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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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The Single Supervisory Mechanism: competitive implications for the banking sectors in the euro area*

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Abstract

This paper investigates the impact of the SSM's launch on the market power of banks in the large euro area economies. We employ the Lerner index and the Boone estimator, non-structural measures that capture different aspects of competition. Using the results of the Lerner index, we find evidence of the significant decrease in market power for the ECB supervised entities in Austria, France, Germany and Spain. In a similar vein, the Boone indicator points toward an increase in competition among significant supervised entities of Austria, France, Germany, Italy and Spain. The evidence on changes for the total banking sector are mixed, whereas no significant effect is found for the banks remaining under national supervision. We do not find any support for significant increases in the market power of banks in Italy or Spain, suggesting that large increases in concentration do not necessarily result in anticompetitive conduct.

Keywords: Banking, SSM, competition, market structure, concentration, Lerner index, Boone indicator.
JEL classifications: G21, G28, L1.

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1. Introduction

The Financial Crisis of 2008 revealed that the Monetary Union is inevitably subject to a financial trilemma: financial stability, financial integration and national supervision cannot be simultaneously nurtured. National policies are solely aimed at maximizing their own welfare without taking full account of negative externalities for other countries in the monetary union, allowing systemic risk build-ups and fragmentation of financial intermediation across national borders. The primary goal of the Single Supervisory Mechanism (SSM) in this respect is ensuring soundness of the aggregate financial sector via uniform regulatory supervision at the euro area level that serves the interests of the monetary union as a whole (Constâncio, 2014a). One of the key facets that such uniform supervision entails is a level playing field with diminished barriers to competition, where credit institutions across various jurisdictions have an equal opportunity to compete. This stems from a reduction in the costs of compliance by making regulatory practices and standards more uniform and consistent across countries (Tröger, 2013; Constâncio, 2014a).

The topic of competition in the European banking sector is of particular importance, as a number of studies report a continuously increasing pattern in the extent of market power, which after the set-back of the global crisis has resumed its growth (Brissimis *et al*. 2014; De Guevara and Maudos, 2017). Ensuring competition is crucial from a welfare perspective due to the pressure it ensues for the prices and quality of the products and services offered (Cetorelli, 2001). Competition promotes efficient production and allocation of financial services, induces innovation, and has a direct effect on accessibility of finance and thereby economic growth (Liu *et al*., 2013). An equally crucial aspect is the facilitating role that competition plays in the transmission of monetary policy, where the policy rates are incorporated faster in the pricing decision of banks in terms of interest charged (Van Leuvensteijn *et al*., 2011). Most importantly, an increase in market power of banks might have implications for financial stability, where higher lending rates can induce risk-taking on the side of the borrowers, in turn making them more vulnerable (ECB, 2017).

As such, this study aims to answer whether the launch of the SSM has significantly affected competition in the banking sectors of five major euro area economies: Austria, France, Germany, Italy and Spain. Our work is the first to empirically quantify changes in the competitive behaviour of euro area banks under uniform supervision. We begin the discussion by examining concentration patterns to identify increases in concentration that might facilitate uncompetitive conduct. While the SSM should promote competition, it equally may serve as a trigger for a consolidation wave in the sector characterized by excess capacity (Constâncio, 2014a), possibly implying a deterioration in the extent of competition. We proceed with the empirical analysis to answer whether significant changes in the competition during two years of the SSM are evident, as compared to two prior years.

To this end, we use the widely-adopted Lerner index of market power and a relatively novel Boone indicator[1] that each capture a different aspect of competitive conduct (Bikker and Van Leuvensteijn, 2015; Leon, 2015).

Secondly, we recognize that the semi-complete nature of supervision, where only significant entities are under direct oversight of the ECB, with the remaining banks delegated to national authorities, suggests that the market power of two bank groups might have changed differently since the launch of the SSM. The ECB can be perceived as a more invasive and rigorous supervisor by the significant banks and induce them to change their behaviour, while no such changes might be observed for the institutions still under a national supervisory authority (Fiordelisi *et al*., 2017). In addition, bank groups might differ in the extent of market power prior to the SSM due to the differences in the clientele and nature of operations (Schoenmaker, 2015a). Thus, we separately quantify the changes in competitive levels for the significant and less significant groups within a banking sector. To our knowledge, this is the first study that looks at the competition in the sub-markets, borders of which are defined in terms of type of supervision.

On the basis of the empirical analysis both indicators point towards a significant decrease in the market power of the ECB-supervised institutions after the commencement of the SSM, as compared to two previous years. Such results are robust to the alternative specification involving balanced panel analysis in the case of the Boone indicator. The all banks sample results and the results of the nationally supervised group are rather mixed.

The rest of this paper is organized as follows: Section 2 provides a literature overview. Section 3 describes empirical methodology. Section 4 exhibits the data input, followed by discussion in Section 5, a robustness check in Section 6 and concluding remarks in Section 7.

2. Literature review

2.1 Essence of the Single Supervisory Mechanism, contribution and hypotheses

A large number of papers focus on the impact of regulation on the behaviour of banks. Some of the areas these papers focus on are, to name a few: lending, risk-taking, issues of equity and competition (Fiordelisi *et al*., 2017). With respect to competition, Calderon and Schaeck (2016) show that liquidity provision, nationalization and recapitalization do not have adverse effects on competition, contrary to the scepticism of policymakers. Yet,

[1] This index has become known as the Boone indicator (Boone 2001, 2008), though Hay and Liu (1996) introduced this approach much earlier.

only a few papers empirically investigate alterations in bank behaviour due to changes in the type of supervision, particularly in the case of the recent establishment of the Single Supervisory Mechanism (Fiordelisi *et al*., 2017). The SSM represents a first pillar of the Banking Union, a major alteration to the regulatory infrastructure of the euro area, necessitated by a need to maintain financial soundness. Due to high degree of interconnectedness, nationally-fragmented supervision inevitably leads to the fallacy of composition: making individual country's financial sectors resilient leads to a suboptimal outcome for the euro area banking sector as a whole. To this end, the Single Supervisory Mechanism (SSM) was launched on 4 November 2014 to provide uniform and consistent supervision at euro area level, not subject to national interests, with the ECB's Single Supervisory Board having primary responsibility to ensure homogeneity of supervisory oversight (Constâncio, 2014a).

The SSM is grounded in a dual supervisory system that is largely based on the close cooperation and exchange of information between the ECB and the euro area national supervisory authorities. The ECB directly oversees banks that are classified as significant in terms of size, importance or cross-border activity. As such, the three largest credit institutions in a state, as well as banks with assets exceeding €30 billion, or a total assets to a GDP ratio above 20%, with significant cross-border assets or liabilities, and those designated by national authorities as significant are under ECB's direct oversight. The remaining credit institutions are supervised by national authorities that act on behalf of the ECB and systematically report on their performance in implementing its guidelines, with the ECB having considerable powers to influence regulatory conduct and request additional information. The dual set-up is motivated by the constrained ability of one regulator to monitor in excess of 6,000 credit institutions and heterogeneity in terms of language, legal, tax and accounting technicalities (Ferrarini, 2015; Tröger, 2013).

Among the empirical literature focusing on the SSM, a number of papers examine changes in bank behaviour in the run-up to implementation of uniform supervision. These comprise studies looking at stock market reactions to the results of the Comprehensive Assessment (CA) published on 26 October 2014. The CA represents a key step in the SSM's preparation for determining optimal capital levels and defining appropriate harmonized regulatory approach, addressed through asset quality review and stress test analysis of a selection of banks (Barucci *et al*., 2018).[2] In this respect, the Bank of Italy (2014) reports that banks facing higher capital requirements, after publication of the results, have experienced substantial losses in their share prices due to the dilution effect of such strengthened requirements, whereas Sahin and De Haan (2015) find limited reaction to

[2] Bank groups included in the CA are identical to those characterized as significant on the September 4, 2014 list, with the exception of a few banks that have been excluded and replaced with other credit institutions.

the publication of results. Carboni *et al*. (2017) consider market reaction to not only results, but also the announcement of the CA review on 23 October 2013, as well as the launch of the SSM itself on 4 November 2014. They show that banks subject to direct supranational supervision are penalized compared to nationally supervised peers on all of the dates considered. The authors attribute such a reaction to investor expectations of a more invasive attitude from the ECB.

Another stream of the literature focuses on accounting data, equally in the run-up to the SSM's implementation. Fiordelisi *et al*. (2017) show that significant banks expecting to be under direct ECB supervision reduced the amount of loans granted, and improved the quality of loans in the 2013-2014 period to a larger extent than less significant groups. As such, banks regarded national supervisors to be more lenient than the ECB and adjusted correspondingly, as no such differences between two groups are evident in years prior to 2013 or for banks outside the EMU.[3] Galema and Koetter (2016) find significant supervised entities (SSE), as defined by the latest available list in 2015, to be less cost and profit efficient over the 2004-2013 period. Thus, larger banks that fall under ECB supervision are characterized by lower efficiency. By examining changes in the composition of significant banks from 2013 to 2015, authors additionally conclude that in the transition phase towards a harmonized regulatory approach, such inefficiency might be partially attributed to supplementary administrative burden.

Steinkamp *et al*. (2017) are to our knowledge the first to incorporate a *post factum* perspective on the effectiveness of the SSM. They use both survey results and balance sheet data to construct an evergreening index that is increasing with the excess of existing loans over new loans. The evidence shows that countries in the euro area are more likely to exhibit evergreening, defined as a roll-over of bad loans by banks. This is largely due to NCB incentives to provide assistance to domestic banks in exchange for collateral on non-performing loans (NPLs), in such a way that potential loan losses are transferred to the ECB, and costs are shifted to other countries. Survey evidence from 2017 indicates that 40% of financial and economic experts perceive supervisory reform to be ineffective in eliminating a common pool problem (or perhaps even to exacerbate the problem). Thus, while the majority of experts believe that creating the SSM has reduced the problem, loopholes are still in place, such as the discretion of NCBs to determine eligible collateral.

[3] Fiordelisi *et al.* (2017) use the ECB selection criteria to identify what significant groups would have been in Bulgaria, Croatia, the Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the United Kingdom. These significant groups are consequently compared with LSSE in the same manner as for EMU.

In this study, we add to the scarce research on the effectiveness of the SSM, with a particular focus on the market power of banks in the major EMU economies. According to the ECB, a shift to uniform supervision should put banks on an equal legal footing and reduce their compliance costs (Constâncio, 2014a). On the one hand, such a level playing field might intensify competition and promote a more efficient capital allocation due to erosion of national regulatory barriers (Ferrarini, 2015; Cruz-García *et al*., 2017). Small and medium-sized enterprises that do not have access to alternative means of funding should be key beneficiaries of such defragmentation, which incentivizes more lending (Constâncio, 2014b). On the other hand, it may induce a consolidation wave that will eliminate excess capacity and mitigate poor earnings patterns (Constâncio, 2014a). The latter development, in terms of increasing bank sizes, might enhance market power, possibly signifying an unfavourable effect in terms of consumer welfare and financial stability. Thus, any competitive effect is ex ante unknown and should be empirically quantified.

Nevertheless, despite a clear goal for transition towards a more uniform oversight, a number of researchers have expressed concerns regarding the true uniformity of supervision inherent in the dual system. The SSM framework might not provide sufficient incentives for adequate provision of supervisory effort due to principal-agent problem (Schoenmaker, 2015). Equally, the ECB does not possess resources to be able to monitor effectiveness of execution at the national level (Tröger, 2013). Whereas monetary policy has been completely assigned to the single institution, the semi-complete nature of SSM supervision at national level leaves room for shirking. In a similar vein, Agarwal *et al*. (2014) show that federal supervisors in the US are stricter than state regulators and this results in banks altering their behaviour depending on the supervisor assigned. This argument is consistent with the findings of Carboni *et al*. (2017) and Fiordelisi *et al*. (2017) that market participants and banks perceived the ECB as a more invasive supervisor, resulting in a corresponding change in the behaviour of banks. Thus, two effects can be identified within the set-up of the SSM. Namely, for all EMU banks establishment of the SSM represents novel, uniform, stricter supervisory standards and guidelines, while for significant institutions there is an additional effect in the form of a change in the direct supervisor. As such, the characteristics of a new supervisory regime are likely to affect significant banks more. This is also due to the fact that supervisory resources are directed to a larger extent to those banks that pose the greatest risk under the new SSM framework (Deloitte, 2014). We cannot extract this additional effect of change in the assigned supervisor in the same way as Fiordelisi *et al*. (2017), as this requires the

application of the difference-in-difference estimator, which is very restrictive in its assumptions.[4] As such, we consider changes in the behaviour of all banks, as well as significant and less significant group in isolation. Yet, we keep in mind that two effects are at play for the significant group.

Furthermore, looking at the individual bank groups is crucial not only due to dissimilarity of effect, but equally owing to inherently different competitive dynamics of both groups. Significant institutions may exhibit competitive patterns different to those of less significant supervised entities (LSSE) not only after the SSM launch, but also before. Such a divergence stems from the possible differences in the client base and product range offered. Competition itself can be perceived as an outcome of interaction of banks with their clients and with each other. Schoenmaker (2015a) shows that, on aggregate, banks in the EMU had a reasonably small share of assets from other EU countries of 14% and only 3% from the third counties in the fiscal year ended in 2013, while the top 20 largest banks had 11% of their assets from other EU countries and a much larger share of 16% from the rest of the world. Thus, the largest banks are more internationally oriented. Correspondingly, European multinational corporations, that have a lot of flexibility in selecting funding sources within the Banking Union and outside, will likely favour such credit institutions with international presence and a wider product range (Schoenmaker, 2015a). In contrast, Degryse and Ongena (2004) show that provision of credit to SMEs is described by segmentation along national lines as it requires knowledge of local market to be able to accurately assess the risk of smaller firms. Households are also likely to display a home bias, regarding domestic banks as the only entity to which they can entrust their funds (Schoenmaker, 2015a). Consequently, smaller banks are likely to have a client base comprised to a larger extent of local customers and businesses.

Taking all aforementioned arguments into account, in this study we examine competitive behaviour of all banks, as well as significant and less significant group in isolation, in the two years after the establishment of SSM. We consider changes on a country basis. A country-by-country approach is motivated by heterogeneity of supervisory culture in the EMU member states prior to the SSM. As such, a shift to common euro area culture

[4] The difference-in-difference estimator demands both bank groups (significant and less significant) to meet a parallel trend in evolution of competition prior to the SSM establishment, to be able to reliably attribute the subsequent deviation from such common trend (for significant banks) to the change in the supervisor. However, the measures of competition at bank level are too volatile for this condition to be fulfilled. We have considered a small remaining subsample of significant and less significant institutions for which a full time series of 6 years (2011-2016) is available in computing the average growth rate of the Lerner index. However, the difference in average Lerner growth between two groups before the SSM was not constant, but rather highly volatile, with one group exhibiting an increase in market power, while for the other a sharp decrease was evident. This implies that applying a difference-in-difference estimator would have yielded misleading results, as the parallel trend assumption is crucial for reliability of inferences based on this estimator.

can present a distinct transition for individual states, with the change being more intrusive in some countries than the others, a difference not evident in a pooled regression. At the same time, we recognize that significant institutions (and possibly also some LSSEs) from different EU Member States might be in direct competition with each other and additionally inquire into the competitive changes for the *aggregat*e of the five EU countries we investigate, from here on called: EU-5.

We argue that despite the fact that large, cross-border groups have been reasonably certain they will fall under the direct supervision since the announcement of the CA, the exact composition of bank subsidiaries is not yet clear. Similarly, a number of other groups has not been included in the CA but nevertheless can be found on a list of SSEs. Thus, the actual ECB supervisory oversight was not known until 4 September 2014, when the ECB published a final list of the institutions. Respectively, due to a publication close to the fiscal year end and delay before the actual implementation, we assume that the resulting changes in the competitive behaviour would only be evident in annual reports of 2015 at the earliest. It is important to note that even if certain banks started to adjust their behaviour in the beginning of 2013, shortly after the Economic and Financial Affairs Council established criteria for significant banks in December 2012, both Fiordelisi *et al*. (2017) and Carboni *et al*. (2017) argue that consequences should be evident only in the medium to long-run, which makes 2015-2016 a relevant time span, where medium run effects should have already materialized.

2.2 Competition in the European banking sector

In order to choose a relevant measure of competition, this section considers for various approaches their qualities and shortcomings. Key findings with respect to the development of competition in the European banking sector over time are complementing this discussion.

Measures of competition can be decomposed into those derived from the structural approach and those that adopt a non-structural path (De Guevara and Maudos, 2017). The most crucial insight of the structural approach is the facilitating role that increased market concentration serves, tacit collusion and uncompetitive behaviour. Thus, the extent of market power can be inferred from the market structure. The two prevailing indices to quantify the market structure are the Herfindahl-Hirschman index (HHI), a sum of squared market shares of all credit institutions, and the k-firm concentration ratio, the aggregate market share of the k largest firms (Bikker and Haaf, 2002). Both have very few data requirements and can be based on the market share defined in terms of total assets (Leon, 2015). Among the most recent studies, De Guevara and Maudos (2017) and IJtsma *et al*. (2017) use ECB's 'Structural financial indicators' database that reports the HHI index and the 5-firm concentration ratio. IJtsma *et al*. (2017) show an increasing market concentration over the period 1998-2014 for

Germany, Italy, Spain and the UK, based on both indexes, but no rise for France. De Guevara and Maudos (2017) conclude that concentration is negatively related to the size of the country and exhibits a considerable variation in EU-15. For the EU-15 as a whole, an increase of 5% to 10% can be inferred since the beginning of the crisis, depending on the concentration measure.

Despite wide application, concentration indices are subject to substantial shortcomings as measures of competition (De Jonghe *et al*., 2016). Major critique stems from the efficiency structure hypothesis that regards higher market concentration as a result of increasing market shares of the firms with higher efficiency, thus shedding no light on the competitive situation (Demsetz, 1973; Peltzman, 1977). Additionally, according to the theory of contestability, even if the market is concentrated, a lack of high entry and exit barriers might induce competitive behaviour (Baumol *et al*., 1982). As such, deficiencies of structural measures induced the search for alternative, non-structural techniques that directly quantify conduct. The first generation of such models is rooted in the neoclassical view on competition and comprises among others such widely adopted measures as the Lerner index and the Panzar and Rosse H-statistic, whereas second generation takes a more dynamic perception manifested in the novel Boone indicator (Hay and Lau, 1997; Boone, 2008).

The Panzar and Rosse H-statistic is the most widely applied measure of bank competition in the literature (Leon, 2015). It measures the elasticity of the revenue with respect to input prices to quantify the extent to which changes in such prices are passed on to changes in revenue for a specific bank. In the case of perfect competition, revenue and marginal cost increase proportionally with input prices, whereas in the monopolistic market an increase in input prices is translated into lower revenue, due to higher marginal cost and lower output. Correspondingly, the H-statistic below zero (one) represents collusive (monopolistic) competition, while a value of unity characterizes perfect competition (Apergis *et al*., 2016). Persistence of application of this method in recent years is somewhat unanticipated given that Bikker *et al*. (2012) show that negative value of the index can coincide with the highly competitive market. Shaffer and Spierdijk (2015; 2017), on the basis of own theoretical inquiry and existing literature, further substantiate incapability of Panzar and Rosse's H statistic to capture either the degree or the magnitude of competition.

Literature focusing on the Lerner index is no less prevalent than previously discussed approaches.[5] The Lerner index quantifies market power of a bank as the ability to set price above marginal cost, expressed as a percentage

[5] Table A1 in the Appendix presents a comprehensive overview of key findings of all the papers that use the Lerner index or the Boone indicator to quantify competition in Europe.

of the former. Since price and marginal cost should be identical in perfect competition, the higher the mark up of price over marginal cost, the greater the market power. As such, the index ranges from zero in case of perfect competition, to the inverse of price elasticity of demand (Leon, 2015). From early 2000s and prior to the crisis there is consistent evidence on the direction of change in competition as suggested by this index. Brissimis *et al*. (2014) and Cruz-García *et al*. (2017) find an increase in market power for most or all EMU. Casu and Girardone (2009) reach identical conclusions for France, Germany, Italy and Spain, while Weill (2013) shows an increase at a more aggregate scale, for 23 out of 27 EU countries. During the crisis of 2007-08, the upward movement in extent of market power has been reversed, with Brissimis *et al*. (2014) highlighting a decline for the EMU countries, while Weill (2013) points to decrease in 18 out of the 27 considered EU countries. After the crisis, evidence is somewhat mixed. While a few studies point towards a resumed upward trend (see Brissimis *et al*., 2014, for EMU and De Guevara and Maudos, 2017, for 15 EU countries), Cruz-García *et al*. (2017) find only Luxembourg, Netherlands and Belgium to show a clear transition to a less competitive banking sector, while Weill (2013) shows a decreasing pattern in the market power for 15 EU countries up until 2010.

Due to the neglect of the market dynamics in the first generation models, Hay and Lau (1997) and Boone (2008) propose a new indicator that perceives efficient firms to benefit disproportionally from the intensified competition. It measures this disproportional benefit as ability to achieve higher profits (or a higher market share) at the expense of less efficient peers, with such benefit monotonically rising with the extent of competition. The Boone indicator is estimated as a coefficient on marginal cost with the profit or market share as a regressand. The more negative such coefficient is the more severe the degree of competition (Schaeck and Cihák, 2014). Unlike the two previously introduced bank-level measures, it provides a single estimate of the extent of competition for the entire market. Due to the novelty of the proposed measure, it has not been extensively applied yet. Brissimis *et al*. (2014) and Clerides *et al*. (2015) report similar pattern in competition using Boone as that suggested by Lerner, namely an increase in the market power prior to the crisis, a deterioration during the 2007-2008 time period, to resume an upward movement thereafter. De Guevara and Maudos (2017) find Boone to be less clear-cut than Lerner in terms of identifying change in competition over time, where for seven countries the value of the index has increased after the crisis as compared to prior years, while the opposite holds for the other six.

Lastly, a number of studies employ a variety of measures in order to compare their consistency. De Jonghe *et al*. (2016) and Liu *et al*. (2013) among others find the Lerner index and the H-statistic to be negatively correlated, in line with theory, while the Boone indicator captures a completely different aspect of competition. In contrast, Carbó *et al*. (2009) find a very weak relationship between Lerner and H-statistic. In a similar vein, Delis (2012) and Clerides *et al*. (2015) find Boone and Lerner to be positively and statistically significantly correlated, while

Brissimis *et al*. (2014) point towards a strong rank correlation of 37%. Additionally, high concentration does not imply high market power. Liu *et al*. (2013) find that none of the concentration measures are correlated with any of the other competitive measures and are correspondingly not reliable gauges of competition, a view supported in many other studies, such as De Guevara and Maudos (2007) and Casu and Girardone (2009). Even more crucially, Bikker (2010) finds that any single indicator only gives an approximate signal on competition and is only moderately correlated with the other indicators.

Correspondingly, in this paper we focus on the Lerner index and the Boone indicator. The Lerner index has an advantage of simplicity and direct applicability, while the Boone indicator has a robust theoretical underpinning (Clerides *et al*., 2015). We additionally present concentration measures to gauge the evolution of market structure over time, considering an increase in concentration as possibly contributing to lower competition in the sector. Yet, owing to inconclusiveness regarding the role of such indexes as measures of competition, only the Lerner index and the Boone indicator are used to make a judgement on the competitive stance. Due to major deficiencies, we do not resort to estimation of H-statistic, a choice undertaken by few recent publications (see Clerides *et al*., 2015, Brissimis *et al*., 2014, Mirzaei and Moore, 2014). It is crucial to note that the Lerner index might be misleading, as more efficient banks that enjoy a higher price-cost margin might increase their market share in times of increased competition in such a way as to increase the average Lerner index (Boone *et al*., 2013). At the same time, the Boone indicator focuses only on the efficiency aspect of competition, while disregarding others. Thus, estimating two measures is necessary for robustness and policy relevance of the results (Liu *et al*., 2013).

3. Methodology

3.1 The Boone indicator

The Boone indicator model is based on the notion that efficient firms achieve larger market shares (profits) than less efficient peers, with such disproportional benefit increasing in the extent of competition (Hay and Lau, 1997; Boone, 2008). In this research we follow the methodology used in De Guevara and Maudos (2017) and estimate the relationship between marginal costs of individual banks (mc_{it}, a measure of efficiency) and their market shares (ms_{it}) as follows:[6]

[6] As such, in country-by-country regressions we assume that the market in which banks operate is constrained by the national borders, whereas in the aggregate regressions we allow for cross-border competition regarding EU-5 as a single

$$ln\, ms_{it} = \alpha + \beta\, ln\, mc_{it} + v_i + \delta_t + \mu_{it} \quad (1)$$

where *i* and *t* are bank and year subscripts, respectively. We define individual market share as the ratio of total assets of bank *i* in time *t* and the sum of totals assets over all banks in the market in year *t*. Market shares are expressed in logarithm form to correct for heteroscedasticity. As the market shares add up to one each year, we follow Boone (2001) and substitute the restriction $ms_{pt} = 1 - \Sigma_j\, ms_{jt}$ for each year (summing over 1, 2, …, *p*-1) into the model equation by dividing each observation by that of the p^{th} insurer (see also Bikker, 2017):

$$ln\,(ms_{it}/ms_{pt}) = \alpha + \beta\, ln\,(mc_{it}/mc_{pt}) + v_i + \delta_t + \mu_{it} \quad (2)$$

Marginal cost are calculated, see Section 3.1.3 below. Coefficient β is the Boone indicator. It is expected to be negative as banks with the lower marginal cost (that are correspondingly more efficient) exhibit an increase in the market share, with the value of the coefficient becoming more negative with the extent of competition (Van Leuvensteijn *et al*., 2011). v_i and δ_t are bank and time fixed effects, μ_{it} is an error term. Estimation is done with the clustered robust standard errors for the entire 2013-2016 time period and by sub-periods (before and after the launch of the SSM).

3.2. The Lerner index

The Lerner index is defined as follows:

$$Lerner_{it} = \frac{(P_{it} - mc_{it})}{P_{it}}, \quad (3)$$

where P_{it} is a price of bank *i*`s product at time *t*. Following Cruz-García *et al*. (2017), Carbó *et al*., (2009) among others, price is proxied by a ratio of interest and non-interest income to total assets. Total assets serve as a synthetic proxy of bank output, as bank`s product range is diverse (De Guevara and Maudos, 2017). Non-interest income is defined as the sum of fee and commission income with other operating income.[7] Marginal cost,

market. Such cross-border definition of the market should be particularly relevant for the significant bank groups in different EU member states that might compete with each other directly.

[7] We exclude trading income from the definition of non-interest income as this variable is not available for most of the banks in the data set.

defined in the same manner as for the Boone indicator, is explained below. Higher values of the index (a higher mark-up of the price over cost) point towards higher degree of market power.

3.3. Marginal cost

In order to obtain the measures of competition presented above, it is necessary to quantify marginal cost. To this end, a translogarithmic cost function needs to be estimated. It models total cost as a function of output (proxied by total assets) and input prices (price of capital, price of labour and price of borrowed funds). We follow Weill (2013) in estimating a single cost function for all countries per year to allow for technological change over time.[8] We equally control for country-specific effects by including a dummy variable for each country in the regression.[9] The assumption of linear homogeneity in input prices is met by scaling two input prices with the third one.[10] This results in the given regression specification:

$$\ln\left(\frac{C_{it}}{w_{3it}}\right) = \alpha_0 + \alpha_1 \, lnA_{it} + \frac{1}{2}\alpha_2 \, (lnA_{it})^2 + \alpha_3 \ln\left(\frac{w_{1it}}{w_{3it}}\right) + \alpha_4 \ln\left(\frac{w_{2it}}{w_{3it}}\right) + \alpha_5 \ln\left(\frac{w_{1it}}{w_{3it}}\right) \ln\left(\frac{w_{2it}}{w_{3it}}\right)$$

$$+ \frac{1}{2}\alpha_6 \left(\ln\left(\frac{w_{1it}}{w_{3it}}\right)\right)^2 + \frac{1}{2}\alpha_7 \left(\ln\left(\frac{w_{2it}}{w_{3it}}\right)\right)^2 + \alpha_8 \, lnA_{it} \ln\left(\frac{w_{1it}}{w_{3it}}\right) + \alpha_9 \, lnA_{it} \ln\left(\frac{w_{2it}}{w_{3it}}\right) + \sum_{k=1}^{N} Country_k + \varepsilon_{it} \qquad (4)$$

Subscripts *i* and *t* refer to bank and year, respectively. C_{it} is total cost, defined as the sum of interest expenses, staff expenses and other operating expenses. A_{it} is total assets. w_{1it} denotes the ratio of staff expenses to total assets, w_{2it} stands for the ratio of other operating expense to fixed assets, while w_{3it} represents the ratio of interest expense to deposits and short-term funding. These ratios define price of labour, price of capital and price of borrowing, respectively. $Country_k$ is a corresponding dummy variable for country k. ε_{it} denotes the error term. The resulting coefficients of the translogarithmic function serve as an input to the marginal cost.

[8] We have considered two alternative specifications of the translogarithmic cost function. The first specification follows Maudos and De Guevara (2017) in estimating the individual function for each country over all years with a linear trend, to control for technological change over time, and bank fixed effects. Second specification involves estimating Equation (4) for every country individually (excluding country dummies). In the first case we have obtained very low estimates of the marginal cost resulting in unreasonably high Lerner indexes, whereas in the latter case the computed Lerner index for Italy was unreasonably low at zero percent. Thus, the model defined in (4) is the preferred specification. As will be shown in Section 5.3, this model equally yields coefficients that result in the Lerner index estimates that are very close to that of Cruz-García *et al*. (2017).

[9] We omit one country dummy to avoid multicollinearity.

[10] A typical property of the cost functions is the linear homogeneity in the input prices. It requires that the sum of all input price elasticities is one, whereas the sum of cross terms and squared terms of all right-hand side variables amounts to zero (Van Leuvensteijn *et al*., 2011).

Such marginal cost constitutes a partial derivative of the translogarithmic cost function (4) with respect to total assets computed as follows:

$$mc_{it} = \frac{\partial \ln(\frac{C_{it}}{w_{3it}})}{\partial lnA_{it}} = \left[\alpha_1 + \alpha_2 lnA_{it} + \alpha_8 \ln\left(\frac{w_{1it}}{w_{3it}}\right) + \alpha_9 \ln\left(\frac{w_{2it}}{w_{3it}}\right)\right] \frac{C_{it}}{A_{it}} \quad (5)$$

3.4. The impact of the Single Supervisory Mechanism

Due to the differences in the dimension, with the Lerner index being a bank-level measure, while the Boone indicator is a single coefficient for the entire market, we define an individual model for each measure of competition to derive the empirically testable hypothesis. Since the Boone indicator is a coefficient on marginal cost with the market share as the regressand, we regard the launch of SSM in late 2014 as a possible trigger of a structural break in the elasticity of market share with respect to marginal cost. Such a change in elasticity across periods will imply a change in the competitive landscape, as measured by the Boone indicator. We adapt Equation (2):

$$ln\,(ms_{it}/ms_{pt}) = \gamma_0 + \beta_0 \ln(mc_{it}/mc_{pt}) + \beta_1 SSM_t\ ln\ mc_{it}/mc_{pt}) + \nu_i + \delta_t + \mu_{it}, \quad (6)$$

This allows us to verify whether the above statement has materialized. SSM_t represents a binary variable corresponding to the period of the SSM, which takes a value of 1 in 2015 and 2016, and 0 otherwise. The key effect we are interested in is the coefficient on the interaction of the SSM_t variable with marginal cost, as the significance of this effect tells us whether there is a statistically significant difference in elasticity of market share with respect to marginal cost before and after the launch of SSM. This is equivalent to a Chow test on a structural break applied to a single coefficient. ν_i and δ_t are bank and time fixed effects, μ_{it} is an error term. Thus, the following hypothesis can be formulated:

H_0: $\beta_1 = 0$ $\qquad$ H_a: $\beta_1 \neq 0$

Under the null hypothesis there is no structural break and elasticity is not affected by the commencement of the SSM. As such, the SSM has not altered the extent of competitive pressure in the market.

When it comes to the Lerner index, the empirical model to study the relationship between extent of market power and the commencement of the SSM is of the following form:

$$L_{it} = \delta_0 + \delta_1\ SSM_t + \delta_2\ X_{it} + \delta_3\ HHI_t + \lambda_i + \tau_{it}, \quad (7)$$

where the regressand L_{it} is the Lerner index of market power of bank i at time t. SSM_t is the main dependent variable of interest and is defined in the identical manner as stated above for the Boone indicator. The slope δ_1 provides the information on the effect that the launch of the SSM has on competition, resulting in the following hypothesis:

H_0: $\delta_1 = 0$ $\quad$ H_a: $\delta_1 \neq 0$

A coefficient equal to zero under the null hypothesis postulates no significant change in the competition across the two periods. As the Lerner index is decreasing in competition, under alternative hypothesis negative coefficient suggests significant increases in competition, while a positive one indicates significant decreases in competition, as compared to the period before the SSM.

Next, we include X_{it}, a vector of bank specific control variables. Due to the complexity inherent in explaining the market power of individual banks, the amount of empirical research on this subject is scarce. We refer to the work of Delis (2012) and Mirzaei and Moore (2014) in selecting the explanatory variables that might drive the outcome variable based on the theory. In particular, following Delis (2012) we control for the natural logarithm of total assets, a proxy for bank size. On the one hand, larger banks might have access to cheaper sources of funding because of moral hazard, asymmetric information and scale economies (Delis, 2012; Mirzaei and Moore, 2014). On the other hand, larger banks can operate on the international market that is more competitive, resulting in lower degree of market power (Mirzaei and Moore, 2014). The ratio of non-interest operating income to total assets proxies for diversification of bank activities, in such a way accounting for differences in the product mix of the different institutions. The more diversified such a mix is, the less competitive pressure a certain bank might feel, resulting in a higher Lerner index (Mirzaei and Moore, 2014). Additionally, banks with higher loans to assets ratios engage in more traditional bank activities, possibly implying a lower degree of competition among such banks (Mirzaei and Moore, 2014).[11]

[11] Delis (2012) and Mirzaei and Moore (2014) additionally control for capitalization, defined as the ratio of total equity to total assets, as an important determinant of competition, as better capitalized banks can have access to the cheaper source of funding. Given the SSM context of our analysis we do not control for capitalization, but rather perceive changes in capitalization as an essential part of the SSM regime. Since the launch of the SSM the ECB and national authorities imposed higher capital requirements on the supervised entities. As such, it is crucial to allow the SSM variable to include this effect, rather than control for it. Additionally, Mirzaei and Moore (2014) include a share of money market funding in the total funding as a possible determinant of market power. Following similar reasoning, the SSM regulation assesses and ensures a sound funding structure of supervised entities with less reliance on the short-term borrowing. Thus, we equally attribute this effect to the SSM variable rather than control for it.

Lastly, one of the tasks of the ECB in the SSM framework is approving acquisitions and mergers, regardless of the significance of a bank. Thus, it is likely that the concentration patterns in the EMU banking sector after the establishment of the SSM are to a certain extent affected by the ECB decision-making. As such, we want to quantify whether the possible effect of the SSM in promoting competition remains once we control for the evolution of concentration. Delis (2012) argues that in countries with strong institutions and robust competition policies, high concentration may not be associated with anticompetitive conduct. Thus, we verify whether the robust supervision results in increased competition despite likely consolidation movement that allows banks to deploy excess capacity more efficiently. Correspondingly, we include the Herfindahl–Hirschman index (HHI_t) published by the ECB, as a proxy for concentration of the banking sector. λ_i controls for time-invariant bank specific effects, while τ_{it} is an error term.

Both empirical models that are presented in this section are estimated jointly for all the countries as well as for each country individually using the entire 2013-2016 time span available. We also account for the fact that significant and less significant groups might represent two distinct sub-markets in terms of competitive pressure and can be affected in a different manner by the launch of the SSM. We use two SSM lists to designate a bank as significant. The initial list of 4 September 2014 is used to define significant banks in 2015, whereas the list of 30 December 2015 serves the same purpose for 2016.[12] Since we are also interested in the time series of the significant banks prior to the SSM, we use the initial list from 2014 to allocate banks to the significant group in the 2013-2014 time period. As such, in Section 5, we equally show the estimates of the models herewith presented for the significant and less significant groups for each country and for the aggregate EU-5 sample.

4. The data

This research uses balance sheet and income statement data from the Orbis Bank Focus database of Bureau van Dijk over the 2013-2016 time span.[13] This time period allows us to compare two years of the SSM with the period of equivalent length before the launch. The analysis focuses on five countries: Austria, France,

[12] We use these lists, as they are the last available lists of the previous fiscal year: the September list is the last before 2015 and the December list is the last one prior to 2016. This gives enough time for actual supervisory change to be implemented within the next year, while incorporating the changes in the composition of the supervised entities during the SSM period.

[13] Orbis Bank Focus database reports six years of observations for the publicly listed entities and only four years for non-publicly listed ones. As a result, the sample in years 2011 and 2012 is only one third of that available in the years 2013-2015. Correspondingly, we exclude years 2011 and 2012 from the analysis, as inclusion would result in a highly unbalanced panel, where very different banks are compared across time.

Germany, Italy and Spain. The last four rank among the most important, in terms of national GDP economies in the EMU. As such, the majority of the publications on competition in the European Union or euro area includes these member states (Gischer *et al*., 2015). These five countries equally have a large number of banks, allowing enough observations for the model estimates.

Similar to other papers on competition, we consider only commercial, savings and cooperative banks. Orbis Bank Focus database reports data from both consolidated (C) and unconsolidated (U) financial statements. In order to capture the actual size of the banking sector we follow a suggestion by Duprey and Lé (2014) and select observations with C_1, C_2 and U_1 consolidation codes.[14] Since the entities with the U_2 consolidation code are omitted, where U_2 is a unconsolidated statement of the bank for which C_2 is an equivalent consolidated account, we mitigate double counting.[15] Total bank year observations in the initial unbalanced panel dataset amount to 10,389, with the vast majority being unconsolidated statements (89%). SSE represent 13% of total bank year observations. We further mitigate double counting issues by removing duplicates within the same year.[16]

We eliminate all banks that are inactive, dissolved or in liquidation. Observations with missing values for the variables used in computing marginal cost are also deleted. Furthermore, in line with other papers (e.g. Brissimis *et al*., 2014; Clerides *et al*., 2015; Van Leuvensteijn *et al*., 2011) all implausible observations, such as negative and zero values for assets, expenses, deposits and short-term funding are deleted. Lastly, to reduce the influence of outliers in the estimation of a translogarithmic cost function, we follow Clerides *et al*. (2015) in additionally removing the 1st and 99th percentile for the input prices. As a result, an unbalanced panel of

[14] C_1, C_2, U_1 and U_2 stand for: consolidated statement without unconsolidated companion, consolidated statement with unconsolidated companion, unconsolidated statement with no consolidated companion in the database and unconsolidated statement with consolidated companion in the database. In other words, U_2 stands for an equivalent unconsolidated statement of a bank that reports the C_2 consolidated statement as well. Banks with C_1 and U_1 consolidation codes report only one type of statement (consolidated or unconsolidated).

[15] Note that it is possible that certain degree of double counting remains. A parent bank could include the balance sheet information of its subsidiaries when netting out intra-group transfers in its consolidated accounts, while at the same time unconsolidated or consolidated account of one or more of its subsidiaries can be equally present, despite already being consolidated at the parent level. A plausible solution in such a case is to select observations at the highest ownership level, such as single location, independent company or global ultimate owner. However, such solution is equally prone to limitations, as ownership type variable does not change over time and correspondingly cannot account for changes in ownership induced by mergers and acquisitions (Duprey and Lé, 2014).

[16] Thus, if a certain bank reports its annual figures in March 2014, for consistency we attribute such observation to the fiscal year ending 2013. Similarly, a November 2013 observation is assumed to belong to the fiscal year ended in 2013. However, if the 31 December 2013 figure is already reported then we delete the observations in March or November to avoid double-counting.

9,210 bank year observations remains. The largest contributors to loss of observations have been missing values for interest expense and fixed assets (261), extreme values of input prices (491), as well as elimination of banks that are dissolved due to a merger (283). To ensure homogeneity in reported values we also convert all the values into millions of euros. This involves both rescaling variables, as well as converting them to the euro using annual average exchange rates.

Table 1 presents the resulting all banks samples and the significant institutions sub-samples by country and year. From Table 1 it is evident that the number of observations is relatively stable over the 2013-2015 time period, while in 2016 the coverage of banks in the sample somewhat deteriorates for Germany and Austria. Similar to other studies, the sample largely comprises German banks (54%). With respect to significant institutions, the ratio of these banks to the all banks sample varies across countries.[17] The number of observations in France for 80% comprises significant entities, as such they account for roughly 90% of the assets of all banks in the sample of this country. In contrast, coverage of significant banks in the sample of German entities ranges from a mere 1% of observations in the 2013-2014 sub-period to 2% (3%) in 2015 (2016), while in terms of total assets they occupy a much larger share of 23% to 42%. Overall, despite the fact that in the first three years significant banks represent only 10% of the total number of observations and 17% in 2016, with regard to bank assets the sample comprises 65% (and 76% in 2016) of the ECB supervised institutions.

We use the all banks sample presented in Table 1 for the computation of marginal cost, as the translogarithmic cost function requires a large number of observations to produce reliable yearly estimates. The summary statistics of the variables used in the translogarithmic cost function is presented in Panel A of Table 2.

[17] Depending on the data availability we deal with a combination of unconsolidated or consolidated accounts of significant bank groups, and individual significant supervised entities where data at the group level is not available. As has been noted in footnote 16 , it is possible that a certain degree of double counting is present. As such, the observations can include both consolidated accounts of parent group, as well as unconsolidated or consolidated statements of individual entities that belong to the parent. Given the nature of the analysis double counting does not have substantial ramifications for the statistical inferences, but at the same time allows us to capture the largest number of significant entities.

Table 1: Number of observations decomposition in the final sample per country

This table reports the number of observations for the total unbalanced panel used in the analysis by country and year. Columns to the left depict decomposition of the all-banks sample, while columns to the right present forn each subsample number of banks falling under direct ECB supervision since the launch of SSM. The list of 4 September 2014 is used to define significant banks in the 2013-2015 time period, whereas the list of 30 December 2015 serves the same purpose for 2016.

	All-banks sample used per country					**Significant banks**				
	2013	*2014*	*2015*	*2016*	*Total*	*2013*	*2014*	*2015*	*2016*	*Total*
Austria	587	472	533	48	1,640	72	68	57	22	219
France	135	141	149	129	554	105	112	117	106	440
Germany	1,485	1,476	1,457	513	4,931	21	22	23	15	81
Italy	414	443	455	416	1,728	29	30	30	25	114
Spain	103	99	92	63	357	44	43	39	30	156
Total	2,724	2,631	2,686	1,169	9,210	271	275	266	198	1,010

We use the largest bank in the market as bank *p*, which occurs in the denominators of *ms* and *mc* terms in Equation (6).[18]

[18] The largest banks in the country samples of Austria, France, Italy and Spain are correspondingly: UniCredit Bank Austria AG, BNP Paribas, UniCredit Spa and Banco Santander SA. For Germany we compared with Deutsche Bank and we used BNP Paribas as the denominator in the ratios for the EU-5 aggregate regressions.

Table 2: Summary statistics of the variables used in the empirical analysis

This table reports summary statistics for the variables used in this research. Panel A presents summary statistics for variables used in a translogarithmic cost function and computation of the marginal cost. Panel B presents additional variables used in the empirical analysis involving the Boone indicator. Panel C describes extra variables required to compute the Lerner index (only first row) and to test the effect of the SSM on the average market power in the banking sector of each country. Except for the first row in Panel C, all other entries are presented for the EU-4, excluding Italy due to its incomplete sample. Total cost and total assets are in millions of euros. Input prices, market share, price of output, diversification and lending are in percentages. Size is a natural logarithm of total assets in millions of euros, while concentration is in points.

	N	*Mean*	*St. Dev.*	*Min*	*Max*
Panel A: Variables used to estimate the marginal cost					
Total cost (EUR millions)	9,210	292.44	2,575	0.38	66,360
Total assets (EUR millions)	9,210	11,122	100,525	9.04	2,264,317
Price of labour (%)	9,210	1.24	0.42	0.24	5.34
Price of capital (%)	9,210	175.52	366.52	20.90	5,280
Price of funding (%)	9,210	1.03	0.60	0.12	3.81
Panel B: Additional variables used in the Boone indicator analysis					
Market share (%)	9,207	0.47	4.21	0.00	98.03
SSM dummy	9,207	0.42	0.49	0	1
Panel C: Additional variables used in the Lerner index analysis					
Price of output (%)	7,511	3.82	2.43	0.98	168.49
SSM dummy	7,436	0.40	0.49	0	1
Size (ln EUR millions)	7,436	6.44	1.78	2.35	14.63
Diversification (%)	7,436	1.03	2.37	0.03	168.48
Lending (%)	7,435	59.89	15.19	0.00	99.10
Concentration (points)	7,436	354.41	139.39	266	937

The resulting amount of observations and additional variables used in the Boone indicator analysis are reported in Panel B of Table 2. From the first row we can infer that the smallest market share is close to 0%, which can be observed in Germany due to the large number of smaller banks, while the average bank in the sample has a very small market share of 0.47%. The mean value of the SSM dummy tells us that 42% of the total observations are from the 2015-16 time period that corresponds to the SSM.

With respect to the Lerner index, we preserve the largest institutions and work with the country samples close in size to those reported in Table 1. Yet, due to the missing values for non-interest income we lose almost all observations in Italy. Thus, for Italian banks we present the Lerner indices of the all banks sample only. In the regression analysis, we exclude Italian banks entirely. Panel C of Table 2 presents summary statistics for the extra variables used in the empirical analysis. The SSM period now covers a 2 percentage point lower amount of observations. The broad range of values of the diversification and lending variables is noteworthy. Another remarkable aspect is the dispersion of the concentration in the EU-4, with the average index at 354 points. We follow Van Leuvensteijn *et al*. (2011) and additionally report the average values of the variables used in the

Boone and Lerner analysis in Table A2 and Table A3 in the Appendix by country and sub-periods (for different bank groups and all banks sample), while Table A4 provides variable definitions, calculation method and source.

5. Empirical results

5.1 Banking sector concentration

As a preliminary inspection, we commence with examining the concentration patterns in the banking sectors of the EU-5 economies over the 2013-2016 time period to verify whether the launch of SSM has induced major changes in the market structure that can potentially alter the competitive conduct.[19] Figures 1 and 2 show the evolution of the entire banking sector concentration and for the percentage of the market controlled by the five largest institutions, respectively.[20] The CR_5 serves as a rough indication on development of relative size of the SSE in the total banking sector. Both figures depict a fairly similar pattern over time. Figure 1 confirms the large dispersion in values of the HHI index across countries observed in Table 2. Spain is characterized by the most concentrated banking sector (HHI of 719 in 2013 and up to 937 in 2016) with the biggest market share attributable to the five largest credit institutions (54-62%), while Germany has the least concentrated banking sector (HHI of 266-277 and CR_5 of around 31%).[21]

In what follows we compare the first year in the sample with the last one to see the patterns over time more clearly. The banking sector of Spain stands out. The concentration is 30% higher in 2016, while the five largest institutions have increased their aggregate market share by 36%. The banking sector of Italy also exhibits an increase in concentration over the four years, albeit slightly. Its index is 11% higher for the country as a whole (9% for the five largest institutions). Despite the fact that the German sector also exhibits a higher level in 2016, there is a monotonically decreasing pattern after the peak of 2014, resulting in an increase of only 4% (and even a smaller increase in market share of 2% for the largest institutions). The pattern in France is less clear-cut. Concentration increases in the years prior to the SSM and decreases afterwards, resulting in a 2% lower level

[19] Note that the concentration indices are in particular unsuitable for comparison of competition across countries, not so much within a country over time.
[20] The data shown in the graphs is obtained from the ECB`s 'Structural financial indicators database', where the concentration indexes are provided using the unconsolidated data. This is consistent with the further analysis since almost all of the dataset used in our research comprises unconsolidated accounts.
[21] A very low share of the five largest banks in Germany is noteworthy. Despite the fact that this includes Deutsche Bank, which is ranked in the top ten largest banks in the world by total assets throughout the sample period, a substantial number of much smaller savings and co-operative banks results in a very modest share of assets attributed to such large banks in Germany.

for large banks and a negligible increase for the total sector. Austria is the only country for which a monotonically decreasing pattern in concentration persists throughout the sample period, resulting in a 12% lower figure for total banking sector (7% for the five largest institutions). All in all, only Italy and Spain reveal an increasing tendency over the sample period considered, while for Austria a downward movement is present. No major changes in the market structure of either France or Germany are evident.

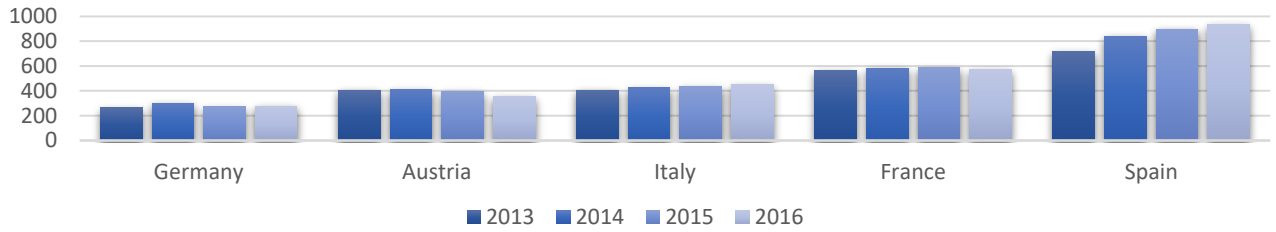

Figure 1: **Herfindahl index for credit institutions' total assets (HHI)**

Source: ECB Structural Financial Indicators

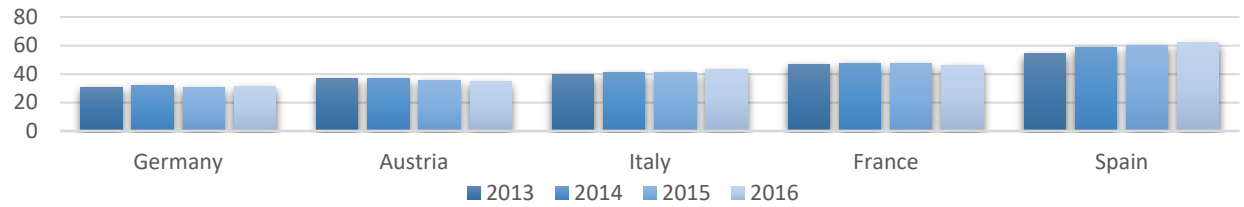

Figure 2: Share of total assets of five largest credit institutions in total assets (CR_5)

Source: ECB Structural Financial Indicators

As such, the tendencies in the evolution of the concentration over the period considered vary a lot per country. The sudden increase in Spain can be attributed to a substantial decrease in the number of competitors associated with the restructuring of the savings bank sector after a burst of the real estate bubble. Table A5 in the Appendix shows that the number of credit institutions has declined by 29%. It is crucial to note that the French banking sector has undergone a reduction of similar magnitude, but no substantial changes in the concentration are evident, suggesting an average increase in the total assets of each bank only commensurate with the decline in the total number of institutions. The decrease in the concentration observed in Austria is somewhat unusual, as the numbers in Table A5 suggest that this country also experienced a reasonably large reduction in the number of competitors of 16%.

5.2 Boone indicator estimates

We proceed with the empirical results on the measures of competition. This section uses the computed marginal costs, as in Equation (5), to measure the relationship between marginal costs and market shares of individual banks in the market, as specified in Model (6). This allows us to obtain the estimates of the Boone indicator by sub-periods and verify whether this indicator is significantly different before and after the launch of SSM. Prior to the estimations, we have compared marginal cost with the average cost, a simple proxy for marginal cost used in a number of studies (see for instance Schaek and Cihák, 2014), defined as total costs divided by total assets. This serves as a robustness check to verify that the translogarithmic cost function has yielded reasonable estimates of the marginal costs that should be very close to average costs but somewhat lower. From Table A6 in the Appendix it is evident that this is the case for all of the values reported, except a few outliers, with the average positive difference in the all banks sample of 0.02 percentage points. Thus, we use marginal cost in the further analysis, as it is an outcome of a more refined estimation process and should correspondingly capture the actual marginal cost better than a simple proxy.

Before we proceed with the estimation results, Table A2 in the Appendix presents average values of the variables used in the Boone model and reveals interesting tendencies. The initially lower marginal cost of the significant banks decreases at a much smaller rate of 12% on average from the pre-SSM value, whereas for LSSE this decrease is much larger at 18%. Even though significant banks remain a relatively more efficient group after the start of SSM as their marginal costs were initially much lower.[22] Correspondingly, the average market share of LSSE increases at a percentage rate double that of significant entities. It is likely that scale economies play a role here, but also competition may be an important determinant as the next analyses may find out.

Columns 1 and 2 of Table 3 present the Boone indicators estimates for the two considered sub-periods. The ranking of the countries in terms of competition across all panels is not clear cut. For France, the coefficients in all panels are significant and with the expected negative sign. For Austria, Italy and Spain (except its significant entities group in panel B) the sign is consistently negative, albeit not always significant. If we focus on the results before the SSM in panel A (in which all estimates are significant), France has the most competitive banking sector (with the Boone index of -0.60), while Germany has the least competitive banking sector (-0.06),

[22] This observation confirms the argument put forward in Section 3.2, that significant institutions, which according to selection criteria are the largest banks, should have lower cost of funding due to scale economies, moral hazard and asymmetric information.

with the average estimate of -0.14 for EU-5 economies. To understand why France has the most competitive sector, we recall from Section 4 that 80% of its sub-sample consists of significant entities. This suggests that the results largely capture the dynamics of their interaction. As has been discussed in the literature review, significant entities are cross-border groups that might face more competitive pressure from abroad resulting in a severer punishment for operating less efficiently. In a similar vein, Delis (2012) finds that the banking sector of France is the most competitive, whereas Schaeck and Cihák (2014) and Van Leuvensteijn *et al*. (2011) find this banking sector to be the least competitive, considering the results of these authors for subset of the same countries. Additionally, consistent with our findings, Clerides *et al*. (2015) and Brissimis *et al*. (2014) find German banking sector to be the least competitive of the EU-5. The result for Germany can be explained by the low level of competition of the savings and cooperative banks that represent 95% of this country's observations. These banks operate mostly in the regional markets, in such a way that they do not compete with other regions (Schaeck and Cihák, 2014). Lastly, Austria (-0.15) and Spain (-0.38) occupy intermediate positions.

Column 3 in Table 3 presents country-by-country estimation results of the Boone indicator in the 2013-16 time period. In line with expectations, all coefficients in this larger sample are now statistically significant with a negative sign (as expected) at the 5% level, except Spain in Panel B and Austria in Panel C. The ranking of the individual countries in Column 3 of Panel A closely corresponds to our previous interpretation of Column 1 in the same panel. With respect to results by sub-markets, the ECB supervised group and the nationally supervised group in France are the most competitive (-0.52 and -0.47). For all countries (except Spain) significant banks exhibits a higher degree of competition than nationally supervised banks.[23] In the case of Germany, this difference is the most prominent, with the Boone indicator four times larger (-0.44 as compared to -0.10). This is due to the fact that the significant sample consists of 63% commercial banks, whereas in the less significant group, commercial banks amount to a modest 4%. The estimates of the significant groups are largely driven by the more competitive conditions of the commercial banks that, as Van Leuvensteijn *et al*. (2011) indicate, which is due to the country-wide spread of operations of these institutions. In a similar vein, in other countries more direct competition among larger banks within a country and possibly also additional competitive pressure from abroad for serving international clients may be a plausible explanation.

[23] It is noteworthy that in the work of Maudos and De Guevara (2017) Spain is also the only country with the unexpected positive estimate that is not significant, but in the earlier 2008-12 time span, considering only the results for the same countries. As has been stated earlier this may reflect incapability of the Boone indicator to account for competition on quality with heterogeneous products.

To be able to clearly see the development over time, Figure 3 depicts change in competitive strength (measured as $-\beta$) by sub-periods for each sample.[24] We observe that Austria is the only country in which overall competition has increased after the start of the SSM, with a 0.34 percentage points increase for SSE and a smaller increase for the LSSE of 0.26 percentage points. Germany shows a remarkably strong increase of 0.93 percentage points for significant banks, but a decrease for the LSSE. The small banks outnumber the large ones, so that overall, competition is weakened. For France, we observe a small improvement in competitive conditions of 0.05 percentage points for banks supervised by the ECB, but a deterioration in competition for the all banks sample and for the nationally supervised banks. The banking sector of Italy exhibits a deterioration in competitive strength equivalent to that of nationally supervised entities in France, with the largest decrease for LSSE (0.26 percentage points). The banking sector of Spain and the nationally supervised group have experienced a decline of 0.36 and 0.52 percentage points, respectively, more than found in the other countries. Added together, this corresponds to a relatively large increase in competition for the EU-5 aggregate of SSE of 0.22 percentage points and a much smaller decrease for the less significant banks and the all-banks group.

[24]Countries are ranked from the highest to lowest increase in competition based on the results of the total sample.

Table 3: Estimation results of the Boone indicator

This table reports empirical results of the Boone indicator from Equations (2) and (6). The Boone indicator is estimated as a coefficient on the natural logarithm of marginal cost (*mc*) with the natural logarithm of market share (*ms*) as regressand, where *mc* and *ms* both are expressed as ratio of the corresponding values of the p^{th} bank. Marginal cost is a partial derivative of the translogarithmic cost function with respect to total assets as defined in Equation (5). The table is split in three panels. Panel A shows results for the entire sample. Panel B and Panel C show the estimates for the significant and the less significant group, respectively. The first three columns exhibit the country-by-country and EU-5 estimates in different time periods, as specified in the Equation (2). N stands for the number of observations. Bank and year fixed effects are included. Standard errors (not reported) are clustered at bank level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The last column depicts the p-value of the test on structural change in the Boone indicator. It tests the null hypothesis of equivalent elasticity of market share with respect to changes in marginal cost across periods. Under the null hypothesis there is no statistically significant difference in the Boone indicator before and after the launch of the SSM. A p-value below 0.05 (5%) rejects the null hypothesis. All regressions in Column 4 include bank fixed effects. As such, the reported p-value is a probability of observing the estimated coefficient on the interaction term of the SSM with the natural logarithm of the marginal cost if the true coefficient is null.

	(1)		(2)		(3)		(4)
	2013-14		2015-16		2013-16		2013-2016
	N	Boone	N	Boone	N	Boone	Chow test on structural change (p-value)
Panel A: All-banks sample							
Austria	1,057	-0.15*	579	-0.50**	1,636	-0.21***	0.243
France	274	-0.60***	276	-0.46***	550	-0.50***	0.691
Germany	2,959	-0.06***	1,968	0.02	4,927	-0.10**	0.285
Italy	855	-0.44***	869	-0.16	1,724	-0.33***	0.517
Spain	200	-0.38***	153	-0.01	353	-0.20***	0.124
EU-5	5,353	-0.14***	3,854	-0.09	9,207	-0.19***	0.335
Panel B: SSE							
Austria	138	-0.13	77	-0.47	215	-0.30***	0.346
France	215	-0.45***	221	-0.50***	436	-0.52***	0.020**
Germany	43	0.13	38	-0.80***	81	-0.44***	0.220
Italy	57	-0.54***	53	-0.39***	110	-0.49***	0.446
Spain	85	0.00	67	0.00	152	0.00	0.012**
EU-5	546	-0.10*	464	-0.32***	1,010	-0.27***	0.009***
Panel C: LSSE							
Austria	919	-0.15	502	-0.41**	1,421	-0.16*	0.311
France	59	-0.66***	55	-0.37***	114	-0.47***	0.198
Germany	2,916	-0.06***	1,930	0.04	4,846	-0.10**	0.335
Italy	798	-0.41***	816	-0.15	1,614	-0.31***	0.560
Spain	115	-0.58***	86	-0.06	201	-0.37***	0.370
EU-5	4,809	-0.14***	3,391	-0.05	8,200	-0.17***	0.329

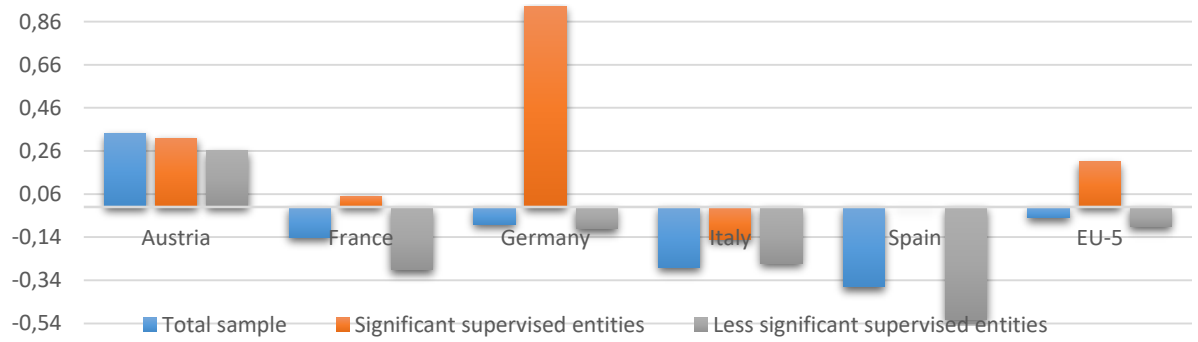

Figure 3: Change in competitive fierceness by type of bank and by country, measured as minus the Boone indicator: 2013/14-2015/16

All in all, it is peculiar to note that once we disregard the results for the German banking sector and the ECB supervised group in Spain, all of the competitive changes in the individual countries by sub-periods correspond in relative magnitude and direction with the evolution of country`s market structure, where increases in concentration coincide with decreases in competition and thus might serve as a plausible explanation for the observed changes in the Boone indicators. This means that in the banking market characterised by decreasing concentration, the most inefficient banks are punished more severely, in the sense of decreasing market shares.

Although we find different results for the pre- and post SSM period, tests on the structural change in the Boone coefficient (presented in the fourth column of Table 3) indicate that – on the country level – there are no structural breaks in the Boone indicator for the all banks sample nor for the LSSE. For the ECB supervised banks in France and Spain, we see that the null hypothesis of no significant change has been rejected at the 5% significance level, while for the EU-5 total the rejection is even at the 1% significance level. Apparently, the larger sample of the EU-5 helps to clearly reveal this significant change over time. Hence, we can infer that, according to the Boone indicator, the sub-market comprising the ECB supervised entities on average have experienced a significant increase in competitive behaviour.

5.3. Lerner index estimates

In computation of the Lerner indexes as defined in Equation (3), we again use marginal cost estimates from Equation (5). In line with other research, we obtain country (group) aggregates of the Lerner index by calculating a yearly asset-weighted mean of the individual Lerner indexes. An average for the sub-period is then obtained by taking a mean value of such yearly asset-weighted Lerner indexes across a few years.[25] As a robustness check, Table A7 in the Appendix compares our Lerner estimates to those of Cruz-García *et al*. (2017) in 2013 and 2014. With the exception of Italy our results are very close and they exhibit the same increasing or decreasing pattern over time.[26]

[25] For simplicity, in further discussion we refer to them as the Lerner indexes, rather than the average asset-weighted Lerner indexes.

[26] A possible explanation for this is a substantial loss of observations that mostly affected smaller banks with missing values for non-interest income resulting in higher Lerner indices, more reflective of market power for a subset of larger banks.

Table 4 reports the resulting Lerner indexes. Considering the all banks sample results, in both time periods the German banking sector is the most competitive (the Lerner index being 11% and 13%), while the banking sectors of Italy and Spain have the highest market power in both sub-periods (ranging from 21% to 26%). This might be explained by the efforts of Italian and Spanish banks to restore their financial health by cutting back lending through setting higher interest rates, in such a way as to result in larger profit margins. The banking sectors of Austria and France hold a more intermediate position (16% to 22%).[27] The resulting EU-5 sample average is 17.5%. Note that the subsequent ranking across countries is different from that according to the Boone indicator. Such an outcome is not surprising and can be observed in other studies as the Lerner index measures the pricing market power, a different aspect of competition.[28] A noteworthy observation in both time periods is that SSE have higher Lerner index values than LSSE. From the mean values in Table A3 we can infer that this is due to the mark-up of significant entities that is on average twice as large as that of LSSE. Such a large pricing power stems from more efficient operations, strict control of costs and superior ability to generate revenue for individual banks (ECB, 2017a). Or from operating on different submarkets, such as wholesale activities, where competition is more limited than on the lending markets.

Figure 4 depicts the change of the Lerner index between the two periods. It appears that only in Spain and Austria have all three samples experienced increases in market power, with the strongest increase for LSSE, 5.3 and 4.0 percentage points, respectively. In France, Germany and Italy there is on average a decrease in market power for the total banking sector of 0.5, 1.6 and 2.1 percentage points. Yet, if we consider only SSE, its market power has increased in Germany and France (1.4 and 0.1 percentage point change), whereas LSSE show patterns consistent with a decrease of 0.5 to 1.6 percentage points in the all-banks sample. Markedly, with the exception of Spain, the Boone and Lerner indices point to a different change in competition over time both at the country

[27] The resulting ranking is very similar to that of Beck *et al*. (2013), Brissimis *et al*. (2014) and Liu *et al*. (2010) (considering their results for the same subset of countries), while similar to Carbó *et al*.(2009) and Weill (2013), we find Germany to have the most competitive banking sector and Spain to have the least. This suggests that differences in the relative levels of market power across countries tend to persist over time.
[28] See De Jonghe *et al*. (2016), Liu *et al*. (2013) and Maudos and De Guevara (2017).

Table 4: Average asset-weighted Lerner index estimates (in %)

This table presents average asset-weighted Lerner indexes that are computed by first obtaining yearly asset-weighted Lerner indexes of all banks in each sample (country, group within a country, EU-5 or EU-4 aggregate) and then taking a mean value across the years. We do not report separate results for significant and less significant bank groups in Italy due limited observations of explanatory variables.

	All-banks sample			**SSE**			**LSSE**		
	2013-14	*2015-16*	*2013-16*	*2013-14*	*2015-16*	*2013-16*	*2013-14*	*2015-16*	*2013-16*
Austria	16.23	21.45	18.08	21.55	26.28	23.26	7.73	13.04	9.60
France	19.32	18.84	19.08	19.35	19.47	19.41	18.67	14.58	16.72
Germany	12.70	11.07	12.05	15.81	17.21	16.48	11.19	8.40	10.08
Italy	25.67	23.61	24.57	-	-	-	-	-	-
Spain	20.97	24.05	22.31	21.46	24.17	22.66	19.85	23.87	21.57
EU-5	17.57	17.48	17.53	-	-	-	-	-	-
EU-4	-	-	-	19.51	20.28	19.87	13.43	12.19	12.94

level and for the aggregate sample. Recall that in this section we use the convention of showing the asset-weighted Lerner indexes, as adopted from the literature. Yet, as Boone *et al*. (2013) argue, such a weighted index can increase (as in the case of declining competition) if under more competitive pressure the effect of expanding market shares of efficient firms with higher-than-average profit margins outweighs the decline in individual Lerner indexes. Although, in the longer run, competition will drive down (excess) profits and, hence, the weighted average Lerner index. We proceed to the next step, where we explain the Lerner index estimates, to show that this might indeed be the case.

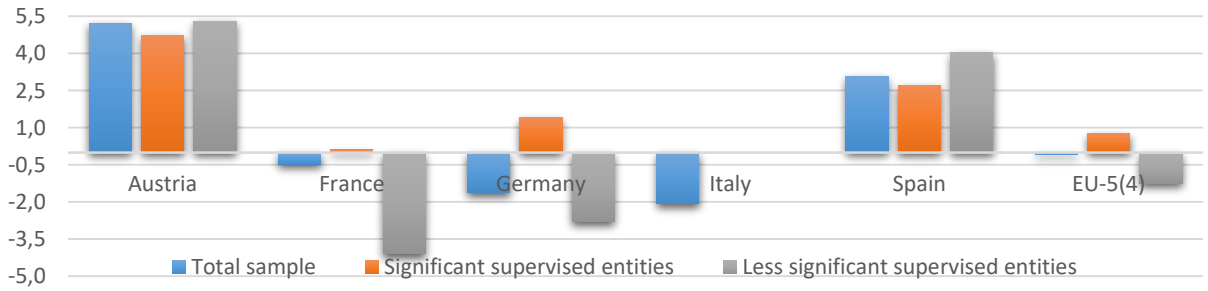

Figure 4: Change in the average asset-weighted Lerner index between 2013/14 and 2015/16

Note: A positive bar indicates a decline in competition. Table 4 explains the use of EU averages over 4 or 5 countries.

In what follows, we exclude Italian banks due to limited observations of explanatory variables. Table 5 shows empirical results of Equation (7) estimating the effect of the SSM on individual Lerner indexes controlling for bank-specific controls and the HHI, as measure of banking concentration. The evidence from the all-banks

sample in Panel A of this table suggests that the SSM years have significantly reduced the extent of market power in the EU-4 countries, where the SSM coefficient is 0.79 percentage points. This outcome is in line with the Boone result. For the individual countries we do not find any significant effect. Apparently, a larger sample size is necessary to obtain a statistical significant effect.

This competition effect becomes stronger once we examine the results in panel B. For the significant institutions, the effect of the SSM launch is now almost three times higher at 2.26 percentage points. We also find a significant effect for the France SSM banks, where the index of market power is reduced by 1.33 percentage points by the commencement of the SSM.[29] Finally, we do not find any SSM impact on the LSSE banks (Panel C).

[29] Note the inconsistency of this effect with that observed in Figure 4. Such a difference arises from the dissimilarity of the computational approach. In Figure 4 we compare asset-weighted Lerner indexes by sub-periods, whereas regression analysis shows the average effect on individual Lerner indexes assigning an equal weight to each bank. As such, we can see an increase in the market power in Figure 4, possibly caused by the relative increase in the total assets of the larger banks with the higher Lerner indexes under more competitive environment, while regression analysis says otherwise.

Table 5: The effect of the SSM on the Lerner indexes

This table reports estimates of Equation (7) for the years 2013-2016 by country and for the EU-4 aggregate sample. Panel A presents estimation results for the all-banks sample, Panel B and C for significant and less significant groups, respectfully. The dependent variable is the Lerner index of individual banks. Columns 1,2,7, 10 and 13 present the regression with only SSM dummy, that takes value of 1 in the 2015-2016 and 0 otherwise, as an explanatory variable. Columns 2, 5, 8, 11 and 14 additionally include bank-level controls: size (natural logarithm of total assets), diversification (ratio of non-interest operating income to total assets in percent) and lending (ratio of loans to total assets in percent). The specification in Columns 3, 6, 9, 12 and 15 additionally includes concentration, proxied by HHI index, to control for the evolution of concentration of the banking sector over time. For ease of interpretation of coefficients HHI index has been divided by 100. Note that in Columns 13-15 HHI index varies per country. Standard errors are clustered at bank-level and are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. All estimations feature bank fixed effects.

Panel A: All-banks sample

	Austria	*France*	*Germany*	*Spain*	*EU-4*
SSM dummy	-0.67	-1.19	0.40	-3.07	-0.79**
	(-0.93)	(-1.21)	(0.75)	(-1.06)	(-2.02)
Size	7.21	16.24	-4.61	14.82	1.65
	(1.19)	(1.59)	(-0.87)	(1.08)	(0.37)
Lending	0.22**	0.16	-0.01	0.38	0.09
	(2.02)	(0.62)	(-1.04)	(1.62)	(1.16)
Diversification	4.86**	13.38***	7.31**	5.84***	6.27***
	(2.25)	(3.80)	(2.03)	(3.65)	(3.92)
HHI	8.49***	-2.29	3.62***	0.62	0.54
	(3.22)	(-0.82)	(2.87)	(0.45)	(0.71)
Constant	-71.95**	-137.70	29.51	-121.90	-9.93
	(-2.09)	(-1.37)	(0.81)	(-1.14)	(-0.31)
Number of observations	1,631	526	4,922	356	7,435
Number of banks	600	161	1,500	111	2,372
R^2 within	0.05	0.18	0.02	0.14	0.03
R^2 between	0.02	0.03	0.00	0.00	0.00
R^2 overall	0.02	0.03	0.00	0.00	0.00

Panel B: SSE

	Austria	*France*	*Germany*	*Spain*	*EU-4*
SSM dummy	-3.09	-1.33**	0.53	-5.95	-2.26***
	(-1.65)	(-2.12)	(0.38)	(-1.61)	(-3.13)
Size	5.05	12.65*	2.62	16.15	12.12**
	(0.95)	(1.88)	(0.58)	(1.07)	(2.19)
Lending	0.21	0.41*	-0.46*	1.19**	0.36**
	(0.81)	(1.67)	(-1.86)	(2.28)	(1.99)
Diversification	4.63**	16.46***	4.83*	15.07***	13.21***
	(2.01)	(3.33)	(1.79)	(4.96)	(5.46)

HHI	2.40	1.33	-6.33	1.82	-0.77
	(0.44)	(0.56)	(-1.04)	(0.88)	(-0.51)
Constant	-42.69	-149.30*	39.05	-217.90	-115.50**
	(-0.80)	(-2.05)	(0.79)	(-1.49)	(-2.22)
Number of observations	219	421	80	156	876
Number of banks	75	124	23	46	268
R^2 within	0.05	0.35	0.10	0.29	0.18
R^2 between	0.08	0.09	0.21	0.15	0.10
R^2 overall	0.07	0.10	0.17	0.14	0.09

Panel C: LSSE

	Austria	*France*	*Germany*	*Spain*	*EU-4*
SSM dummy	0.03	-0.57	0.38	1.53	-0.33
	(0.04)	(-0.24)	(0.70)	(0.39)	(-0.77)
Size	6.91	26.83	-5.10	17.98	-0.01
	(0.84)	(1.38)	(-0.94)	(1.14)	(-0.00)
Lending	0.19*	-0.42	-0.07	0.15	0.01
	(1.84)	(-1.25)	(-0.72)	(0.74)	(0.11)
Diversification	5.06*	8.10**	7.46**	4.73***	5.51***
	(1.80)	(2.53)	(2.04)	(6.42)	(3.80)
HHI	12.01***	-21.71**	3.75***	-1.42	1.70**
	(4.51)	(-2.16)	(2.94)	(-0.74)	(1.97)
Constant	-81.39**	-53.98	29.92	-105.60	1.75
	(-2.05)	(-0.34)	(0.82)	(-0.94)	(0.05)
Number of observations	1,412	105	4,842	200	6,559
Number of banks	526	37	1,477	66	2,106
R^2 within	0.06	0.22	0.020	0.14	0.02
R^2 between	0.01	0.03	0.000	0.02	0.00
R^2 overall	0.01	0.02	0.001	0.01	0.00

With respect to the bank-level control variables, we find bank size to have a positive and significant effect on competition for the ECB supervised entities in the EU-4 sample in panel B, while we see no significant effect

for the other samples. Apparently, larger banks have access to cheaper sources of funding because of moral hazard, asymmetric information and scale economies (Delis, 2012; Mirzaei and Moore, 2014). When it comes to share of lending, the evidence on significant banks in Spain and the entire EU-4 in panel B supports the argument put forward by Mirzaei and Moore (2014) that banks that are involved in more traditional banking business of granting loans have a higher degree of market power. Similar conclusion can be reached from the all-banks result of Austria in panel A. The results regarding diversification of bank activities are the most significant among bank-level controls and have expected positive and statistical significant sign at the 5% level in 14 of the 15 samples, just like in Mirzaei and Moore (2014). A one percentage point increase in the ratio of non-interest operating income to total assets in the French all-banks sample in panel A raises the Lerner index of market power by 13 percentage points. This might be due to the dominance of significant institutions in their sample that place a higher emphasis on diversifying their activities to minimize the direct competition.

Lastly, we consider the HHI index, a proxy for market concentration. For expositional brevity, values of the HHI index are divided by 100. We recall from the methodology section that the ECB has direct influence on the market structure through its approval or disapproval of mergers and acquisitions, as well as granting or withdrawing bank licenses, apart from possible indirect effects. Independent drivers of the market structure are strategic interaction of banks, changes in customer preferences, emergence of fintechs, to name a few. A clear pattern is lacking. We see positive and significant HHI coefficients of LSSE in the EU-4 as well as Austria and Germany (in line with – static – economic theories), but an opposite effect in France (Panel C). In the all-banks sample of Panel A we find positive effects again for Austria and Germany. Surprisingly, concentration does not affect the pricing power of the significant institutions in any of the countries considered.

6. Robustness checks

One possible shortcoming of our analysis lies in the discontinuity of the sample and its changing composition of banks. As such, as a further robustness check we reproduce the results using a smaller but fully balanced panel and present them in Tables A8-9 in the Appendix. The Boone indicators estimated with the fully balanced panel in Table A8 are fairly similar to those presented in the main text (Table 3). The change in the elasticity across periods for the significant group in France is now significant at the more strict threshold of 1%. Most importantly, the conclusion of the significant decrease in the Boone indicator across periods for the EU-5 ECB supervised sub-market holds. New is that such a significant increase in competition now is found also for the all banks group (in Panel A) which includes the SSM banks.

With respect to the balanced sample Lerner index results from Table A9, we infer that the results in Austria lose their significance in all three panels. Two plausible explanation can be put forward. Firstly, notice the substantial reduction in the number of banks from 600 to just 43. This implies that a sample may be simply too small to estimate the effect in the reliable manner. Secondly, the significant results in Table 5 can be driven by a substantial reduction in the available data, with the number of observations in 2016 being only roughly 10% of the amount in the previous years. As such, the significant effect might merely reflect a change in the composition of banks. Note also that the SSM has no significant effect in both Panel B and C, while a significant reduction has been evident in Panel B of Table 5. Unlike the balanced panel results of Boone, the results of France in Panel B lose their significance rather than being attributed more statistical power. This can be accredited to a small sample size, as the only result that is consistent in both tables is a statistically significant reduction in the Lerner indexes in EU-4 all banks sample regression, where the number of the observations remains large. Note that such effect is almost two times larger than in unbalanced panel.

7. Conclusion

This paper investigates whether the commencement of the SSM has significantly affected the market power of the entire banking sector, as well as the two sub-groups of significant and less significant banks in five EU economies. For robustness of estimation results, two measures of competition have been used, namely, the Boone index, which captures the disproportional benefit of more efficient banks (in terms of higher market share) in the more competitive markets, and the Lerner index, which quantifies the market power of banks as the ability to set the price above marginal cost.

On the basis of the Boone indicator analysis, we find significant increase in competition, in the years 2015-16 as compared to the 2013-14 time period, in the sub-market comprising of SSE in five EU economies, while an identical conclusion can be reached for a subset of these institutions in the largest individual country sample of France. This outcome is robust to the alternative analysis involving a smaller fully balanced sub-sample. Consistent with the results of the Boone indicator, we find a significant decrease in the market power of the ECB supervised entities using the Lerner index for the same countries (but excluding Italy due to lacking observations of explanatory variables). Also a significant decrease in the market power of all banks in the EU-4 aggregate market is evident using both unbalanced and balanced panel analysis involving the Lerner index, possible driven by the ECB supervised banks. Taking all these arguments in account, we conclude that the years of the SSM has resulted in a significant decrease of market power of banks subject to direct ECB supervision in Austria, France, Germany, Italy and Spain. Note that we cannot directly attribute such a result to the novel rules or change in the direct supervisor that affected significant and less significant banks alike. No significant

effect is evident for the sub-market remaining under the national supervision, whereas the results for the total market are mixed.

Countries which experienced substantial increases in concentration did not reveal a significant anticompetitive effect. Thus, consolidation per se should not be perceived as an unfavourable phenomenon for competition in the countries with robust supervision. Likely, consolidation is a tool for banks to mitigate poor earnings patterns and reduce inefficiencies arising from double marginalization of administrative and operating costs, rather than significantly increasing their influence in the market.

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Appendix

Table A1: Literature overview

This table presents an extensive overview of the studies that have used the Lerner index or Boone indicator in the analysis focused on the subset or all of the EU countries. The studies are sorted by the year of publication and alphabetically within each year,

Author	Time period	Measure of competition	Countries	Main findings
Carbó *et al*.(2009)	1995-2001	Lerner Index, H-statistic, HHI, ROA, net interest margin	14 EU countries	There is a weak relationship between measures considered and the signal about extent of competition that they convey differs in time and across countries is not consistent. Once cost efficiency and non-traditional banking activities effects are subtracted from traditional non-structural measures European banking sector is more competitive, than implied by unadjusted measures prevalent in the literature.
De Guevara and Maudos (2007)	1986-2002	HHI, Lerner Index	Spain	Market power of Spanish banks substantially deteriorated until middle of 1990s, but has been consistently increasing since then. Concentration ratios are not reliable gauges of market power.
Maudos and De Guevara (2007)	1993-2002	HHI, Lerner Index	15 EU countries	An increase in the market power in the loan markets over time can be observed, while contrary is true for the deposit markets.
Ayadi *et al*.(2009)	1996-2006	Lerner Index	15 EU countries	Compared to commercial and savings banks cooperative banks exhibit significantly smaller degree of market power in Austria, Germany and Netherlands, while converse is true in Italy, Finland and Spain. Average Lerner index for cooperative banks is 26.5.
Casu and Girardone (2009)	2000-2005	Lerner Index, H-statistic, HHI, CR_5	France, Germany, Italy, Spain and UK	Concentration of EU commercial banking sector has increased over time, with the 5 largest credit institutions enlarging their market shares from 37.8 to 42.3. Lerner index is higher in 2004 than in 2000 for all countries but UK, while H-statistic suggests monopolistic competition and is in a range of 0.3715 to 0.7783. As such, no build up of competitive pressure is evident indicating that concentration measures are not valid quantifiers of competition.
Koetter and Poghosyan (2009)	1994-2004	Lerner Index	Germany	Universal and Relationship technological regime banks have the highest market power index of 32.13 points, whereas for Small and Specialized banks its 23.09 points, followed by 15.95 points for the most competitive Public

				and Retail regime banks. Small and Specialized regime has a linear pattern of Lerner index over time, whereas the two other regimes faced a deterioration in the market power before 2001. All three types of banks on average experienced market power increases thereafter.
Agoraki *et al*.(2011)	1998-2005	Lerner Index	CEE countries	Bulgaria and Romania have fairly competitive banking sector, while a more anticompetitive behaviour holds for the Lithuania and Slovenia. The other countries are in the middle of the spectrum. Change in competition over time substantially varies per country.
Van Leuvensteijn *et al*. (2011)	1994-2004	Boone Indicator	France, Germany, Italy, Netherlands, Spain, UK, US, Japan	German and Spain lending markets can be characterized as one of the most competitive in EU, with Netherlands taking a somewhat intermediate position. French and British markets are situated closer to the opposite side of the competitive axis, with Italy exhibiting a substantial decrease over time in the extent of competitive behaviour.
Delis (2012)	1987-2005	Boone Indicator, Lerner Index, CR3	84 countries	Boone indicator points to high-income countries exhibiting a low and stable degree of market power up until 2002. Afterwards, an increase can be observed. Boone indicator is positively and statistically significantly correlated with Lerner index, while it is not correlated with concentration ratio. As such, concept of concentration is distinct from that of competition.
Beck *et al*. (2013)	1994-2009	Lerner Index, H-statistic, HHI, CR3	79 countries	Authors find a larger variation in Lerner index between banks of a particular country in a certain year than between countries, with the average Lerner index of 12.4. For panel of individual banks between variation is much larger than within variation. Lerner index is positively and significantly related to CR3 and negative H-statistic, but for Herfindahl index.
Liu *et al*. (2013)	2000-2009	Lerner Index, Boone Indicator, H-statistic, CR3, HHI, Profit Persistence Parameter	9 EU countries	Belgium has the most concentrated market, with the contrary being true for Luxemburg based on CR3. In contrast, HHI points to Austria as a most concentrated market. H-statistic indicates that Denmark, France and Luxemburg have banking sector characterized by monopoly, while for other countries monopolistic competition is evident. UK banks are placed somewhere between monopoly and monopolistic competition. Lerner index identifies Luxemburg as a country with the highest market power in the banking sector, with the contrary being true for Austria. It shows a significant and negative correlation with the H-statistic, implying that such measures are statistically associated in their competitive implications. However, Boone indicator is not significantly correlated with any other measures. It attributes the highest degree of competition to banking sector of France and the lowest to Luxembourg, with the Austria, Belgium and Denmark being reasonably competitive. UK banking sector has rather some attributes a monopoly.
Weill (2013)	2002-2010	Lerner Index, H-statistic, HHI	27 EU countries	In the entire time span considered old EU countries exhibit a higher degree of competition that that prevalent in the new EU members. Over time period of 2002-2006 Lerner index has increased in 23 out of 27 EU countries, with the aggregate rise of 5.84 points, indicating deterioration in the degree of competition. During the crisis it has somewhat

				decreased for 18 countries resulting in the overall decrease of 1.71 points at the aggregate EU level. In particular, the most reduction occurs in the new EU countries, with the old countries exhibiting only a slight deterioration. However, it still remains above that observed in 2002. As such, crisis represents a setback in the increasing pattern of increasing market power. The extent of competition has converged over time, with the most competitive sectors experiencing lesser further increases, than less competitive sectors, as well as reduction in the dispersion of the mean Lerner indicator across EU states. Conclusions are the same if H-statistic is considered in place of Lerner Index for the years 2002-2008, whereas between 2008 and 2010 H-statistic points to an increase, not decrease in the competition. HHI confirms findings on the basis of non-structural measures.
Brissimis *et al*. (2014)	1997-2010	Lerner index, Boone indicator	EMU and US	Authors show a tendency of both Lerner and Boone indicators to increase up until 2006, with the decline in 2007-2008 to resume an upward movement in 2009 onwards. Belgium, Luxembourg and Netherlands are on the higher end of the competitive spectrum, with the Greece, Italy and Finland being on the opposite side. There is a certain degree of inconsistency regarding this spectrum depending on the choice of the competitive measure, with the rank correlation being a strong 37.
Coccorese (2014)	1994-2012	Lerner index	87 countries	Authors employ novel stochastic frontier estimation of the Lerner index that is shown to be weakly correlated with the conventional Lerner index and has an advantage of being always nonnegative. Nevertheless, the estimated patters of competition are very similar to works of De Guevara and Maudos (2007), De Guevara et al. (2007), Casu and Girardone (2009), Weill (2013) and Agoraki et al. (2011), while absolute values can be consistently higher or lower.
Schaeck and Cihák (2014)	1995-2005	Boone indicator, HHI, H-statistic	10 EU countries	Netherlands, UK and Switzerland have the most competitive banking sector, whereas competition is the least in Germany. These results are consistent with those of Carbó et al. (2009). Boone indicator is significantly negatively correlated with the H-statistic, implying that such indicators are associated with each other as lower Boone indicator and a higher H-statistic are consistent with a higher degree of competition.
Clerides *et al*. (2015)	1997-2010	Lerner Index, adjusted Lerner, Boone Indicator	148 countries	Focusing on European results only, Lerner indicates that Austria, Belgium and Germany have the most competitive banking sector among 148 countries considered, while Boone identifies Finland as the least competitive. Both suggest same competitive pattern for OECD countries over time: market power reaches its height in 2006(2004) based on Lerner (Boone) measure of competition, slightly decreases in 2006-2008 time span, to take off again afterwards. Lerner Index and Boone indicator are positively and statistically significantly correlated.
Gischer *et al*. (2015)	2003-2013	Lerner index	EMU	Using a lending business segment oriented Lerner index authors find that conventional Lerner index underestimates a true market power of European banks with respect to their lending activities. Nevertheless, both indexes produce

				an identical ranking of individual countries. Austria exhibits the highest competition, while Greece and Portugal are the least competitive.
de Jonghe *et al*. (2016)	2000-2015	HHI, CR3, CR_5, Lerner index, H-statistic	28 EU countries	Lerner index and negative H-statistic are positively correlated, while Boone indicator captures a completely different aspect of competition as evident from its negative correlation with the other measures. Yet, for all indices average value indicates monopolistic competition. While concentration measures are positively correlated with Lerner index, they are insignificantly correlated to negative H-statistic and negatively to Boone. Thus, high concentration does not imply high market power.
Cruz-García *et al*. (2017)	2000-2014	Lerner index	EMU	Lerner index is the highest for Finland, Greece, Luxembourg and Spain and lowest for Belgium, Denmark and Ireland. It has exhibited an upward trend for 10 out of 12 countries over the period considered, signalling an increase in the market power. After the crisis, Luxembourg, Netherlands and Belgium show the largest transition to a less competitive banking sector, whereas Portugal and Ireland reveal the contrary transition. A clear tendency towards less absolute difference in Lerner index across countries is observed, signifying a convergence in extent of competition in individual countries. However, the difference in market power of banks within a given country is still substantial.
De Guevara and Maudos (2017)	2002-2014	Boone, Lerner, CR_5, HHI	15 EU countries	Lerner index is higher in 12 out of 15 countries considered in the period after crisis, than prior to the crisis, whereas Boone indicator results are rather mixed. Based on Boone for 7 countries the value of the index has increased after the crisis as compared to years prior to the crisis, while for the other 6 it has increased. Rank correlation between two measures indicates that there is no statistically significant relationship implying that a conclusion regarding the evolution of competition differs depending on the method employed. Non-structural indexes are only weakly correlated with concentration indexes.
Fungáčová *et al*. (2017)	2001-2011	HHI,CR_5, Lerner and H-statistic	20 EU countries	CR_5 is highest for Estonia and lowest for France. Judging by HHI European banking sector is fairly concentrated, with Estonia equally being at the high end and Italy at a low end. Lowest average Lerner index is observed for Finland and Germany, with the highest market power attributed to Italy. Estonia is the least competitive according to average H-statistic, while the opposite holds for Ireland.

Table A2 : Mean values of the variables used in the Boone estimation (in %) by country and their percentage variation by sub-periods

		All banks sample			SSE			LSSE		
Variable	*Country*	*2013-14*	*2015-16*	*% change*	*2013-14*	*2015-16*	*% change*	*2013-14*	*2015-16*	*% change*
Market share	Austria	0.6	1.1	92%	1.9	4.7	144%	0.4	0.6	54%
	France	3.1	3.4	10%	3.6	3.6	0%	1.4	2.7	90%
	Germany	0.2	0.2	44%	3.6	4.5	24%	0.1	0.2	36%
	Italy	0.6	0.6	7%	5.9	6.3	7%	0.2	0.2	22%
	Spain	2.4	2.6	7%	3.3	3.4	5%	1.8	1.9	7%
	Total	0.6	0.8	40%	3.4	4.1	23%	0.2	0.3	39%
Marginal cost	Austria	2.8	2.5	-9%	2.9	2.7	-8%	2.7	2.5	-9%
	France	3.5	3.1	-12%	3.4	2.9	-13%	4.1	3.9	-6%
	Germany	4.1	3.2	-22%	3.3	2.7	-17%	4.1	3.2	-22%
	Italy	3.2	2.9	-11%	3.1	3.0	-5%	3.2	2.9	-11%
	Spain	3.1	2.5	-18%	3.3	2.6	-20%	2.9	2.4	-17%
	Total	3.6	3.0	-17%	3.2	2.8	-12%	3.7	3.0	-18%

Table A3 : Mean values of the variables used in the Lerner index analysis by country and their percentage variation by sub-periods

Note: Mean values of price of output, marginal cost, diversification and lending are displayed in percent.

		All banks sample			Significant entities			LSSE		
Variable	*Country*	*2013-14*	*2015-16*	*% change*	*2013-14*	*2015-16*	*% change*	*2013-14*	*2015-16*	*% change*
Price of output	Austria	3.4	3.1	-9%	3.7	3.4	-7%	3.4	3.1	-0.3%
	France	4.7	4.1	-13%	4.5	3.9	-14%	5.5	5.2	-0.3%
	Germany	4.1	3.7	-11%	4.7	3.9	-17%	4.1	3.7	-0.4%
	Italy	4.7	4.0	-14%						
	Spain	4.2	3.2	-23%	4.3	3.4	-22%	4.1	3.1	-1.0%
	Total	4.0	3.6	-10%	4.3	3.7	-13%	3.94	3.5	-0.4%
Marginal cost	Austria	2.8	2.5	-9%	2.9	2.7	-7%	2.7	2.5	-0.3%
	France	3.5	3.1	-12%	3.3	2.9	-13%	4.2	3.9	-0.3%
	Germany	3.6	3.2	-11%	3.3	2.7	-18%	3.6	3.3	-0.3%
	Italy	3.9	3.9	1%						
	Spain	3.1	2.5	-18%	3.3	2.7	-20%	2.9	2.4	-0.5%
	Total	3.4	3.1	-10%	3.2	2.8	-12%	3.4	3.1	-0.3%
Size	Austria	5.2	5.5	5%	6.6	7.4	13%	5.0	5.2	0.2%
	France	8.8	9.1	3%	9.1	9.3	2%	7.8	8.1	0.3%
	Germany	6.4	6.6	3%	9.4	9.8	4%	6.3	6.5	0.2%
	Spain	7.4	7.6	4%	7.8	1.1	-86%	7.1	7.3	0.2%
	Total	6.3	6.7	6%	8.1	8.8	8%	6.1	6.3	0.3%
Diversification	Austria	1.1	1.1	0%	1.1	1.2	4%	1.0	1.0	-0.0%
	France	1.5	1.4	-7%	1.4	1.3	-7%	1.9	1.8	-0.1%
	Germany	0.9	1.0	9%	1.1	1.0	-5%	0.9	1.0	0.1%
	Spain	1.3	1.0	-20%	1.4	1.1	-24%	1.1	1.0	-0.2%
	Total	1.0	1.1	4%	1.3	1.2	-6%	1.0	1.0	0.1%
Lending	Austria	59.3	60.5	2%	62.6	66.7	7%	58.8	59.5	0.7%
	France	67.9	65.8	-3%	69.1	67.0	-3%	63.5	60.9	-2.5%
	Germany	59.1	60.3	2%	62.5	59.8	-4%	59.0	60.3	1.3%
	Spain	55.6	53.7	-3%	63.1	62.3	-1%	49.8	46.8	-3.1%
	Total	59.5	60.5	2%	65.5	65.4	-0%	58.8	59.7	0.9%
Concentration	Austria	408.1	393.8	-4%	408.4	381.1	-7%	408.1	395.0	-13.1%
	France	576.1	581.1	1%	576.2	581.0	1%	575.6	581.5	6.0%
	Germany	282.9	274.0	-3%	283	274.6	-3%	282.9	274.0	-9.0%
	Spain	777.8	912.7	17%	778.3	913.8	17%	777.4	911.7	134.3%
	Total	352.0	358	-99%	537.9	570.8	6%	329.8	324.9	-4.9%

Table A4: Definition of the variables used in the empirical analysis

This table reports variable name, notation, definition and calculation method, as well as the source. Panel A presents this description for the variables used in a translogarithmic cost function and computation of the marginal cost. Panel B presents additional variables used in the empirical analysis involving the Boone indicator. Panel C describes extra variables required to compute the Lerner indexes and execute further empirical analysis.

Variable name and notation	Definition and Calculation Method	Source
Panel A: Variables used in the translogarithmic cost function and marginal cost computation		
Total cost (C)	Sum of interest expenses, staff expenses and other operating expenses in millions of euros.	Orbis Bank Focus and author`s own calculations
Total assets (A)	Total assets in millions of euros.	Orbis Bank Focus
Price of labour (w_1)	Ratio of staff expenses to total assets.	Orbis Bank Focus and author`s own calculations
Price of capital (w_2)	Ratio of other operating expenses to fixed assets.	Orbis Bank Focus and author`s own calculations
Price of funding (w_3)	Ratio of interest expenses to deposits and short-term funding.	Orbis Bank Focus and author`s own calculations
Marginal cost (mc)	Partial derivative of the translogarithmic cost function with respect to total assets.	Orbis Bank Focus and author`s own calculations
Panel B: Additional variables used in the analysis involving the Boone indicator		
Market share (ms)	Ratio of total assets of bank i to the total assets of the largest bank in the market, where market is limited by the national borders in country regressions and spans all the countries considered in the EU-5 regressions.	Orbis Bank Focus, annual reports and author`s own calculations
The Single Supervisory Mechanism (SSM)	A dummy variable that takes value of 1 in 2015 and 2016, 0 in 2013 and 2014.	Author`s own elaboration
Panel C: Additional variable used in the analysis involving the Lerner index		
Price of output (P)	Ratio of interest, fee and commission, and other operating income to total assets.	Orbis Bank Focus and author`s own calculations
Diversification (X)	Ratio of non-interest operating income to total assets in percent.	Orbis Bank Focus and author`s own calculations
Lending (X)	Ratio of total loans to total assets in percent.	Orbis Bank Focus and author`s own calculations
Bank size (X)	Natural logarithm of total assets in millions of euros.	Orbis Bank Focus and author`s own calculations
Concentration (HHI)	Herfindahl-Hirschman index defined as the sum of the squares of the market shares of all banks in a country. Scaled by 100 for comprehensiveness of the coefficients.	ECB`s Structural Financial Indicators Database

Table A5: Number of credit institutions per country and percentage variation

Country	2013	2016	% Variation
Austria	731	615	-16%
France	623	445	-29%
Germany	1842	1702	-8%
Italy	694	611	-12%
Spain	290	207	-29%

Source: ECB

Table A6: Marginal and average cost comparison

This table presents yearly mean of marginal and average cost per country. The last row gives mean values for all countries in the sample. The figures are reported in percent.

	Marginal cost				**Average cost**			
Country	*2013*	*2014*	*2015*	*2016*	*2013*	*2014*	*2015*	*2016*
Austria	2.82	2.69	2.52	2.60	2.85	2.70	2.50	2.60
France	3.56	3.45	3.27	2.90	3.62	3.49	3.28	2.92
Germany	4.39	3.85	3.31	2.96	4.45	3.87	3.31	2.94
Italy	3.35	3.07	2.98	2.76	3.35	3.08	3.01	2.75
Spain	3.29	2.86	2.53	2.50	3.32	2.88	2.54	2.50
Total	3.81	3.45	3.07	2.84	3.86	3.47	3.07	2.83

Table A7: Comparison of the Lerner index estimates

This table serves as a robustness check in comparing own estimates (presented in bold) of the Lerner index in year 2013 and 2014 to the estimates of Cruz-García *et al*. (2017).

Country	**2013**	2013	**2014**	2014
Austria	**16%**	17%	**16%**	17%
France	**20%**	17%	**18%**	16%
Germany	**12%**	13%	**14%**	14%
Italy	**21%**	16%	**30%**	17%
Spain	**19%**	17%	**23%**	23%

Source: Cruz-García *et al*. (2017) and own computations.

Table A8: Balanced panel estimation results of the Boone indicator

This table reports empirical results of the Boone indicator from Equation (6). The Boone indicator is estimated as a coefficient on the natural logarithm of marginal cost (*mc*) with the natural logarithm of market share (*ms*) as regressand where *mc* and *ms* are expressed as ratio of the corresponding values of the p^{th} bank. Marginal cost is a partial derivative of the translogarithmic cost function with respect to total assets as defined in Equation (5). This table is split in three panels. Panel A shows results for the entire sample. Panel B and Panel C show the estimates for the significant and the less significant group, respectively. The first three columns exhibit the country-by-country and EU-5 estimates in different time periods, as specified in the Equation (1). N stands for the number of observations. Bank and year fixed effects included. Standard errors (not reported) are clustered at bank level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. The last column depicts the p-value of the test on structural change in the Boone indicator. It tests the null hypothesis of equivalent elasticity of market share with respect to changes in marginal cost across periods. Under the null hypothesis there is no statistically significant difference in the Boone indicator before and after the launch of the SSM. A p-value below 0.05 (5%) rejects the null hypothesis. All regressions in Column 4 include bank fixed effects. As such, the reported p-value is a probability of observing the estimated coefficient on the interaction term of the SSM with the natural logarithm of the marginal cost if the true coefficient is null.

Panel A: All banks sample

	(1)		(2)		(3)		(4)
	2013-14		2015-16		2013-16		2013-2016
	N	Boone	N	Boone	N	Boone	Chow test on structural change (p-value)
Austria	84	-0.12	84	-0.58*	168	-0.20	0.539
France	198	-0.50***	198	-0.47***	396	-0.49***	0.340
Germany	1,012	-0.06***	1,012	0.02	2,024	-0.06	0.422
Italy	706	-0.47***	706	-0.61***	1,412	-0.59***	0.478
Spain	102	-0.34*	102	-0.02	204	-0.17*	0.061
EU-5	2,108	-0.19***	2,108	-0.16**	4,216	-0.22***	0.006***

Panel B: SSE

	(1)		(2)		(3)		(4)
	2013-14		2015-16		2013-16		2013-16
	N	Boone	N	Boone	N	Boone	Chow test on structural change (p-value)
Austria	36	-0.25	36	-0.79	72	-0.33*	0.585
France	166	-0.32*	166	-0.50***	332	-0.51***	0.009***
Germany	28	0.16	28	-0.80***	56	-0.40**	0.755
Italy	42	-0.71***	43	-0.37***	85	-0.51***	0.747
Spain	52	0.12	53	0.01	105	0.00	0.084*
EU-5	330	-0.02	332	-0.33***	662	-0.27***	0.008***

Panel C: LSSE

	(1)		(2)		(3)		(4)
	2013-14		2015-16		2013-16		2013-16
	N	Boone	N	Boone	N	Boone	Chow test on structural change (p-value)
Austria	48	0.16	48	-0.41**	96	0.03	0.045*
France	32	-0.58**	32	-0.40***	64	-0.48***	0.554
Germany	984	-0.06***	984	0.04	1,968	-0.05	0.721
Italy	664	-0.45***	663	-0.63***	1,327	-0.58***	0.526
Spain	50	-0.64**	49	-0.12	99	-0.36**	0.146
EU-5	1,778	-0.21***	1,776	-0.13	3,554	-0.21***	0.110

Table A9: The effect of the SSM on the Lerner indexes in the balanced panel

This table reports estimates of Equation (7) for the years 2013-2016 by country and for the EU-4 aggregate using a balanced panel. Panel A presents estimation results for the all banks sample, Panel B and C for significant and less significant groups, respectfully. The dependent variable is the Lerner index of individual banks. Columns 1,2,7, 10 and 13 present the regression with only SSM dummy, that takes value of 1 in the 2015-2016 and 0 otherwise, as an explanatory variable. Columns 2, 5, 8, 11 and 14 additionally include bank-level controls: size (natural logarithm of total assets), diversification (ratio of non-interest operating income to total assets in percent) and lending (ratio of loans to total assets in percent). The specification in Columns 3, 6, 9, 12 and 15 additionally includes concentration, proxied by HHI index, to control for the evolution of concentration of the banking sector over time. For ease of interpretation of coefficients HHI index has been divided by 100. Note that in Columns 13-15 HHI index varies per country. Standard errors are clustered at bank-level and are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. All estimations feature bank fixed effects.

Panel A: All banks sample

	Austria	France	Germany	Spain	EU-4
	(3)	(6)	(8)	(12)	(15)
SSM	-0.03	-1.25	-0.55	-4.97**	-1.20**
	(-0.02)	(-1.48)	(-0.79)	(-2.28)	(-2.03)
Size	3.33	15.68	-2.98	21.05	2.19
	(0.67)	(1.41)	(-0.45)	(1.66)	(0.34)
Lending	0.02	-0.06	-0.34**	0.33	-0.14
	(0.07)	(-0.79)	(-2.43)	(1.33)	(-1.38)
Diversification	2.00	9.16**	6.82	10.68***	8.05***
	(1.06)	(2.07)	(1.28)	(3.38)	(2.95)
HHI	4.89*	0.19	4.70**	1.61	0.27
	(1.76)	(0.08)	(2.36)	(0.96)	(0.27)
Constant	-28.00	-127.40	33.25	-190.90*	-1.20
	(-0.59)	(-1.27)	(0.67)	(-1.71)	(-0.02)
Number of observations	172	372	2,016	207	2,767
Number of banks	43	93	504	52	692
R^2 within	0.04	0.10	0.01	0.20	0.03

R^2 between	0.12	0.00	0.00	0.03	0.08
R^2 overall	0.11	0.00	0.00	0.03	0.06

Table A9: The effect of the SSM on the Lerner indexes (continued)

Panel B: SSE

	Austria	France	Germany	Spain	EU-4
	(3)	(6)	(9)	(12)	(15)
SSM	-0.71	-0.64	1.90	-4.32	-1.08
	(-0.28)	(-1.11)	(1.29)	(-1.12)	(-1.54)
Size	5.10	7.39	3.35	26.40	16.06**
	(0.80)	(0.83)	(0.36)	(1.10)	(2.40)
Lending	-0.18	-0.04	-0.31	1.04	-0.00
	(-0.50)	(-0.26)	(-1.06)	(1.61)	(-0.05)
Diversification	3.71	9.89	3.51	15.66***	13.71***
	(0.91)	(1.54)	(1.13)	(4.74)	(4.43)
HHI	2.60	3.22	-7.22	1.56	-0.89
	(0.50)	(1.65)	(-0.79)	(0.53)	(-0.51)
Constant	-25.73	-72.36	25.95	-300.90	-134.40**
	(-0.38)	(-0.78)	(0.24)	(-1.29)	(-2.02)
Number of observations	76	312	52	109	549
Number of banks	19	78	13	28	138
R^2 within	0.04	0.12	0.14	0.30	0.19
R^2 between	0.07	0.00	0.23	0.13	0.03
R^2 overall	0.05	0.00	0.18	0.10	0.03

Table A9: The effect of the SSM on the Lerner indexes (continued)

Panel C: LSSE

	Austria	France	Germany	Spain	EU-4
	(3)	(6)	(9)	(12)	(15)
SSM	-0.34	-2.99	-0.13	-4.49*	-0.97
	(-0.21)	(-1.03)	(-0.16)	(-1.97)	(-1.43)
Size	3.59	42.00	-3.15	7.98	-1.07
	(0.26)	(1.49)	(-0.46)	(0.73)	(-0.16)
Lending	0.35*	-0.11	-0.31**	0.09	-0.16
	(1.81)	(-0.67)	(-2.10)	(0.42)	(-1.49)
Diversification	1.21	10.75	7.32	3.70	4.90
	(0.55)	(1.73)	(1.26)	(1.22)	(1.63)
HHI	5.48**	-20.94	5.02**	1.56	1.18
	(2.30)	(-1.48)	(2.45)	(1.13)	(1.18)
Constant	-47.98	-201.60	31.00	-57.00	21.40
	(-0.43)	(-1.14)	(0.62)	(-0.64)	(0.42)
Number of observations	96	60	1,964	98	2,218
Number of banks	24	15	491	25	555
R^2 within	0.13	0.29	0.02	0.07	0.01
R^2 between	0.00	0.017	0.01	0.00	0.03
R^2 overall	0.00	0.017	0.01	0.00	0.02

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