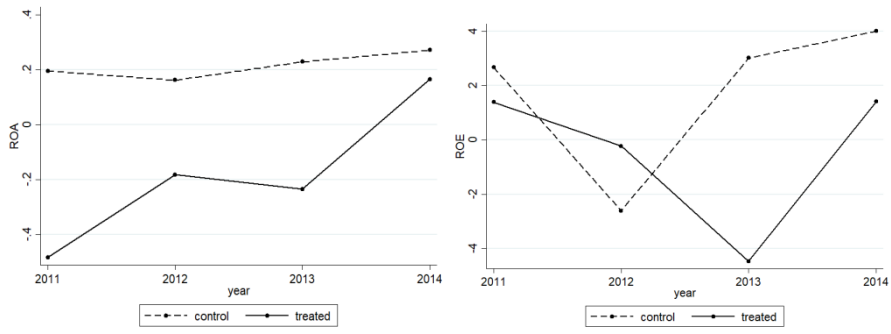


Figure 2
Change in average ROA and average ROE conditional on bank characteristics and macroeconomic variables

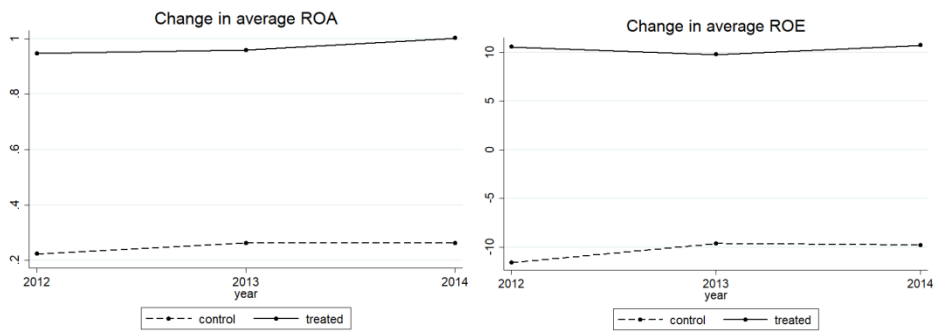


Figure 3
Propensity score for the full sample

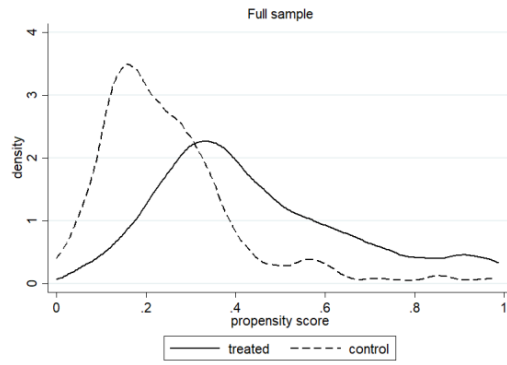


Figure 4
Propensity score for the matched samples based on all of the bank specific variables

