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Watching over 21,000 Billion Euros: Does the ECB Single Supervisory Mechanism Affect Bank Competition in the Euro Area?

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Watching over 21,000 Billion Euros: Does the ECB Single Supervisory Mechanism Affect Bank Competition in the Euro Area?

Burkhard Raunig[1], Michael Sigmund[1]

Abstract

Under the Single Supervisory Mechanism (SSM), introduced in 2014, systemically important euro area banks with combined assets of about 21,000 billion euros are directly supervised by the ECB. We examine from a static and a dynamic perspective how this fundamental shift to unified supervision under the SSM affects the competitive position of SSM banks. We find that the SSM reduced competition for SSM banks in countries affected by the sovereign debt crisis. Otherwise, the impact of the SSM was limited or competition increased. Furthermore, our results suggest that anti-competitive side effects of the SSM are unlikely to be permanent.

Keywords: ECB Single Supervisory Mechanism; Banking supervision; Competition; Lerner index; Persistence of profits

JEL Classification: D43; E58; G28

Email addresses: burkhard.raunig@oenb.at (Burkhard Raunig), michael.sigmund@oenb.at (Michael Sigmund)

[1]Oesterreichische Nationalbank (OeNB), Otto-Wagner-Platz 3, A-1090 Vienna, Austria. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Eurosystem or the OeNB. We thank the participants of the EARIE 2023 conference, the World Finance Conference in Norway 2023 and the International Panel Data Conference in Amsterdam 2023.

Non-Technical Summary

The European Union introduced the Single Supervisory Mechanism (SSM) in 2014 to establish a common approach to day-to-day supervision, harmonized supervisory actions and corrective measures, and to ensure the consistent application of regulations and supervisory policies. Before the introduction of the SSM, all banks in the euro area were under the supervision of national authorities. With the introduction of the SSM, about 110 "significant" banks (SSM banks, for short), collectively holding about 82% of all banking assets in the euro area, are now subject to direct supervision by the ECB. The value of bank assets under ECB supervision amounted to about 21,000 billion euros at the beginning of 2015. For comparison, in 2015, the nominal GDP of the USA was 16,310 billion euros, and the nominal GDP of the euro area was 11,150 billion euros.

In this paper, we examine whether the shift to direct and uniform supervision by the ECB affects the competitive position of SSM banks from both a static and a dynamic perspective. The static analysis provides information about SSM effects on the market power of SSM banks. The dynamic analysis provides information about the intensity of competition and potential long-run effects of the SSM.

Examining the impact of the SSM on competition is important because changes in bank competition can affect the financing conditions for millions of consumers and firms in the euro area. Little is known on the effects of regulatory changes on bank competition. There is a tension between bank competition and financial stability. Finally, supervision under the SSM is likely to be more rigorous and consistent than supervision by national authorities.

Our empirical analysis reveals the following pattern: in countries less affected by the sovereign debt crisis, the SSM did not increase the market power of SSM banks. In countries that were heavily affected by the sovereign debt crisis, the SSM contributed to the stability of SSM banks. This stability was achieved either by enabling low-profitability SSM banks to remain in the market, leading to increased profit persistence, or by improving the profitability of SSM banks, resulting in higher Lerner indices. Overall, we find that the SSM has little impact on the long-run profit rates of SSM banks, suggesting that anti-competitive side effects of the SSM are unlikely to be permanent.

1. Introduction

In response to deficiencies in bank regulation and supervision that emerged during the global financial crisis of 2007–2008 and the subsequent sovereign debt crisis, the European Union introduced the Single Supervisory Mechanism (SSM) in November 2014. Prior to the SSM, all banks were supervised by national authorities. Under the SSM, "less significant" banks continue to be supervised by national authorities, while "significant" euro area banks are directly supervised by the European Central Bank (ECB).[2]

Currently, the ECB supervises about 110 significant banks. For convenience, we will refer to these banks as SSM banks from now on. SSM banks collectively hold about 82% of all banking assets in the euro area, which amounted to about 21,000 billion euros at the beginning of 2015. For comparison, in 2015, the nominal GDP of the USA was 16,310 billion euros, and the nominal GDP of the euro area was 11,150 billion euros.[3]

In addition to the SSM, other regulatory reforms have taken place (e.g., Basel III), and the macroeconomic environment has changed as well (e.g., the negative interest rate environment). All these changes apply to all banks in the euro area, however. The shift from national supervision to ECB supervision is the only fundamental regulatory change that applies exclusively to SSM banks. In this paper, we investigate whether the shift to direct and uniform supervision by the ECB affects the competitive position of SSM banks.

Examining the impact of the SSM on competition is important for at least four reasons. First, changes in bank competition can affect the financing conditions for millions of consumers and firms in the euro area. Second, very little is known regarding the effects of regulatory changes on bank competition. The ECB's objective with direct ECB supervision under the SSM is to establish a common approach to day-

[2]A bank is considered significant if it meets at least one of the following criteria: its assets exceed 30 billion euro, it is important for either the country or the euro area as a whole, it engages in important cross-border activities, or it has requested or received funding from the European Stability Mechanism or the European Financial Stability Facility. Significant banks are typically the largest banks in a country. However, "less significant" banks in large euro area countries can be larger than significant banks in small euro area countries.

[3]Total assets of non-SSM banks amounted to approximately 4,000 billion euros in 2015.

to-day supervision, harmonized supervisory actions and corrective measures, and ensure the consistent application of regulations and supervisory policies.[4] However, the ECB does not comment on the possible effects of the SSM on competition.

Third, there is a tension between bank competition and financial stability arising from asymmetric information problems, implicit "too big to fail" insurance and institutional and regulatory design (Beck et al., 2013; Berger et al., 2017). In this context, the competition-fragility view posits that banks under competitive pressure may take excessive risks in the search for yield (Keeley, 1990; Matutes and Vives, 2000; Vives, 2019), leading to increased financial fragility (Jiménez et al., 2013). In contrast, the competition-stability view argues that more competition leads to lower lending rates, promoting firm profitability and reducing default risk (Boyd and De Nicolo, 2005). Anginer et al. (2014), for instance, find that more competition reduces systemic risk, and Goetz (2018) finds for the US that more competition increases bank profitability and reduces the probability of bank failure. In contrast, Martinez-Miera and Repullo (2010) find a U-shaped relationship between competition and bank failure. In any case, from the financial stability perspective, it is crucial to examine whether the SSM increases or decreases competition for SSM banks.

Fourth, it is sometimes argued that regulatory capture can lead to lenient supervision by national authorities (Barth et al., 2012; Boyer and Ponce, 2012). Under the SSM, the ECB supervises SSM banks in cooperation with national supervisors. However, national supervisors act independently from their national board of directors under the SSM, and decisions about SSM banks are made by the ECB's Supervisory Board and approved by the Governing Council. Consequently, supervision under the SSM is likely to be more rigorous and consistent than supervision by national authorities, which may increase confidence in SSM banks and give them a competitive advantage over non-SSM banks. However, more consistent supervision could also increase competition in the banking sector.

In summary, the SSM may have both pro- and anti-competitive effects and the overall impact on competition is difficult to predict based on theoretical considerations alone. An empirical investigation of this

[4] https://www.bankingsupervision.europa.eu/about/thessm/html/index.en.html

issue is therefore essential.

In this paper, we examine the impact of the SSM on competition from both a static and a dynamic perspective. We employ both views for two reasons. First, it allows us to comprehensively measure the impact of the SSM on the competitive position of SSM banks. In particular, the static analysis provides information about SSM effects on the market power of SSM banks, while the dynamic analysis provides information about the intensity of competition and potential long-run effects of the SSM on SSM banks. Second, as we will see, the dynamics of bank profit rates also affects the interpretation and precision of estimated SSM effects on static measures of market power.

In the traditional static view of competition, prices and output are the key choice variables and the focus is on equilibrium outcomes. Outcomes where prices are above marginal costs are interpreted as evidence of market power or collusive behavior that leads to welfare losses for society. The dynamic view of competition (Mueller, 1977, 1986; Geroski and Jacquemin, 1988; Mueller, 1990; Goddard et al., 2011; Gugler and Peev, 2018) adopts a more Schumpeterian perspective, in which equilibria are less important. Competition is seen as a process where many forms of non-price competition also exist. Firms that introduce new successful products gain a competitive advantage and enjoy temporary monopoly rents, but these rents are eroded by competition over time.

Consistent with the static view, we examine how the SSM affects the market power of SSM banks. We measure market power by the Lerner index (Lerner, 1934), which captures the difference between output price and marginal cost at the profit-maximizing output. Other measures of competition such as the Panzar and Rosse H-statistic (Panzar and Rosse, 1987) and the Boone indicator (Boone, 2008) are also used in the literature, but the Lerner index is by far the most popular measure (Blair and Sokol, 2015).[5]

Like any measure of market power, the Lerner Index has certain weaknesses. The Lerner index may be biased when certain assets are incorrectly categorized as output (Shaffer and Spierdijk, 2020). Furthermore, bias can be introduced by non-maximizing behavior (Berger and Humphrey, 1991) and economies

[5] Shaffer and Spierdijk (2020) cite over 45 recent studies that use the Lerner index to measure competition in the banking sector.

of scale (Spierdijka and Zaourasa, 2018). With this in mind, we estimate the Lerner index with the standard inputs and total assets as output using a translog cost function, as is common in the banking literature. We improve on previous studies in that we estimate a system of equations with bank-specific fixed effects to obtain more stable estimates of the Lerner indices.

In the dynamic analysis, we examine whether the intensity of bank competition has changed since the introduction of the SSM. To this end, we use the persistence of profits approach developed in Mueller (1986).[6] In this approach, profit rates are modeled as a reduced form autoregressive process in which the speed of convergence of profit rates reflects the intensity of competition. Competition is intense when profit rates converge quickly to the long-run profit rate, and less intense when profit rates converge slowly.

The literature on bank competition and its implications for financial stability is extensive. For an overview, see Vives (2016). Recent work on competition in the EU banking sector includes Apergis et al. (2016), Coccorese et al. (2021), Cruz-Garcia et al. (2017), Maudos and Vives (2019), and Weill (2013), among others. Most of these studies conclude that competition in the EU banking sector first increased until the financial crisis of 2007-2008 and then decreased slightly because of government bailouts and financial assistance.

In contrast, the literature on the impact of the SSM is small. With respect to bank lending, Fiordelisi et al. (2017) note that the introduction of the SSM had the unintended consequence that SSM banks reduced lending in order to shrink their balance sheets and increase their capitalization. Ampudia et al. (2021) find that firms borrowing from SSM banks shift investments from knowledge-based intangible assets to capital-based physical assets. In terms of profitability, Avgeri et al. (2021) and Raunig and Sigmund (2022) find that the SSM has a positive impact on the profitability of SSM banks. Okolelova and Bikker (2022) is the only work we know of that examines the impact of the SSM on bank competition. Their study covers Austrian, French, German, Italian and Spanish banks over the period 2013–2016. Using the Lerner index and the Boone indicator, they find that the market power of SSM banks in these five countries decreased under the SSM.

[6] See, Goddard et al. (2011) and Gugler and Peev (2018) for recent applications to banking.

Our paper is the first to examine the impact of the SSM on the competitive position of SSM banks from both a static and a dynamic perspective. We cover sixteen euro area countries and estimate Lerner indices and the dynamics of bank profit rates using a panel data set for the period 2004-2019 that includes banks from Austria, Belgium, Cyprus, Germany, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovenia, and Slovakia.

We also point out that the persistence of bank profit rates has implications for estimates of the effects of the SSM on static measures of competition. Static measures of competition, such as the Lerner index, assume that an industry is in long-run equilibrium. However, in most countries bank profit rates converge slowly to long-run profit rates, implying that the banking sector is not in long-run equilibrium. As we will see, SSM effects are still identified when profit rates systematically deviate from long-run profit rates, but the estimated effects should then be interpreted as disequilibrium effects or a combination of equilibrium and disequilibrium effects. We also point out that disequilibrium inflates the standard errors of the estimated SSM effects.

We find average country-specific Lerner indices ranging from about 0.01 to 0.30. During the financial crisis of 2007–2008, the average Lerner index fell slightly in most countries. Otherwise, the country-specific Lerner indices do not show a clear trend. The effects of the SSM on the individual Lerner indices of SSM banks turn out to be heterogeneous. We find positive SSM effects on the Lerner indices of SSM banks from Ireland, Italy and Portugal. For the SSM banks in the other countries, the SSM effects are close to zero or negative.

We find persistent bank profit rates for all countries in our sample, implying that the banking sectors in the countries are not in long-run equilibrium. Since the introduction of the SSM, the persistence of profit rates of SSM banks has fallen significantly in Luxembourg, Malta and Slovenia and has considerably increased in Cyprus, Greece, Netherlands, Portugal, and Slovakia. In the other countries, the persistence of the profit rates of SSM banks has not changed much or has increased only slightly. Finally, in most countries, the SSM has little impact on the projected long-run profit rates of SSM banks.

We continue as follows. In the next section, we explain in detail how we estimate Lerner indices and how we measure the persistence of bank profit rates. In Section 3, we describe how we estimate SSM effects on the Lerner index and discuss how to interpret such estimates. In Section 4, we outline how we estimate changes in the persistence of profit rates of SSM banks. In Section 5, we describe our data and in Section 6 we discuss our empirical results in detail. In the last section, we draw conclusions.

2. Measuring Competition

In this section, we describe how we measure competition. From a static perspective, we measure market power using the Lerner index. Following the dynamic view, we measure the intensity of competition by estimating how fast profit rates converge to their long-run level.

2.1. Lerner Index

The approach to estimating Lerner indices dates back to Iwata (1974) and Appelbaum (1982). Angelini and Cetorelli (2003) were the first to apply the approach to the banking sector. Since then, the Lerner index has been used in many empirical banking studies to measure market power (Maudos and de Guevara, 2004; Maudos and Solís, 2009; Maudos and Vives, 2019; Yildirim and Kasman, 2021).

Using a translog functional form (Christensen et al., 1973), we follow the empirical banking literature (see, Angelini and Cetorelli, 2003; Agoraki et al., 2011; Efthyvoulou and Yildirim, 2014, among others) and specify the following logarithmic cost function:

$$\begin{aligned} ln(C_{it}) \quad = \quad & \alpha_{1i} + s_0 ln(q_{it}) + \tfrac{s_1}{2}(ln(q_{it}))^2 + ln(q_{it}) \textstyle\sum_{j=1}^{3} s_{j+1} ln(w_{jit}) + \\ & \textstyle\sum_{j=1}^{3} c_j ln((w_{jit}) + c_4 ln(w_{1it}) * ln((w_{j3}) + \\ & c_5 ln(w_{1it}) * ln(w_{2it}) + c_6 ln(w_{2it}) * ln(w_{3it}) + \\ & \textstyle\sum_{i=1}^{3} c_{i+6} ln(w_{ji})^2 + \epsilon_{1it} \ , \end{aligned} \tag{1}$$

where $ln(C_{it})$ refers to the logarithm of the bank's total costs, α_{1i} is the bank-specific fixed effect, q_{it} denotes total assets, and ϵ_{1it} is an error term. As is common in the literature, we use interest rate expenses

(w_{1it}), staff expenses (w_{2it}), and other operating expenses (w_{3it}) as input factors. As suggested in Mester (1996), we also include the equity ratio as an additional input factor in an extended version of Eq. (1) to account for the possibility that capital is used as a funding source for loans.

Static Cournot optimization (see Appendix B) shows that the marginal revenue function is equal to the marginal cost function and a mark-up, which leads to

$$p_{it} = \frac{C_{it}}{q_{it}}\left(s_0 + s_1 ln(q_{it}) + \sum_{j=1}^{3} s_{j+1} ln(w_{jit})\right) + \eta_i + \epsilon_{2it} \, , \tag{2}$$

where ϵ_{2it} is an error term and p_{it} is the "price" of the aggregate bank output, which is defined as the sum of interest income, fee and commission service income, income from investment and other income divided by total assets. The term η_i in Eq. (2) captures the average ability of bank i to set the price over its marginal costs. The mark-up for bank i at time t is then defined as $\zeta_{it} = \eta_i + \epsilon_{2it}$.

We calculate ζ_{it} for each bank in each time period as follows. We estimate Eq. (1) and Eq. (2) as a system of equations with bank-specific fixed effects to obtain stable coefficient estimates. We also restrict the parameters s_0, s_1, s_2, s_3, s_4 and s_5, if the equity ratio is used as an additional input, to be identical in both equations to increase the precision of the estimated coefficients (Bresnahan, 1989). Since all right-hand side variables in Eq. (2) depend on the variable C_{it} in Eq. (1), we instrument these variables with all exogenous variables from Eq. (1). As a result, we obtain consistent estimates of the coefficients $\hat{s}_0, \hat{s}_1, \hat{s}_2, \hat{s}_3, \hat{s}_4$ and $\hat{s}_5$. Finally, we calculate the Lerner index for each bank i at time t as

$$L_{it} = \frac{p_{it} - \frac{C_{it}}{q_{it}}\left(\hat{s}_0 + \hat{s}_1 ln(q_{it}) + \sum_{j=1}^{3} \hat{s}_{j+1} ln(w_{jit})\right)}{p_{it}} \, . \tag{3}$$

2.2. *Persistence of Profits*

The static view of competition assumes that a country's banking sector is in long-run equilibrium. Deviations of bank profit rates from long-run profit rates should, therefore, be purely random. In contrast, in the dynamic view, competition may not immediately eliminate excess profits, and profit rates may deviate systematically from long-run profit rates. Moreover, banks may earn permanent rents due to barriers to entry and market power.

Following Cable and Mueller (2008), we assume that the profit rate π_{it} of bank i in year t is made of two components,

$$\pi_{it} = \pi_{ip} + \mu_{it} \ , \tag{4}$$

where π_{ip} is a constant permanent bank-specific profit rate and μ_{it} is a transitory component. In the persistence of profits literature, profits are measured by the return on assets to capture the performance of all assets under the management of a firm (Berger et al., 2000; Chronopoulos et al., 2015; Gugler and Peev, 2018). Since profit rates may vary with the business cycle, we follow Mueller (1990) and compute the normalized profit rate $\pi_{it} = \Pi_{it} - \bar{\Pi}_t$ for bank i in year t as the deviation of the bank's return on assets Π_{it} from the average return on assets $\bar{\Pi}_t$ of the country's banking industry in year t.

In the static view of competition, all firms are in long-run equilibrium. The transitory component μ_{it} would then be a zero mean random variable, representing unsystematic shocks to profitability. Furthermore, under perfect competition, banks cannot permanently earn positive excess rents (i.e., $\pi_{ip} = 0$). If banks have market power or there are barriers to entry, then banks can achieve positive excess profit rates in the long run (i.e., $\pi_{ip} > 0$).

According to the dynamic view of competition, profits erode over time due to competition from incumbent firms, entry of new firms, or the threat of entry. Following the literature, we assume that profit erosion follows a simple first order autoregressive process,

$$\mu_{it} = \lambda_i \mu_{it-1} + u_{it} \ , \tag{5}$$

where $|\lambda_i| < 1$ for stationarity and u_{it} is an error term with zero mean and constant variance. Assuming that Eq. (4) holds every period, μ_{it-1} can be written as

$$\mu_{it-1} = \pi_{it-1} - \pi_{ip} \ . \tag{6}$$

Substituting Eq. (6) into Eq. (5), and then Eq. (5) into Eq. (4) yields

$$\pi_{it} = \pi_{ip}(1 - \lambda_i) + \lambda_i \pi_{it-1} + u_{it} \ , \tag{7}$$

where π_{ip} measures the firm-specific long-run profit rate and λ_i measures the persistence of short-run profit rates. Eq. (7) is the workhorse equation for modeling the dynamics of firm profit rates in the persistence of profits literature.[7]

In measuring the intensity of competition, we focus on the parameter λ_i. A small λ_i indicates that the competition intensity is high, while a large λ_i indicates that the intensity of competition is low. If $\lambda_i = 0$ for all banks in a country, then profit rates fluctuate randomly around the permanent long-run profit rate, and the country's banking sector is in long-run equilibrium.

In long-run equilibrium, there is a connection between the permanent profit rate and the Lerner index. In Eq. (2), $\zeta_{it} = \eta_i + \epsilon_{2it}$ defines the mark-up for bank i at time t as a permanent mark-up η_i plus some random noise. The Lerner index, $L_{it} = \zeta_{it}/p_{it}$, is just the mark-up divided by the price p_{it}. In long-run equilibrium, Eq. (7) simplifies to $\pi_{it} = \pi_{ip} + u_{it}$. Thus, the only difference between π_{it} and ζ_{it} is that ζ_{it} measures profitability as a mark-up over marginal costs, while π_{ip} measures profitability as a deviation from the cross-sectional mean profit rate.

3. Estimating SSM Effects on the Lerner Index

Since we have repeated observations on the same banks over time, we use panel data models to estimate SSM effects on the Lerner index. In these models, we need to control for selection into the SSM to obtain

[7] Eq. (5) could be extended to higher order AR-processes such as $\mu_{it} = \sum_{j=1}^{p} \lambda_{ij}\mu_{it-j} + u_{it}$, which results in $\pi_{it} = \pi_{ip}(1 - \sum_{j=1}^{p} \lambda_{ij}) + \sum_{j=1}^{p} \lambda_{ij}\pi_{it-j} + u_{it}$.

unconfounded estimates of SSM effects. As we will explain shortly, we achieve unconfoundedness by using bank size and bank-specific fixed effects to control for selection into the SSM.

3.1. Econometric Models

We use four models of increasing flexibility to estimate the effects of the SSM on the Lerner index of SSM banks. Our simplest model assumes a constant SSM effect. The next model also assumes a constant SSM effect, but allows for different time effects for SSM and non-SSM banks. In the third model, the SSM effects can vary over time. In the fourth model, the SSM effects can vary over time and the time effects for SSM and non-SSM banks can be different.

The first model is given by the following regression,

$$L_{it} = \delta \cdot SSM_{it} + \beta \cdot BS_{it} + a_i + b_t + \epsilon_{it} , \tag{8}$$

where L_{it} is the Lerner index for bank i at time t, BS_{it} is bank size measured by the log of total assets, a_i is a time-constant bank-specific effect, b_t is an aggregate time effect, and ϵ_{it} is an error term. $SSM_{it} = (G_i \cdot I_t)$ is an indicator variable, where $G_i = 1$ when bank i is an SSM bank and zero otherwise and $I_t = 1$ when the SSM is active and zero otherwise. Hence, $SSM_{it} = 1$ when bank i is an SSM bank and the SSM is active. The coefficient δ measures the SSM effect. The model can be estimated using a standard fixed effects estimator, and robust standard errors can be obtained with a cluster robust variance matrix estimator.

In the second model,

$$L_{it} = \delta \cdot SSM_{it} + \beta \cdot BS_{it} + \theta g_t + a_i + b_t + \epsilon_{it} , \tag{9}$$

the additional term $g_t = (G_i \cdot t)$ allows for different time effects for SSM and non-SSM banks. Thus, SSM_{it} can also be correlated with unobserved variables that are responsible for a specific trend for SSM banks.

The third model,

$$L_{it} = \sum_{\tau=1}^{q} \delta_{+\tau} \cdot SSM_{i,t+\tau} + \sum_{\tau=0}^{m} \delta_{-\tau} \cdot SSM_{i,t-\tau} + \beta \cdot BS_{it} + a_i + b_t + \epsilon_{it} \,, \tag{10}$$

allows for time-varying SSM effects. The q leads (δ_{+1}, ..., δ_{+q}) capture possible anticipatory effects and the *m* lags (δ_0, ..., δ_{-m}) capture the possibly time-varying SSM effects. Since the SSM was first announced in September 2012, Fiordelisi et al. (2017) argue that in 2013 banks could already see whether they would become an SSM bank. Banks may therefore have adapted their business strategy before the launch of the SSM in 2014. To account for this possibility, we allow for an anticipatory SSM effect in 2013.

Our fourth and most flexible model is

$$L_{it} = \sum_{\tau=1}^{q} \delta_{+\tau} \cdot SSM_{i,t+\tau} + \sum_{\tau=0}^{m} \delta_{-\tau} \cdot SSM_{i,t-\tau} + \beta \cdot BS_{it} + \theta g_t + a_i + b_t + \epsilon_{it} \,. \tag{11}$$

This model allows for time-varying SSM effects and different time effects for SSM and non-SSM banks.

For the estimated SSM effects to have a causal interpretation, the effects must not be confounded by variables that affect the outcome variable and at the same time determine selection into the SSM. Bank size almost exclusively determines selection into the SSM. In 2014, for example, 112 out of 116 banks were in the SSM because of their size or their size relative to GDP. To achieve unconfoundedness, we therefore always control for bank size BS_{it}. The other SSM criteria, such as important cross-border activities and direct public financial assistance requested or received from the European Stability Mechanism or the European Financial Stability Facility, play almost no role. Nonetheless, in these few cases, the bank-specific fixed effect should absorb possible confounding effects.

We measure the total (or overall) effect of the SSM on the Lerner index of SSM banks, which subsumes all direct and indirect effects of the SSM. A direct SSM effect could for example result from increased confidence of market participants (e.g., bank customers, other banks and financial institutions in OTC markets) in the soundness of SSM banks. Indirect SSM effects could arise if SSM banks adjust key business variables in response to SSM regulation.

To identify the total effect of the SSM on the Lerner index, we control for selection into the SSM to avoid confounding, but allow direct and indirect SSM effects to operate. Therefore, the models (8) - (11) do not contain any firm-specific control variables other than bank size. If we were to include additional firm-specific variables, we would run the risk of "controlling away" the indirect SSM effects. For example, the SSM could have an indirect effect on market power via adjustments of the capital ratio. If we included the capital ratio as a control variable, our estimated SSM effect would not capture this indirect effect, since the capital ratio would be held constant. We also do not include any macroeconomic variables, as they are not required to identify SSM effects.

3.2. Lerner Index and Persistence of Profits

The static theory behind the Lerner index assumes that a country's banking sector is in long-run equilibrium (Geroski, 1990; Elzinga and Mills, 2011). However, Berger et al. (2000), Goddard et al. (2011) and Gugler and Peev (2018) find that short-run profits of banks decline slowly. Thus, a banking sector may not be in long-run equilibrium at all points in time when the data used to estimate the Lerner index are observed. This raises the question of how disequilibrium affects estimates of SSM effects. We now show that Eq. (8) – Eq. (11) identify the SSM effects in equilibrium and out of equilibrium.

In equilibrium, the estimated Lerner index L_{it} and the equilibrium Lerner index L_i^* should differ only by some random noise (see Section 2.2). In disequilibrium, however, the Lerner index may be estimated with disequilibrium data and therefore contain a systematic measurement error $\epsilon_{it}^d = (L_{it} - L_i^*)$. Following Geroski (1990), we now work out the SSM effect that Eq. (8) estimates in different situations. What follows applies analogously to Eq. (9) – Eq. (11).

In equilibrium, $L_i^* = \delta \cdot SSM_{it} + \beta \cdot BS_{it} + a_i + b_t$ is the systematic part in Eq. (8). In addition to any error ϵ_{it} in Eq. (8), disequilibrium adds a measurement error ϵ_{it}^d and the model becomes

$$L_{it} = \delta \cdot SSM_{it} + \beta \cdot BS_{it} + a_i + b_t + \epsilon_{it} + \epsilon_{it}^d \, . \tag{12}$$

We consider three cases. In the first case, the SSM shifts the equilibrium Lerner index L_i^*. In the second case, the SSM causes disequilibrium and helps to explain the measurement error ϵ_{it}^d. In the third case, the SSM causes disequilibrium and a shift in the equilibrium Lerner index. In all three cases, we allow for the possibility that bank size BS_{it} may also help to explain deviations from equilibrium.

If the SSM only shifts the equilibrium Lerner index L_i^*, then the coefficient δ in Eq. (12) captures this effect correctly, because SSM_{it} is then unrelated with $\epsilon_{i,t}^d$. Since BS_{it} may help to explain the measurement error,

$$\epsilon_{it}^d = \alpha \cdot BS_{it} + \epsilon_{it}^l \ . \tag{13}$$

Substituting Eq. (13) into Eq. (12) shows that the slope coefficient on BS_{it} becomes $(\alpha + \beta)$, but this is unproblematic because we only want to identify the effect of the SSM and not the effect of bank size.

If the SSM causes only disequilibrium and does not shift L_i^*, then $\delta = 0$ and the SSM effect enters via the measurement error $\epsilon_{i,t}^d$. In this case, Eq. (13) becomes

$$\epsilon_{it}^d = \alpha \cdot BS_{it} + \gamma \cdot SSM_{it} + \epsilon_{it}^l \ . \tag{14}$$

Plugging Eq. (14) into Eq. (12) shows that the estimated coefficient on SSM_{it} in Eq. (12) yields γ, which is just the disequilibrium effect of the SSM on the Lerner index.

If the SSM causes disequilibrium and a shift in the equilibrium Lerner index, then $\delta \neq 0$ and the SSM effect also enters via ϵ_{it}^d. Plugging Eq. (14) into Eq. (12) shows that the estimated coefficient for the variable SSM_{it} in Eq. (12) is now $(\delta + \gamma)$, which is the overall effect of the SSM on the Lerner index that results from the equilibrium and disequilibrium effects of the SSM.

As we have just seen, disequilibrium does not impede the estimation of SSM effects, but the estimates may capture disequilibrium effects or a combination of equilibrium and disequilibrium effects. Disequilibrium does, however, inflate the standard errors of the estimated SSM effects because the disequilibrium measurement error ϵ_{it}^{d} adds additional noise to Eq. (8).

4. SSM and the Persistence of Profits

In Section 2.2 we argued that the parameter λ in Eq. (7) measures how quickly competition erodes short-run rents. We now describe how we examine whether the λ for SSM banks has changed since the launch of the SSM. Given that we have fifteen years of data, we do not estimate λ separately for each bank. Instead, we estimate a single λ for all countries and separate λ coefficients for each of the sixteen countries in our sample. Furthermore, to see whether the SSM has an impact on the permanent profit rates of SSM banks, we compute the average long-run projected profit rates for SSM banks before and after the introduction of the SSM for each country.

To measure the λ for SSM banks before and after the introduction of the SSM, we estimate the autoregressive panel data model

$$\pi_{it} = \mu_i + \delta_0 SSM_{it} + \delta_1 \pi_{it-1} SSM_{it} + \lambda \pi_{it-1} + u_{it} \, , \tag{15}$$

where $\mu_i = \pi_{ip}(1 - \lambda)$ is a bank-specific fixed effect and u_{it} is an error term. $SSM_{it} = 1$ if bank i is an SSM bank and the SSM is effective, otherwise $SSM_{it} = 0$. The coefficient δ_0 captures a shift in the fixed effects of SSM banks, and δ_1 captures the change in the λ for SSM banks since the launch of the SSM.

When we estimate a single λ for all countries, we assume that λ is the same for all banks in the sample. Then λ should provide information about the average persistence of profits in the euro area before the introduction of the SSM, and δ_1 should provide information about a change in the average persistence of profits of SSM banks since the introduction of the SSM. When we estimate Eq. (15) separately for each country, we assume that λ is the same for all banks in a country and thus obtain county-specific information about the intensity of competition.

In Eq. (15) the SSM can affect long-run profit rates of SSM banks by changing λ and (or) the "combined" fixed effect $\mu_i + \delta_0$. The long-run projected profit rates that follow from Eq. (15) for SSM banks before and after the introduction of the SSM are

$$\pi_{ip}^{pre} = \frac{\mu_i}{1-\lambda}\,, \tag{16a}$$

$$\pi_{ip}^{ssm} = \frac{\mu_i + \delta_0}{1-(\lambda+\delta_1)}\,. \tag{16b}$$

We calculate the average long-run projected profit rates $\bar{\pi}_{ip}^{pre}$ and $\bar{\pi}_{ip}^{ssm}$ for the SSM banks of a country by averaging over the individual long-run projected profit rates of the SSM banks in the country.

5. Data

Our panel dataset consists of annual balance sheet data for euro area banks over the period 2004–2019 from the SNL Financial's database. Our initial sample contains more than 2,600 banks and includes all banks at the unconsolidated level that report to SNL. Of these banks, 116 are SSM banks. To eliminate outliers and reporting errors, we clean the data in four steps.

First, we remove all banks that report a Tier 1 capital ratio below the minimum regulatory Tier 1 capital ratio of 4% under Basel II. In compliance with legal regulations, it is theoretically possible for a bank to maintain a Tier 1 capital ratio below 4%. However, such a situation triggers intervention by regulatory authorities, who implement rigorous measures to address the issue. These measures may include the dismissal of bank management, revocation of the banking license, and the possibility of forced resolution for the bank.[8] Second, we remove a few banks that seem to report twice with slightly different bank identifiers.[9] Third, for ratios we calculate the interquartile range and discard values outside the four-fold

[8]This ratio was gradually increased to 6% as part of Basel III from 2014 onward.

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

interquartile range to eliminate reporting errors. In the fourth step, we exclude banks that report data for less than three years in our sample period and extremely small banks reporting total assets of less than one million euros.

5.1. Explanatory Variables

Our explanatory variables consist of bank size, measured by the log of total assets, and the variables used to estimate the Lerner index. To estimate the translog cost function given by Eq. (1), we use total assets, interest rate expenses, staff expenses, other operating expenses, the equity ratio, and total costs. Total costs are the sum of interest expenses, labor costs and provisions and other expenses. In the marginal revenue equation given by Eq. (2), we include total income divided by total assets. Total income includes interest income, dividends from equity, fee and commission income, and other non-interest income.

Table 1: Summary statistics

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max	Data.Cov
Input variables							
Total Assets	1,000	282,021	1,097,68	26,445,228	5,199,353	2,601,695,000	61.11
Interest expenses	0	1,602	8,196	499,668	52,233	101,786,000	59.89
Labor Costs	1	3,180	11,093	168,542	44,202	17,553,000	59.45
Labor Costs over TA	0	0.01	0.01	0.01	0.01	0.03	58.39
Provision and other expenses	10	2,403	8,802	157,041	38,522	29,752,000	59.49
Provision and other expenses over TA	0	0.01	0.01	0.01	0.01	0.02	57.21
Total costs	10	8,088	32,073	821,014	151,087	105,905,000	59.73
Total costs over TA	0	0.02	0.03	0.03	0.04	0.09	58.45
Interest income	1	7,118	29,515	796,098	143,360	107,859,000	59.92
Dividends from equity	1	1,399	8,541	52,460	29,032	1,808,000	7.18
Fee and commission income	100	66,259	163,149	737,965	398,975	16,412,000	11.53
Fee and commission expenses	0	9,361	27,776	195,156	104,526	6,500,000	11.56
Net fee and commission income	-576,000	1,464	6,089	124,462	27,893	12,765,000	60.02
Other non-interest income	2	6,102	20,626	101,710	62,048	8,389,000	8.92
Total income	-60,410	9,666	38,5,72	936,603	185,166	109,461,000	60.28
Total income over TA	-0.01	0.03	0.04	0.04	0.04	0.10	59.25
Tier 1 capital ratio	0.04	0.12	0.15	0.16	0.19	0.44	48.40
Lerner indices							
2 SLS Lerner Index (no equity)	-0.36	0.17	0.25	0.24	0.32	0.85	56.41
3 SLS Lerner Index (no equity)	-0.41	0.12	0.20	0.19	0.27	0.80	56.28
2 SLS Lerner Index (equity ratio)	-0.34	0.17	0.25	0.24	0.32	0.81	47.05
3 SLS Lerner Index (equity ratio)	-0.39	0.12	0.19	0.18	0.26	0.75	46.93
Persistence of profits							
ROA before Tax and Risk	-1.56	0.58	0.85	0.88	1.15	3.27	58.13
Dev ROA	-2.81	-0.27	-0.01	0	0.24	2.57	58.13

Data sources: SNL.

The table shows the minimum (Min.), first quantile (1st Qu.), median (Median), mean (Mean), third quantile (3rd Qu.), maximum (Max) and the data coverage (Data Cov.) for the variables used in this paper. Data Cov. refers to the percentage of available observations if the data was a balanced panel. The dataset contains yearly data of over 2,600 banks over the period 2004–2019 for the following countries: Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI) and Slovakia (SK).

All variables except ratios are in thousands of euros.

Provision and other expenses is defined as operating expenses minus compensation benefits.

Total costs are the sum of interest rate expenses and operating expenses, which are the sum of operating DD&A, compensation and benefits, occupancy and equipment, tech and communications expense, marketing and promotion expense, other provisions and other expense.

Total income is defined as the sum of interest income, dividends from equity, other non-interest income, and net fee and commission income. We use net fee and commission income instead of the split fee and commission income and fee and commission expenses, as it has a much higher data coverage. Consequently, we do not include fee and commission expenses in the total costs to avoid double counting.

All Lerner indices are estimated as described in Section 2.1. The 2 SLS Lerner Index (no equity) and the 3 SLS Lerner Index (no equity) are estimated with two-stage least squares and three-stage least squares in a system of equations framework based on Eq. (1) and Eq. (2). The 2 SLS Lerner Index (equity ratio) and the 3 SLS Lerner Index (equity ratio) are estimated in the same way but with the Tier 1 capital ratio as an additional input factor in Eq. (1).

ROA before Tax and Risk refers to the standard definition of return on assets. The sum of net interest income, dividends income from equity, net fee and commission income, and net other non-interest income is divided by total assets.

Dev ROA refers to the deviation of the ROA of bank i in year t in country j from the average ROA of all banks in country j in year t.

5.2. Dependent Variables

The dependent variable in the static analysis is the Lerner index given by Eq. (3). Using Eq. (1) and Eq. (2), we estimate the Lerner index in four different ways. The "2 SLS Lerner Index (no equity ratio)" and the "3 SLS Lerner Index (no equity ratio)" are estimated with two and three-stage least squares using interest rate expenses, staff expenses, and other operating expenses as input factors. The "2 SLS Lerner Index (equity ratio)" and the "3 SLS Lerner Index (equity ratio)" are estimated with the equity ratio (approximated by the Tier 1 capital ratio) as an additional input factor.[10]

The dependent variable in the dynamic analysis is the normalized profit rate (Dev ROA), defined as the deviation of the return on assets of bank i in year t in country j from the average return on assets of all banks in country j in year t. For completeness, we also show the return on assets before tax and risk in Table 1.

6. Empirical Results

In this section, we present our empirical results about the impact of the SSM on the competitive position of SSM banks. First, we describe the evolution of the average Lerner indices for the countries in our sample over time. Next, we present our findings on the SSM effects on the Lerner index and the persistence of profits of SSM banks, both for the euro area and at the county level. In the last subsection, we put our results together and discuss their implications.

6.1. Results for the Lerner Index

We begin with the evolution of the country-specific Lerner indices over the period 2005–2019. As mentioned in Section 5, we estimate the Lerner index in four different ways. Since we obtain very similar results (see Table 1), we report only the results for our most efficient estimate – the 3 SLS Lerner index (equity ratio).

[10] Appendix B and Appendix C provide further details on the estimation of the Lerner indices.

We calculate the country-specific Lerner index in year *t* as an unweighted average over the individual Lerner indices for the banks in a country in year *t*. Table 2 reports the country-specific Lerner indices for each year of the sample period. Most Lerner indices range between 0.01 and 0.30, suggesting low to medium levels of bank market power in most countries. Note that the Lerner indices do not show a strong overall trend, but in many countries the Lerner index falls slightly during the financial crisis and then rises again.

To check the plausibility of our estimated country-specific Lerner indices, we compare them with estimates from other studies. For Austrian banks with subsidiaries in Slovakia and Slovenia, Feldkircher and Sigmund (2017) obtain similar Lerner indices for these countries with quarterly regulatory reporting data over the period 2008–2016. Our results are also similar to those of Yildirim and Kasman (2021), based on BankFocus data for the period 2013–2018. Maudos and Vives (2019) also obtain similar results for selected euro area countries.

Table 2: Average country-specific Lerner index developments over time

Year	AT	BE	CY	DE	ES	FI	FR	GR	IE	IT	LU	MT	NL	PT	SI	SK
2005	0.17	0.16	0.22	0.06	0.23	0.15	0.01	0.26	0.17	0.24	0.07		0.09	0.11		
2006	0.12	0.14	0.24	0.06	0.19	0.11	0.02	0.18	0.11	0.25	0.08	0.05	0.04	0.13	0.21	
2007	0.11	0.09	0.23	0.06	0.17	0.14	0.07	0.15	0.07	0.21	0.09	0.24	-0.01	0.14	0.16	
2008	0.12	0.11	0.15	0.08	0.14	0.11	0.09	0.13	0.07	0.19	0.09	0.23	0.02	0.13	0.18	0.27
2009	0.16	0.12	0.13	0.11	0.23	0.10	0.14	0.14	0.13	0.23	0.16	0.24	-0.01	0.14	0.22	0.24
2010	0.20	0.14	0.12	0.18	0.17	0.06	0.17	0.16	0.24	0.15	0.15	0.32	0.09	0.21	0.24	0.25
2011	0.20	0.12	0.20	0.18	0.15	0.12	0.16	0.13	0.20	0.17	0.18	0.25	0.10	0.21	0.20	0.29
2012	0.15	0.12	0.18	0.17	0.20	0.08	0.13	0.01	0.15	0.17	0.20	0.23	0.06	0.19	0.18	0.24
2013	0.17	0.17	0.21	0.19	0.19	0.06	0.16	0.11	0.14	0.14	0.21	0.25	0.15	0.17	0.15	0.30
2014	0.20	0.21	0.27	0.20	0.25	0.13	0.17	0.20	0.14	0.13	0.24	0.23	0.17	0.20	0.20	0.35
2015	0.19	0.24	0.27	0.21	0.26	0.14	0.19	0.24	0.17	0.11	0.23	0.30	0.18	0.21	0.25	0.35
2016	0.19	0.22	0.23	0.22	0.20	0.11	0.17	0.25	0.20	0.10	0.20	0.29	0.15	0.25	0.25	0.30
2017	0.20	0.21	0.18	0.23	0.26	0.10	0.19	0.22	0.19	0.13	0.18	0.25	0.19	0.26	0.23	0.35
2018	0.22	0.21	0.16	0.23	0.28	0.14	0.19	0.22	0.15	0.16	0.15	0.29	0.18	0.24	0.28	0.34
2019	0.24	0.21	0.11	0.22	0.26	0.15	0.18	0.21	0.13	0.15	0.21	0.25	0.17	0.24	0.28	0.29

Source: SNL, authors' calculations.
This table reports the average Lerner index of banks in Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI) and Slovakia (SK) over the period 2005–2019.
To calculate the mean Lerner index for each country in each time period, we first estimate the Lerner index for each bank in each time period in accordance with Eq. (3). Second, we calculate the (unweighted) mean for each country and time period based on the all available bank-specific Lerner indices.

We now turn to the effects of the SSM on the market power of SSM banks. Table 3 shows the SSM effects estimated with the full sample of over 2,200 banks. In all four models, the SSM effects are very small and rather imprecisely estimated. The coefficient on the SSM dummy for 2013 in Eq. (10) and Eq. (11) is also very small, indicating that there are no announcement effects. In the most flexible specification Eq. (11), the SSM effects increase over time from about 0.019 in 2016 to 0.043 in 2019, but these estimates are also small and rather imprecise. As explained in Section 3.2, the low precision may be due to disequilibrium measurement error.

Tables 4 and 5 report the country-specific SSM effects obtained with our most flexible specification given by Eq. (11). For comparison, the first column in Table 4 again shows the results for the entire euro area. As before, the SSM effects are often imprecisely estimated. However, for some countries, the SSM effects are quite large and statistically significant. In particular, we find sizable positive SSM effects for Ireland, Italy, and Portugal, suggesting that the market power of SSM banks increased in these countries. It is striking that all three countries were at the center of the sovereign debt crisis. In contrast, the SSM effects are often slightly negative in most of the other countries, indicating that the market power of SSM banks may have slightly declined. We find the strongest negative SSM effects for Austria, Malta, the Netherlands, and Slovakia.

Table 3: SSM effects on Lerner Index

	Lerner Index 1	Lerner Index 2	Lerner Index 3	Lerner Index 4
log(TA)	0.0388^{***}	0.0387^{***}	0.0389^{***}	0.0391^{***}
	(0.0109)	(0.0109)	(0.0109)	(0.0109)
SSM dummy	0.0106	0.0160		
	(0.0109)	(0.0126)		
SSM 2013			−0.0045	0.0054
			(0.0103)	(0.0109)
SSM 2014			0.0057	0.0185
			(0.0111)	(0.0145)
SSM 2015			0.0127	0.0285
			(0.0138)	(0.0191)
SSM 2016			0.0002	0.0190
			(0.0149)	(0.0220)
SSM 2017			0.0113	0.0330
			(0.0141)	(0.0249)
SSM 2018			0.0153	0.0400
			(0.0142)	(0.0275)
SSM 2019			0.0153	0.0429
			(0.0153)	(0.0304)
$G_i \times t$		−0.0009		−0.0029
		(0.0016)		(0.0027)
Year 2006	-0.0112^{*}	-0.0105^{*}	-0.0112^{*}	−0.0092
Year 2007	-0.0256^{***}	-0.0244^{***}	-0.0255^{***}	-0.0220^{***}
Year 2008	-0.0419^{***}	-0.0404^{***}	-0.0418^{***}	-0.0373^{***}
Year 2009	−0.0108	−0.0090	−0.0107	−0.0053
Year 2010	0.0031	0.0053	0.0034	0.0099
Year 2011	0.0090	0.0113	0.0093	0.0160
Year 2012	−0.0086	−0.0062	−0.0083	−0.0014
Year 2013	−0.0052	−0.0028	−0.0047	0.0018
Year 2014	0.0063	0.0085	0.0069	0.0133
Year 2015	0.0046	0.0068	0.0048	0.0112
Year 2016	−0.0006	0.0016	0.0003	0.0067
Year 2017	0.0133	0.0156	0.0135	0.0199
Year 2018	0.0186^{*}	0.0209^{*}	0.0186^{*}	0.0250^{*}
Year 2019	0.0080	0.0105	0.0079	0.0143
Bank FE	*yes*	*yes*	*yes*	*yes*
R-squared	0.72	0.72	0.72	0.72
Adj. R-squared	0.68	0.68	0.68	0.68
Number of obs.	18,585	18,585	18,585	18,585
Number of groups	2,229	2,229	2,229	2,229
Average. Obs. group	8.34	8.34	8.34	8.34
Min. Obs. group	3	3	3	3
Max. Obs. Group	15	15	15	15

Source: Own calculations. SNL.
The dependent variable is 3 SLS Lerner Index (equity ratio).
log(TA) refers to the logarithm of total assets. Bank FE denote bank fixed effects.
SSM is a dummy variable that is 1 when a bank is an SSM bank and the SSM is active and 0 otherwise. The SSM 2013-SSM 2019 dummies are 1 for SSM banks when the SSM is active or anticipated in the corresponding year and 0 otherwise. $g_t = G_i \times t$, where G_i is a dummy variable which is one when a bank belongs to the group of SSM banks and is zero otherwise. The variable t denotes time.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the bank level.

Table 4: SSM on Lerner Index: Euro Area and AT to GR

	EA	AT	BE	CY	DE	ES	FI	FR	GR
log(TA)	0.0391***	0.0216	−0.0634	0.1055**	0.0620***	−0.0302	0.0715***	0.0037	0.0527
	(0.0109)	(0.0206)	(0.0521)	(0.0511)	(0.0165)	(0.0407)	(0.0250)	(0.0265)	(0.0735)
SSM 2013	0.0054	−0.0245	−0.0315	−0.0286	0.0006	−0.0257	0.1168	−0.0323	−0.0581
	(0.0109)	(0.0459)	(0.0389)	(0.0506)	(0.0118)	(0.0532)	(0.1184)	(0.0276)	(0.0579)
SSM 2014	0.0185	−0.0868	−0.0162	0.0263	−0.0157	−0.0168	0.0850	−0.0194	−0.0731
	(0.0145)	(0.0738)	(0.0472)	(0.1028)	(0.0210)	(0.0548)	(0.0946)	(0.0354)	(0.0721)
SSM 2015	0.0285	−0.1679	−0.0106	−0.0518	−0.0041	−0.0070	0.1473	−0.0307	−0.1388*
	(0.0191)	(0.1073)	(0.0682)	(0.1226)	(0.0232)	(0.0664)	(0.1138)	(0.0421)	(0.0793)
SSM 2016	0.0190	−0.1446	−0.0298	−0.0087	−0.0503	0.0480	0.0911	−0.0336	0.0156
	(0.0220)	(0.1258)	(0.0859)	(0.1068)	(0.0312)	(0.0728)	(0.0855)	(0.0403)	(0.0764)
SSM 2017	0.0330	−0.1639	−0.0222	−0.0406	−0.0234	0.0380	0.0745	−0.0230	0.0713
	(0.0249)	(0.1295)	(0.1080)	(0.1248)	(0.0342)	(0.0834)	(0.0878)	(0.0513)	(0.0733)
SSM 2018	0.0400	−0.1940	−0.0538	−0.0765	−0.0108	0.0412	−0.0662	−0.0515	0.0067
	(0.0275)	(0.1536)	(0.1011)	(0.1133)	(0.0410)	(0.0962)	(0.0811)	(0.0625)	(0.0801)
SSM 2019	0.0429	−0.2163	−0.0882	−0.0341	−0.0241	0.0948	−0.1758	−0.0411	0.0604
	(0.0304)	(0.1614)	(0.1194)	(0.1244)	(0.0435)	(0.1067)	(0.1113)	(0.0645)	(0.0982)
g_t	−0.0029	0.0089	0.0026	0.0052	0.0050	−0.0065	−0.0105	0.0012	0.0251***
	(0.0027)	(0.0129)	(0.0077)	(0.0119)	(0.0046)	(0.0102)	(0.0122)	(0.0048)	(0.0077)
Year 2006	−0.0092	−0.0085	−0.0034	0.0187	−0.0052	−0.0181	−0.0135	−0.0117	−0.0604**
Year 2007	−0.0220***	−0.0294**	−0.0136	0.0080	−0.0175	−0.0012	−0.0685*	−0.0035	−0.1054***
Year 2008	−0.0373***	−0.0093	−0.0372**	−0.0671	−0.0276	−0.0292	−0.1093***	0.0130	−0.1585***
Year 2009	−0.0053	0.0120	0.0082	−0.1003*	−0.0135	0.0616***	−0.0749	0.0705***	−0.1637***
Year 2010	0.0099	0.0517**	0.0440	−0.0730	0.0052	−0.0178	−0.0995*	0.1028***	−0.1573**
Year 2011	0.0160	0.0556***	0.0310	0.0232	0.0042	−0.0142	−0.0395	0.0922***	−0.2179***
Year 2012	−0.0014	0.0081	0.0326	−0.0349	−0.0075	0.0377	−0.0831	0.0681**	−0.3448***
Year 2013	0.0018	0.0218	0.0705	0.0269	0.0033	0.0405	−0.1228**	0.1038***	−0.2728***
Year 2014	0.0133	0.0511**	0.0735***	0.0704	0.0056	0.0912	−0.0523	0.1059***	−0.2240***
Year 2015	0.0112	0.0428**	0.0966***	0.0907	0.0097	0.0970	−0.0482	0.1204***	−0.1577**
Year 2016	0.0067	0.0265	0.0895**	0.0178	0.0183	0.0314	−0.0739	0.1146***	−0.2292***
Year 2017	0.0199	0.0349	0.0850	−0.0366	0.0286	0.0995	−0.0782	0.1186***	−0.2693***
Year 2018	0.0250*	0.0525**	0.0861***	−0.0583	0.0222	0.1315**	−0.0458	0.1134***	−0.2727***
Year 2019	0.0143	0.0694***	0.1008***	−0.1735*	0.0064	0.1085	−0.0608	0.1037***	−0.3449***
Bank FE	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
R-squared	0.72	0.75	0.78	0.73	0.80	0.60	0.60	0.85	0.77
Adj. R-squared	0.68	0.72	0.72	0.63	0.78	0.51	0.54	0.83	0.70
N. of obs.	18,585	3,444	229	134	7,335	641	672	853	161
N. of groups	2,229	422	26	16	875	88	73	93	18
Avg. Obs. group	8.34	8.16	8.81	8.38	8.38	7.28	9.21	9.17	8.94
Min. Obs. group	3	3	3	5	3	3	5	3	3
Max. Obs. Group	15	15	15	14	15	15	15	15	15
N. of SSM banks	102	6	6	3	20	8	4	10	4

Source: Own calculations. SNL.
The dependent variable is 3 SLS Lerner Index (equity ratio).
Countries/Area: Euro area (EA), Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR).
log(TA) refers to the logarithm of total assets. Bank FE denote bank fixed effects.
SSM is a dummy variable that is 1 when a bank is an SSM bank and the SSM is active and 0 otherwise. The SSM 2013-SSM 2019 dummies are 1 for SSM banks when the SSM is active or anticipated in the corresponding year and 0 otherwise. $g_t = G_i \times t$, where G_i is a dummy variable which is one when a bank belongs to the group of SSM banks and is zero otherwise. The variable t denotes time.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the bank level.

Table 5: SSM on Lerner Index: IE to SK

	IE	IT	LU	MT	NL	PT	SI	SK
log(TA)	0.0050	0.0898***	0.0026	−0.1532***	−0.0685*	0.0040	0.0034	0.1525
	(0.0209)	(0.0167)	(0.0476)	(0.0423)	(0.0367)	(0.0917)	(0.0414)	(0.1019)
SSM 2013	0.0861	0.0291	−0.0299	−0.1472*	−0.0189	−0.0270	−0.1362**	−0.0569
	(0.0726)	(0.0240)	(0.0624)	(0.0785)	(0.0323)	(0.0288)	(0.0676)	(0.0703)
SSM 2014	0.1521	0.0681***	−0.0735	−0.2129**	−0.0765**	0.0952	0.0385	−0.1333
	(0.0946)	(0.0256)	(0.0909)	(0.0808)	(0.0387)	(0.0758)	(0.1323)	(0.1018)
SSM 2015	0.2349*	0.0722*	−0.0677	−0.2799***	−0.1370*	0.0546	0.1975***	−0.1380
	(0.1319)	(0.0439)	(0.1280)	(0.0904)	(0.0702)	(0.0560)	(0.0512)	(0.1349)
SSM 2016	0.2393	0.0740	−0.0934	−0.2862**	−0.1247	0.0810	0.0980**	−0.1584
	(0.2489)	(0.0457)	(0.1403)	(0.1289)	(0.0786)	(0.0695)	(0.0431)	(0.1711)
SSM 2017	0.3501	0.1102**	−0.0734	−0.2514**	−0.1377	0.1017	0.0728	−0.2124
	(0.2640)	(0.0435)	(0.1545)	(0.1223)	(0.1082)	(0.0848)	(0.0588)	(0.2190)
SSM 2018	0.4967**	0.1364***	−0.1096	−0.3493**	−0.1313	0.1965**	0.0868	−0.1822
	(0.2330)	(0.0423)	(0.1608)	(0.1442)	(0.1149)	(0.0859)	(0.0608)	(0.2426)
SSM 2019	0.4993**	0.1541***	−0.1772	−0.4636***	−0.1389	0.2651***	0.0934	−0.1533
	(0.2274)	(0.0475)	(0.1958)	(0.1457)	(0.1167)	(0.0772)	(0.0593)	(0.2940)
g_t	−0.0376**	−0.0165***	0.0143	0.0344**	0.0228**	−0.0021	0.0023	0.0215
	(0.0166)	(0.0041)	(0.0240)	(0.0161)	(0.0092)	(0.0072)	(0.0070)	(0.0347)
Year 2006	0.0019	0.0088	0.0341		−0.0239	0.0108		
Year 2007	−0.0172	−0.0184	0.0821	0.2007**	−0.0396	0.0137	−0.0169	
Year 2008	−0.0366	−0.0452**	0.0780**	0.1886***	−0.0349	0.0032	−0.0006	
Year 2009	0.0446	−0.0092	0.1510***	0.1921***	−0.0645	0.0081	−0.0026	0.0152
Year 2010	0.0935	0.0045	0.1596***	0.2667***	−0.0443	0.0035	−0.0132	0.0487
Year 2011	0.0879	0.0270	0.1386***	0.2022***	−0.0418	0.0147	−0.0517	0.0846
Year 2012	0.0595	0.0242	0.1564***	0.1830***	−0.0785*	−0.0055	−0.0770*	0.0190
Year 2013	0.0670	−0.0132	0.1779***	0.2143***	−0.0259	−0.0195	−0.0942**	0.0750
Year 2014	0.0764	−0.0255	0.1941***	0.2426***	0.0172	0.0016	−0.0661	0.1360
Year 2015	0.0776	−0.0522**	0.1735***	0.3172***	0.0116	0.0142	−0.0546	0.1167
Year 2016	0.0611	−0.0659***	0.1198**	0.2849***	−0.0206	0.0629	−0.0425	0.0702
Year 2017	0.0284	−0.0394*	0.1295***	0.2552***	−0.0152	0.0678	−0.0600	0.0903
Year 2018	−0.0473	−0.0111	0.0919	0.3184***	−0.0211	0.0388	−0.0119	0.0544
Year 2019	−0.0579	−0.0321	0.1132**	0.3192***	−0.0338	0.0331	−0.0101	−0.0175
Bank FE	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
R-squared	0.70	0.69	0.74	0.75	0.73	0.62	0.66	0.71
Adj. R-squared	0.60	0.65	0.67	0.65	0.67	0.55	0.56	0.59
N. of obs.	182	3,204	260	119	299	569	179	107
N. of groups	22	384	36	13	34	64	20	12
Avg. Obs. group	8.27	8.34	7.22	9.15	8.79	8.89	8.95	8.92
Min. Obs. group	3	3	3	3	3	3	3	4
Max. Obs. Group	15	15	15	13	15	15	14	12
N. of SSM banks	4	13	5	3	5	3	3	3

Source: Own calculations. SNL.
The dependent variable is 3 SLS Lerner Index (equity ratio).
Countries: Ireland IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI), Slovakia (SK).
log(TA) refers to the logarithm of total assets. Bank FE denote bank fixed effects.
SSM is a dummy variable that is 1 when a bank is an SSM bank and the SSM is active and 0 otherwise. The SSM 2013-SSM 2019 dummies are 1 for SSM banks when the SSM is active or anticipated in the corresponding year and 0 otherwise. $g_t = G_i \times t$, where G_i is a dummy variable which is one when a bank belongs to the group of SSM banks and is zero otherwise. The variable t denotes time.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the bank level.

6.2. Results for the Persistence of Profits

We now turn to the results for the persistence of SSM banks' profit rates before and after the introduction of the SSM. Since Eq. (15) is a dynamic fixed effects model, the standard fixed effects estimator yields inconsistent estimates for λ, even if the number of cross-sectional units tends towards infinity (Nickell, 1981). This "Nickel bias" can be quite severe when the time dimension is small. To obtain consistent estimates for λ, we therefore use the system GMM estimator of Blundell and Bond (1998), as implemented by Sigmund and Ferstl (2021). As described in Section 4, we estimate Eq. (15) for euro area as a whole and for the individual countries. Table 6 and Table 7 show the results.

The first column (EA) in Table 6 shows the estimates for Eq. (15) for the euro area based on the full sample. The persistence parameter λ before the introduction of the SSM is 0.40 and highly statistically significant, implying that bank profit rates do not erode quickly. The estimated δ_1, the change in the persistence of profits of SSM banks, is about 0.29 and also highly statistically significant. This suggests that overall, the persistence of profits of SSM banks has increased since the introduction of the SSM.

The country-specific estimates for Eq. (15), reported in the other columns of Tables 6 and 7, present a more nuanced picture. The country-specific pre-SSM estimates for λ range from 0.20 to 0.75, and almost all the estimates are statistically significant. Since our estimates are clearly positive, this suggests that the banking sectors in the countries are not in long-run equilibrium. Moreover, our pre-SSM estimates for λ are also similar to those in Goddard et al. (2011).

We now turn to the estimates for δ_1 – the change in λ since the introduction of the SSM. For Belgium, Spain, France, and Ireland δ_1 is close to zero. For Austria, Finland, and Italy δ_1 is about 0.20, which implies some increase in the persistence of short-run profit rates of SSM banks. For Luxembourg, Malta, and Slovenia δ_1 is negative, suggesting that competitive pressure on SSM banks has increased in these countries. For Cyprus, Greece, Netherlands, Portugal, and Slovakia the estimated δ_1 is well above 0.30, indicating a substantial increase in the persistence of SSM banks' profit rates in these countries since the launch of the SSM. Note that these five countries all struggled during the European debt crisis, with Cyprus, Greece, and Portugal requiring assistance from the ECB or the International Monetary Fund to manage their debt.

The last two rows in Tables 6 and 7 show the country-specific average long-run projected profit rates for SSM banks before the SSM ($\bar{\pi}_{ip}^{pre}$) and after the introduction of the SSM ($\bar{\pi}_{ip}^{ssm}$).[11] In half of the countries, the SSM has essentially no impact on the average long-run profit rate of SSM banks, as neither δ_0 nor δ_1 are statistically significant for these countries. The SSM effect on the long-run project profit rate in the euro area estimation is also close to 0. In almost all the other countries, the effect of the SSM on long-run profit rates is also rather modest. A notable exception is Greece, where we observe a noticeable increase in average long-run projected profit rates of SSM banks. A possible explanation for this increase might be that the direct supervision of the troubled SSM banks in Greece by the ECB has boosted confidence in the stability of these banks.

[11] As the numbers for $\bar{\pi}_{ip}^{ssm}$ are based on the estimated changes in λ and μ_i, regardless of whether these changes are statistically significant or not, they should be interpreted as an upper (lower) bound.

Table 6: Country level SSM effects on persistence of profits: EA and AT to GR

	EA	AT	BE	CY	DE	ES	FI	FR	GR
Dev ROA (-1)	0.4008^{***}	0.2627^{***}	0.6085^{***}	0.4816	0.4275^{***}	0.3667^{***}	0.2658^{***}	0.5032^{***}	0.4006^{***}
	(0.0256)	(0.0535)	(0.1787)	(0.3947)	(0.0465)	(0.0637)	(0.0500)	(0.1027)	(0.1112)
Dev ROA (-1) x SSM	0.3095^{***}	0.2009	0.0281	0.4386	0.1197	−0.0292	0.2076	0.0688	0.5547^{**}
	(0.0557)	(0.1763)	(0.1770)	(0.5977)	(0.1454)	(0.2049)	(0.2494)	(0.2036)	(0.2685)
SSM dummy	−0.0013	0.1170^{**}	0.0141	-0.1009^{**}	−0.0781	0.1391^{**}	-0.1724^{***}	−0.0188	−0.0419
	(0.0140)	(0.0465)	(0.0455)	(0.0437)	(0.0569)	(0.0699)	(0.0480)	(0.0395)	(0.0511)
Bank FE	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Number of Obs	17,569	2,970	305	148	6,937	664	553	1,583	164
Number of Groups	2,483	440	38	21	914	118	77	187	23
Obs per group: min	1	1	1	3	1	1	2	1	1
Obs per group: avg	7.10	6.80	8.00	7.00	7.60	5.60	7.20	8.50	7.10
Obs per group: max	13	13	13	13	13	13	13	13	13
N. of SSM banks	113	7	7	3	21	13	4	12	4
Hansen statistics:	95.49	9.31	11.33	3.82	50.17	15.31	19.06	26.11	3.07
nof para:	11	10	10	10	10	10	10	10	10
p-value:	0.00	0.50	0.33	0.96	0.00	0.12	0.04	0.00	0.98
SSM banks									
$\bar{\pi}_{ip}^{pre}$	−0.02	0.27	−0.20	0.11	−0.27	0.13	0.07	−0.12	0.33
$\bar{\pi}_{ip}^{ssm}$	−0.05	0.59	−0.18	−0.52	−0.51	0.33	−0.23	−0.19	3.49

Source: Own calculations. SNL.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

We apply the two-step system GMM estimator by Blundell and Bond (1998) with Windmeijer corrected standard errors (Windmeijer, 2005). The dependent variable is Dev ROA (the deviation of the return on assets of bank *i* at time *t* from the country average at time *t*).

Dev ROA (-1) is the lagged dependent variable by one year. Dev ROA (-1) x SSM is an interaction term of Dev ROA (-1) and the SSM dummy. The SSM dummy is a dummy variable that is 1 when a bank is an SSM bank and the SSM is active and 0 otherwise.

$\bar{\pi}_{ip}^{pre}$ refers to the average long-run projected profit rate of all SSM banks in a country before the SSM. $\bar{\pi}_{ip}^{ssm}$ refers to the average long-run projected profit rate of all SSM banks after the introduction of the SSM.

Countries/Area: Euro area (EA), Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR).

Table 7: Country level SSM effects on persistence of profits: IE to SK

	IE	IT	LU	MT	NL	PT	SI	SK
Dev ROA (-1)	0.7583***	0.4256***	0.4207***	0.5448**	0.4065	0.1921**	0.2958***	0.3360*
	(0.2162)	(0.0389)	(0.1633)	(0.2723)	(0.2608)	(0.0845)	(0.0808)	(0.1975)
Dev ROA (-1) x SSM	0.0158	0.3921***	−0.1851	−0.4109	0.4900	0.3603**	−0.3544	0.4774
	(0.2988)	(0.0983)	(0.2655)	(1.3890)	(0.3027)	(0.1437)	(0.2724)	(0.3495)
SSM dummy	−0.0226	0.0155	−0.0228	−0.1665	−0.0009	0.0046	0.4479***	−0.2469
	(0.0942)	(0.0460)	(0.0919)	(0.2399)	(0.0371)	(0.1818)	(0.1023)	(0.2303)
Bank FE	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Number of Obs.	228	2,469	451	114	277	454	144	108
Number of Groups	29	393	77	16	45	68	21	16
Obs per group: min	1	1	1	1	1	1	1	2
Obs per group: avg	7.90	6.30	5.90	7.10	6.20	6.70	6.90	6.80
Obs per group: max	13	13	13	13	13	13	13	11
N. of SSM banks	4	13	5	3	7	4	3	3
Hansen statistics:	11.30	9.57	16.96	9.15	15.59	7.19	5.11	7.80
nof para:	10	10	10	10	10	10	10	10
p-value:	0.33	0.48	0.08	0.52	0.11	0.71	0.88	0.65
SSM banks								
$\bar{\pi}_{ip}^{pre}$	−0.15	−0.08	0.05	0.17	−0.05	−0.13	0.03	0.65
$\bar{\pi}_{ip}^{ssm}$	−0.26	−0.17	0.01	−0.10	−0.28	−0.23	0.44	1.00

Source: Own calculations. SNL.

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

We apply the two-step system GMM estimator by Blundell and Bond (1998) with Windmeijer corrected standard errors (Windmeijer, 2005).

The dependent variable is Dev ROA (the deviation of the return on assets of bank *i* at time *t* from the country average at time *t*). Dev ROA (-1) is the lagged dependent variable by one year. Dev ROA (-1) x SSM is an interaction term of Dev ROA (-1) and the SSM dummy. The SSM dummy is a dummy variable that is 1 when a bank is an SSM bank and the SSM is active and 0 otherwise.

$\bar{\pi}_{ip}^{pre}$ refers to the average long-run projected profit rate of all SSM banks in a country before the SSM. $\bar{\pi}_{ip}^{ssm}$ refers to the average long-run projected profit rate of all SSM banks after the introduction of the SSM.

Countries: Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI), Slovakia (SK).

6.3. *The Results Combined*

We now combine the results from the static and the dynamic analyses to obtain a comprehensive picture of the competitive effects of the SSM. Table 8 provides a summary of our main results for the sixteen euro area countries. We begin with the Lerner index and then proceed to the persistence of profits and long-run projected profit rates.

We find positive trends in the Lerner index for SSM banks in Greece, Malta, and the Netherlands, and negative trends for Ireland and Italy.[12] For the other countries, we find no separate trend in the Lerner index for SSM banks. In these countries, the SSM effects on the Lerner index are almost always close to zero or negative, indicating an increase in competition from the static point of view.

From a static perspective, the SSM has contributed to increased competition in Greece, Malta, and the Netherlands, by mitigating the positive trend in the Lerner index of SSM banks. In Ireland and Italy, the SSM has reduced competition, as the SSM counteracts the negative trend in the Lerner index. However, in both of these countries, the profit rates of SSM banks are below average. Consequently, the SSM has helped to improve the profit rates of SSM banks in these countries (see Tables 9 and 10). The SSM also led to an increase of the Lerner index for Portuguese SSM banks, whose average profitability was also below average.

The persistence of profit rates of SSM banks has either remained unchanged or increased only moderately in seven countries since the introduction of the SSM, while it has decreased in three countries. In nine out of these ten countries, the SSM effects on the Lerner index are also close to zero or negative. However, in Ireland, which faced significant challenges during the sovereign debt crisis, the SSM also increased the Lerner index.

The persistence of SSM banks' profit rates increased rather sharply in Cyprus, Greece, Italy, Netherlands, Portugal, and Slovakia. However, the increase in persistence is statistically significant only for Italy, Greece, and Portugal. Furthermore, profit persistence in these countries was typically at an average or

[12] The column "Trend" in Table 8 refers to the coefficient of g_t in Tables 4 and 5.

below average level before the introduction of the SSM. More importantly, these are again all countries that faced difficulties during the sovereign debt crisis.

Finally, we turn to the question of whether the SSM has an impact on the long-run profit rates of SSM banks? Our results suggest that this is unlikely to be the case, as except for Greece, country-specific average long-run projected profit rates show little or no change.

In summary, our empirical analysis reveals the following pattern: in countries less affected by the sovereign debt crisis, the SSM did not increase the market power of SSM banks. In countries that were heavily affected by the sovereign debt crisis, the SSM contributed to the stability of SSM banks. This stability was achieved either by enabling low-profitability SSM banks to remain in the market, leading to increased profit persistence, or by improving the profitability of SSM banks, resulting in higher Lerner indices.

Table 8: Overview of competitive effects of SSM on SSM banks

	Lerner Index		Persistence of Profits		
Country	Trend	SSM effects	Pre-SSM λ	SSM effect on λ	SSM effect on $\bar{\pi}_{ip}$
AT	no	negative	below average	small increase	modest increase
BE	no	zero	above average	no change	no change
CY	no	zero	average	large increase	modest decrease
DE	no	zero	average	small increase	no change
ES	no	zero	average	no change	small increase
FI	no	positive/negative	below average	small increase	small decrease
FR	no	zero	above average	no change	no change
GR	positive	negative/zero	average	large increase	large increase
IE	negative	positive	above average	no change	no change
IT	negative	positive	average	large increase	no change
LU	no	zero/negative	average	small decrease	no change
MT	positive	negative	above average	large decrease	no change
NL	positive	negative	average	large increase	no change
PT	no	positive	below average	large increase	small decrease
SI	no	positive/zero	below average	large decrease	modest increase
SK	no	negative	below average	large increase	no change

Countries: Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI), Slovakia (SK).
Lerner Index: Trend refers to the coefficient of g_t reported in Tables 4 and 5. SSM effects refer to the estimated coefficients on SSM 2013 to SSM 2019 dummies reported in Tables 6 and 7.
Persistence of Profits: Pre-SSM λ refers to the estimated coefficient on Dev ROA (-1) reported in Tables 6 and 7. SSM effect on λ refers to the estimated coefficient on Dev ROA (-1) x SSM in Tables 6 and 7. "No change","small increase (decrease)", and "large increase (decrease)" means that the change in λ is close to 0, below 0.3, and above 0.3, respectively. SSM effect on $\bar{\pi}_{ip}$ refers to the change in the average long-run projected profit rates of SSM banks. "Large increase ","modest increase (decrease)", "small increase (decrease)" means that the change is above 1 pp, between 1 - 0.3 pp , below 0.3 pp, respectively. "No change" means that the estimated change in λ and μ_i in Eq. (15) is statistically insignificant, implying no change in the long-run projected profit rates of SSM banks under conservative interpretation.

Table 9: Mean deviations of return on assets of SSM banks from the country averages

	AT	BE	CY	DE	ES	FI	FR	GR	IE	IT	LU	MT	NL	PT	SI	SK
2005	-0.00	-0.09	0.12	-0.22	0.22	0.05	-0.41	0.57	0.21	-0.05			-0.36	-0.04	0.00	
2006	0.26	-0.09	0.12	-0.22	0.37	0.14	-0.42	0.67	0.24	-0.05	-0.63		-0.37	-0.04	-0.01	
2007	0.51	-0.17	-0.05	-0.20	0.44	0.12	-0.44	0.82	0.24	-0.19	-0.33	-0.05	-0.23	-0.15	-0.14	
2008	0.10	-0.16	0.30	-0.38	0.43	0.11	-0.35	0.76	0.23	-0.18	0.06	-0.04	-0.02	0.08	0.12	0.28
2009	0.37	-0.34	-0.06	-0.23	0.59	0.06	-0.40	0.83	-0.04	-0.10	-0.07	-0.17	-0.02	-0.16	0.00	0.78
2010	0.68	-0.24	0.17	-0.54	0.65	0.02	-0.48	0.35	-0.04	0.13	0.06	0.14	-0.28	0.13	0.00	1.15
2011	0.37	-0.22	0.18	-0.58	0.24	-0.11	-0.27	0.61	-0.02	0.04	0.30	0.22	-0.17	-0.11	-0.03	1.07
2012	0.28	-0.33	0.05	-0.49	-0.02	0.06	-0.26	0.55	-0.54	-0.20	-0.20	0.28	-0.10	0.02	0.25	0.77
2013	0.45	-0.36	0.26	-0.41	0.22	0.14	-0.37	0.23	-0.25	-0.18	0.18	0.30	-0.17	-0.16	-0.41	1.19
2014	0.17	-0.17	0.67	-0.42	0.23	-0.49	-0.21	-0.23	-0.04	-0.32	0.08	-0.14	-0.22	-0.24	-0.37	0.90
2015	0.26	-0.16	0.27	-0.33	0.23	-0.33	-0.24	-0.29	-0.10	-0.24	0.06	-0.05	-0.14	-0.19	0.81	0.77
2016	0.43	-0.16	0.18	-0.43	0.29	-0.03	-0.17	0.16	-0.20	-0.06	-0.07	-0.10	-0.09	-0.19	0.17	0.55
2017	0.33	-0.15	-0.07	-0.34	0.34	0.02	-0.07	0.53	-0.21	-0.05	-0.00	0.16	-0.10	-0.03	0.25	0.43
2018	0.33	-0.16	-0.23	-0.36	0.23	0.07	-0.12	0.44	-0.09	0.04	0.03	-0.07	-0.05	0.03	0.47	0.17
2019	0.35	-0.20	-0.23	-0.33	0.19	-0.09	-0.07	0.22	-0.29	0.09	-0.10	-0.19	-0.18	-0.00	0.35	0.12

Source: SNL. Own calculations.
Countries: Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI), Slovakia (SK).

Table 10: Mean deviations of return on assets of non-SSM banks from the country averages

	AT	BE	CY	DE	ES	FI	FR	GR	IE	IT	LU	MT	NL	PT	SI	SK
2005	0.00	0.05	-0.06	0.11	-0.08	-0.03	0.07	-0.33	-0.11	0.04	-0.00	0.00	0.09	0.04		0.00
2006	-0.09	0.05	-0.08	0.10	-0.10	-0.09	0.05	-0.38	-0.12	0.03	0.13	0.00	0.08	0.03	0.03	
2007	-0.14	0.12	0.03	0.07	-0.09	-0.06	0.04	-0.47	-0.10	0.07	0.03	0.05	0.05	0.08	0.42	0.00
2008	-0.03	0.11	-0.30	0.13	-0.08	-0.06	0.03	-0.51	-0.09	0.07	-0.01	0.04	0.01	-0.04	-0.36	-0.42
2009	-0.10	0.24	0.04	0.08	-0.11	-0.03	0.04	-0.48	0.02	0.03	0.01	0.11	0.00	0.08		-0.78
2010	-0.01	0.06	-0.06	0.01	-0.05	-0.00	0.03	-0.07	0.01	-0.01	-0.00	-0.03	0.05	-0.01	-0.00	-0.31
2011	-0.01	0.05	-0.05	0.01	-0.03	0.01	0.02	-0.08	0.00	-0.00	-0.02	-0.04	0.03	0.01	0.01	-0.27
2012	-0.00	0.08	-0.01	0.01	0.00	-0.00	0.02	-0.15	0.11	0.01	0.02	-0.05	0.02	-0.00	-0.04	-0.19
2013	-0.01	0.09	-0.05	0.01	-0.03	-0.01	0.03	-0.07	0.05	0.01	-0.01	-0.08	0.02	0.01	0.03	-0.30
2014	-0.00	0.05	-0.11	0.01	-0.04	0.03	0.02	0.08	0.01	0.01	-0.01	0.04	0.03	0.02	0.07	-0.27
2015	-0.00	0.04	-0.05	0.01	-0.04	0.02	0.02	0.10	0.02	0.01	-0.01	0.01	0.03	0.01	-0.16	-0.26
2016	-0.01	0.04	-0.03	0.01	-0.05	0.00	0.01	-0.06	0.05	0.00	0.01	0.03	0.02	0.01	-0.04	-0.17
2017	-0.01	0.04	0.01	0.01	-0.05	-0.00	0.01	-0.19	0.05	0.00	0.00	-0.04	0.03	0.00	-0.06	-0.14
2018	-0.01	0.04	0.03	0.01	-0.04	-0.00	0.01	-0.17	0.02	-0.00	-0.00	0.02	0.01	-0.00	-0.11	-0.06
2019	-0.01	0.07	0.03	0.01	-0.04	0.00	0.01	-0.10	0.08	-0.00	0.01	0.05	0.05	0.00	-0.09	-0.04

Source: SNL. Own calculations.
Countries: Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI), Slovakia (SK).

7. Conclusion

Before the introduction of the SSM in 2014, all banks in the euro area were under the supervision of national authorities. With the introduction of the SSM, significant banks in the euro area are now subject to the direct supervision by the ECB. We empirically examined whether this profound regulatory change has an impact on the competitive position of SSM banks.

From a static perspective, we examined how the SSM affects the market power of SSM banks using the Lerner index. From a dynamic perspective, we examined whether the dynamics of bank profit rates changed under the SSM. We also worked out how disequilibrium affects estimates of SSM effects on the Lerner index. We showed that SSM effects are correctly identified, but they may reflect a combination of equilibrium and disequilibrium effects. Moreover, disequilibrium measurement error may inflate the standard errors of estimated SSM effects.

Our empirical results suggest the following three main conclusions. First, the SSM has had little impact on the market power of SSM banks in countries that were not heavily affected by the sovereign debt crisis. However, market power of SSM banks increased in "crisis countries" such as Ireland, Italy, and Portugal. The persistence of bank profit rates indicates that profits erode rather slowly, implying that banking sectors are not in long-run equilibrium. Banks with above-average profit rates enjoy above-average profits for some time, and banks with below-average profit rates face lower profits for a period of time.

Second, the SSM played an important role in improving the stability of the banking sector in the "crisis countries". In these countries, the stabilization of weak SSM banks led to reduced competition, resulting either in increased profit persistence (Cyprus, Greece, Netherlands, Portugal, and Slovakia), or increased Lerner indices (Ireland, Italy, and again Portugal). In contrast, in other countries the SSM either had no discernible impact on competition or slightly increased competition for SSM banks.

Third, we found that overall the SSM has little impact on the long-run profit rates of SSM banks. This suggests that anti-competitive side effects of the SSM may persist for some time, but are unlikely to be permanent.

References

Agoraki, M.-E. K., Delis, M. D., and Pasiouras, F. (2011). Regulations, competition and bank risk-taking in transition countries. *Journal of Financial Stability*, 7(1):38–48.

Ampudia, M., Beck, T., and Popov, A. (2021). Out with the new, in with the old? Bank supervision and the composition of firm investment. *CEPR Discussion Paper*, 16225.

Angelini, P. and Cetorelli, N. (2003). The effects of regulatory reform on competition in the banking industry. *Journal of Money, Credit and Banking*, 35(5):663–684.

Anginer, D., Demirguc-Kunt, A., and Zhu, M. (2014). How does competition affect bank systemic risk? *Journal of Financial Intermediation*, 23(1):1–26.

Apergis, N., Fafaliou, I., and Polemis, M. L. (2016). New evidence on assessing the level of competition in the european union banking sector: A panel data approach. *International Business Review*, 25(1):395–407.

Appelbaum, E. (1982). The estimation of the degree of oligopoly power. *Journal of Econometrics*, 19(2–3):287–299.

Avgeri, I., Dendramis, Y., and Louri, H. (2021). The single supervisory mechanism and its implications for the profitability of european banks. *Journal of International Financial Markets, Institutions and Money*, 74:101382.

Barth, J. R., Caprio Jr, G., and Levine, R. (2012). *Guardians of finance: Making regulators work for us*. Mit Press.

Beck, T., De Jonghe, O., and Schepens, G. (2013). Bank competition and stability: Cross-country heterogeneity. *Journal of financial Intermediation*, 22(2):218–244.

Berger, A. N., Bonime, S. D., Covitz, D. M., and Hancock, D. (2000). Why are bank profits so persistent? the roles of product market competition, informational opacity, and regional/macroeconomic shocks. *Journal of Banking & Finance*, 24(7):1203–1235.

Berger, A. N. and Humphrey, D. B. (1991). The dominance of inefficiencies over scale and product mix economies in banking. *Journal of Monetary Economics*, 28(1):117–148.

Berger, A. N., Klapper, L. F., and Turk-Ariss, R. (2017). Bank competition and financial stability. In *Handbook of Competition in Banking and Finance*. Edward Elgar Publishing.

Blair, R. D. and Sokol, D. D. (2015). *The Oxford handbook of international antitrust economics*, volume 2. Oxford Handbooks.

Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1):115–143.

Boone, J. (2008). A new way to measure competition. *The Economic Journal*, 118(531):1245–1261.

Boyd, J. H. and De Nicolo, G. (2005). The theory of bank risk taking and competition revisited. *The Journal of Finance*, 60(3):1329–1343.

Boyer, P. C. and Ponce, J. (2012). Regulatory capture and banking supervision reform. *Journal of Financial Stability*, 8(3):206–217.

Bresnahan, T. (1989). Empirical studies of industries with market power. In Schmalensee, R. and Willig, R., editors, *Handbook of Industrial Organization*, volume 2, chapter 17, pages 1011–1057. North Holland.

Cable, J. R. and Mueller, D. C. (2008). Testing for persistence of profits' differences across firms. *International Journal of the Economics of Business*, 15(2):201–228.

Christensen, L., Jorgenson, D., and Lau, L. (1973). Transcendental Logarithmic Production Frontiers. *The Review of Economics and Statistics*, 55(1):28–45.

Chronopoulos, D. K., Liu, H., McMillan, F. J., and Wilson, J. O. (2015). The dynamics of US bank profitability. *The European Journal of Finance*, 21(5):426–443.

Clark, J. A. and Speaker, P. J. (1994). Economies of scale and scope in banking: evidence from a generalized translog cost function. *Quarterly Journal of Business and Economics*, pages 3–25.

Coccorese, P., Girardone, C., and Shaffer, S. (2021). What affects bank market power in the euro area? a country-level structural model approach. *Journal of International Money and Finance*, 117:102443.

Cruz-Garcia, P., de Guevara, J. F., and Maudos, J. (2017). The evolution of market power in european banking. *Finance Research Letters*, 23:257–262.

Efthyvoulou, G. and Yildirim, C. (2014). Market power in CEE banking sectors and the impact of the global financial crisis. *Journal of Banking and Finance*, 40:11–27.

Elzinga, K. G. and Mills, D. E. (2011). The lerner index of monopoly power: origins and uses. *American Economic Review*, 101(3):558–64.

Feldkircher, M. and Sigmund, M. (2017). Comparing market power at home and abroad: Evidence from Austrian banks and their subsidiaries in CESEE. *Focus on European Economic Integration*, Q3/2017:59–77.

Fiordelisi, F., Ricci, O., and Stentella Lopes, F. S. (2017). The unintended consequences of the launch of the single supervisory mechanism in europe. *Journal of Financial and Quantitative Analysis*, 52(6):2809–2836.

Geroski, P. A. (1990). Modeling persistent profitability. In Mueller, D. C., editor, *The Dynamics of Company Profits*. Cambridge University Press.

Geroski, P. A. and Jacquemin, A. (1988). The persistence of profits: a european comparison. *The Economic Journal*, 98(391):375–389.

Goddard, J., Liu, H., Molyneux, P., and Wilson, J. O. (2011). The persistence of bank profit. *Journal of Banking & Finance*, 35(11):2881–2890.

Goetz, M. R. (2018). Competition and bank stability. *Journal of Financial Intermediation*, 35:57–69.

Gugler, K. and Peev, E. (2018). The persistence of profits in banking: an international comparison. *Applied Economics*, 50(55):5996–6009.

Iwata, G. (1974). Measurement of conjectural variations in oligopoly. *Econometrica*, 42(5):947–966.

Jiménez, G., Lopez, J. A., and Saurina, J. (2013). How does competition affect bank risk-taking? *Journal of Financial stability*, 9(2):185–195.

Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *The American Economic Review*, 80(5):1183–1200.

Lerner, A. (1934). The concept of monopoly and the measurement of monopoly power. *The Review of Economic Studies*, 1(3):157–175.

Martinez-Miera, D. and Repullo, R. (2010). Does competition reduce the risk of bank failure? *The Review of Financial Studies*, 23(10):3638–3664.

Matutes, C. and Vives, X. (2000). Imperfect competition, risk taking, and regulation in banking. *European Economic Review*, 44(1):1–34.

Maudos, J. and de Guevara, J. (2004). Factors explaining the interest margin in the banking sectors of the European Union. *Journal of Banking and Finance*, 28(9):2259–2281.

Maudos, J. and Solís, L. (2009). The determinants of net interest income in the mexican banking system: An integrated model. *Journal of Banking & Finance*, 33(10):1920–1931.

Maudos, J. and Vives, X. (2019). Competition policy in banking in the european union. *Review of Industrial Organization*, 55(1):27–46.

Mester, L. J. (1996). A study of bank efficiency taking into account risk-preferences. *Journal of banking & finance*, 20(6):1025–1045.

Mueller, D. C. (1977). The persistence of profits above the norm. *Economica*, 44(176):369–380.

Mueller, D. C. (1986). *Profits in the long run*. Cambridge University Press.

Mueller, D. C. (1990). The persistence of profits in the united states. In Mueller, D. C., editor, *The Dynamics of Company Profits*, pages 35–58. Cambridge University Press.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica*, 47:1417–1426.

Okolelova, I. and Bikker, J. A. (2022). The single supervisory mechanism: Competitive implications for the banking sectors in the euro area. *International Journal of Finance & Economics*, 27(2):1818–1835.

Panzar, J. C. and Rosse, J. N. (1987). Testing for "monopoly" equilibrium. *The Journal of Industrial Economics*, 35(4):443–456.

Raunig, B. and Sigmund, M. (2022). The ECB single supervisory mechanism: Effects on bank performance and capital requirements. Working Paper 244, Oesterreichische Nationalbank.

Shaffer, S. and Spierdijk, L. (2020). Measuring multi-product banks' market power using the lerner index. *Journal of Banking and Finance*, 117:105859.

Sigmund, M. and Ferstl, R. (2021). Panel vector autoregression in r with the package panelvar. *The Quarterly Review of Economics and Finance*, 80:693–720.

Spierdijka, L. and Zaourasa, M. (2018). Measuring banks' market power in the presence of economies of scale: A scale-corrected lerner index. *Journal of Banking and Finance*, 87:40–48.

Vives, X. (2016). *Competition and stability in banking*. Princeton University Press.

Vives, X. (2019). Competition and stability in modern banking: A post-crisis perspective. *International Journal of Industrial Organization*, 64:55–69.

Weill, L. (2013). Bank competition in the EU: How has it evolved? *Journal of International Financial Markets, Institutions and Money*, 26:100–112.

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, 126(1):25–51.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Yildirim, C. and Kasman, A. (2021). Market power evolution and convergence in european banking: An empirical note. *Bulletin of Economic Research*, 73(4):535–544.

Appendix A. Summary Statistics: SSM and Non-SSM Banks

Tables A.11 and A.12 provide separate summary statistics for SSM and non-SSM banks. For comparability, the summary statistics for the SSM banks and non-SSM banks are computed over the entire sample period, and not just since 2014 when the SSM was introduced.

Table A.11: Summary statistics: SSM Banks

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max	Data.Cov
Input Variables							
Total Assets	75,133	31,722,729	62,101,107	206,762,271	181,820,904	2,202,423,000	82.86
Interest expenses	69	303,964	1,061,000	4,216,997	3,648,000	101786000	81.94
Labor Costs	1,167	132,000	381,000	1,360,410	941,913	17,553,000	82.29
Labor Costs over TA	0.00	0.00	0.01	0.01	0.01	0.02	82.34
Provision and other expenses	1,009	138,140	343,064	1,250,505	928,032	19,124,000	82.11
Provision and other expenses over TA	0.00	0.00	0.01	0.01	0.01	0.02	81.82
Total costs	3,120	836,397	1,850,000	6,835,051	5,829,750	105,905,000	81.71
Total costs over TA	0.00	0.02	0.03	0.03	0.04	0.08	80.27
Interest income	2,536	754,409	1,906,556	6,548,441	5,862,660	107,859,000	82.34
Dividends from equity	1	3,213	13,556	101,517	74,450	1,808,000	46.62
Fee and commission income	100	170,267	412,494	1,675,215	1,518,047	16,412,000	68.09
Fee and commission expenses	0	34,802	92,263	467,786	293,974	6,500,000	68.09
Net fee and commission income	-134,000	80,212	260,653	1,033,490	741,000	12,765,000	82.46
Other non-interest income	146	18,957	61,715	213,721	213,875	3,871,000	49.57
Total income	2,536	1,020,914	2,278,230	7,742,384	6,682,250	109,461,000	82.63
Total income over TA	0.00	0.03	0.04	0.04	0.05	0.10	81.30
Tier 1 capital ratio	0.04	0.10	0.13	0.14	0.16	0.44	78.07
Lerner Indices							
2 SLS Lerner Index (no equity)	-0.36	0.05	0.18	0.17	0.29	0.74	78.59
3 SLS Lerner Index (no equity)	-0.39	0.05	0.16	0.16	0.26	0.75	78.88
2 SLS Lerner Index (equity ratio)	-0.33	0.06	0.19	0.18	0.29	0.75	76.63
3 SLS Lerner Index (equity ratio)	-0.39	0.05	0.16	0.16	0.25	0.75	76.80
Persistence of Profits							
ROA before Tax and Risk	-1.30	0.44	0.78	0.89	1.29	3.25	81.88
Dev ROA	-2.48	-0.42	-0.12	-0.05	0.24	2.09	81.88

Data sources: SNL, all Lerner indices are estimated as described in Section 2.1.
The table shows the minimum (Min.), first quantile (1st Qu.), median (Median), mean (Mean), third quantile (3rd Qu.), maximum (Max) and the data coverage (Data Cov.) for the variables used in this paper. Data Cov. refers to the percentage of available observations if the data was a balanced panel. The dataset contains yearly data for 2,668 banks over the period 2004–2019 for the following countries: Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI) and Slovakia (SK).
All variables except ratios are in thousands of euros.
Provision and other expenses is defined as operating expenses minus compensation benefits.
Total costs are the sum of interest rate expenses and operating expenses, which are the sum of operating DD&A, compensation and benefits, occupancy and equipment, tech and communications expense, marketing and promotion expense, other provisions and other expense.
Total income is defined as the sum of interest income, dividends from equity, other non-interest income and net fee and commission income. We use net fee and commission income instead of the split fee and commission income and fee and commission expenses, as it has a much higher data coverage. Consequently, we do not include fee and commission expenses in the total costs to avoid double counting.
All Lerner indices are estimated as described in Section 2.1. The 2 SLS Lerner Index (no equity) and the 3 SLS Lerner Index (no equity) are estimated with two-stage least squares and three-stage least squares in a system of equations framework based on Eq. (1) and Eq. (2). The 2 SLS Lerner Index (equity ratio) and the 3 SLS Lerner Index (equity ratio) are estimated in the same way but with the Tier 1 capital ratio as an additional input factor in Eq. (1).
ROA before Tax and Risk refers to the standard definition of return on assets. The sum of net interest income, dividends income from equity, net fee and commission income and net other non-interest income is divided by total assets.
Dev ROA refers to the deviation of the ROA of bank i in year t in country j from the average ROA of all banks in country j in year t.

Table A.12: Summary statistics: Non-SSM Banks

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max	Data.Cov
Input Variables							
Total Assets	1,000	259,300	916,193	15,170,997	3,671,496	2,601,695,000	60.12
Interest expenses	0	1,437	6,917	265,043	34,288	93,021,000	58.89
Labor Costs	1	2,942	9,539	92,381	33,761	16,772,000	58.41
Labor Costs over TA	0	0.01	0.01	0.01	0.01	0.03	57.30
Provision and other expenses	10	2,245	7,571	87,375	27,621	29,752,000	58.46
Provision and other expenses over TA	0	0.01	0.01	0.01	0.01	0.02	56.10
Total costs	10	7,455	27,296	441,467	101,260	97,738,000	58.73
Total costs over TA	0.00	0.02	0.03	0.03	0.04	0.09	57.46
Interest income	1	6,517	25,262	431,304	99,700	97,578,000	58.90
Dividends from equity	1	1,000	6,764	33,199	24,383	1,763,000	5.39
Fee and commission income	141	54,337	132,759	415,152	271,786	14,883,000	8.97
Fee and commission expenses	0	6,892	20,614	101,528	59,830	4,162,000	8.99
Net fee and commission income	-576,000	1,369	5,305	66,834	20,287	10,796,000	59
Other non-interest income	2	4,887	15,107	66,127	42,000	8,389,000	7.08
Total income	-60,410	8,854	32,578	506,132	127,627	101,763,000	59.26
Total income over TA	-0.01	0.03	0.04	0.04	0.04	0.10	58.25
Tier 1 capital ratio	0.04	0.12	0.15	0.16	0.19	0.44	47.05
Lerner Indices							
2 SLS Lerner Index (no equity)	-0.36	0.17	0.25	0.24	0.32	0.85	55.40
3 SLS Lerner Index (no equity)	-0.41	0.13	0.20	0.19	0.27	0.80	55.25
2 SLS Lerner Index (equity ratio)	-0.34	0.18	0.25	0.24	0.32	0.81	45.71
3 SLS Lerner Index (equity ratio)	-0.39	0.12	0.20	0.18	0.26	0.75	45.58
Persistence of Profits							
ROA before Tax and Risk	-1.56	0.59	0.85	0.88	1.15	3.27	57.05
Dev ROA	-2.81	-0.26	-0.01	0.00	0.24	2.57	57.05

Data sources: SNL, all Lerner indices are estimated as described in Section 2.1.
The table shows the minimum (Min.), first quantile (1^{st} Qu.), median (Median), mean (Mean), third quantile (3^{rd} Qu.), maximum (Max) and the data coverage (Data Cov.) for the variables used in this paper. Data Cov. refers to the percentage of available observations if the data was a balanced panel. The dataset contains yearly data for 2,668 banks over the period 2004–2019 for the following countries: Austria (AT), Belgium (BE), Cyprus (CY), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Malta (MT), Netherlands (NL), Portugal (PT), Slovenia (SI) and Slovakia (SK).
All variables except ratios are in thousands of euros.
Provision and other expenses is defined as operating expenses minus compensation benefits.
Total costs are the sum of interest rate expenses and operating expenses, which are the sum of operating DD&A, compensation and benefits, occupancy and equipment, tech and communications expense, marketing and promotion expense, other provisions and other expense.
Total income is defined as the sum of interest income, dividends from equity, other non-interest income and net fee and commission income. We use net fee and commission income instead of the split fee and commission income and fee and commission expenses, as it has a much higher data coverage. Consequently, we do not include fee and commission expenses in the total costs to avoid double counting.
All Lerner indices are estimated as described in Section 2.1. The 2 SLS Lerner Index (no equity) and the 3 SLS Lerner Index (no equity) are estimated with two-stage least squares and three-stage least squares in a system of equations framework based on Eq. (1) and Eq. (2). The 2 SLS Lerner Index (equity ratio) and the 3 SLS Lerner Index (equity ratio) are estimated in the same way but with the Tier 1 capital ratio as an additional input factor in Eq. (1).
ROA before Tax and Risk refers to the standard definition of return on assets. The sum of net interest income, dividends income from equity, net fee and commission income and net other non-interest income is divided by total assets.
Dev ROA refers to the deviation of the ROA of bank i in year t in country j from the average ROA of all banks in country j in year t.

Appendix B. Details on the Lerner Index Derivation

This appendix provides details on the derivation of the Lerner index. Following the literature, we assume that a bank i faces the same optimization problem in every time period t,

$$\max_{q_{it}} \Pi_{it} = p_{it}(Q_t, z_t) \cdot q_{it} - C(q_{it}, W_{it}) \,, \tag{B.1}$$

where Π_{it} is profit and p_{it} is the price of the aggregate bank output. The price of the aggregate bank output is the sum of interest income, fee and commission service income, income from investment and other income divided by total assets. The variable q_{it} refers to the total output of bank i at time t and is approximated by total assets. The term $Q_t = \sum_{i=1}^{N} q_{it}$ represents the total banking industry output and z_t refers to exogenous variables affecting the inverse demand function. $C(q_{it}, W_{it})$ denotes the cost function with q_{it} as output and W_{it} is the vector of input factors $(w_{1it}, w_{2it}, w_{3it})$, where w_{1it} denotes interest rate expenses, w_{2it} denotes staff expenses, and w_{3it} are other operating expenses of bank i at time t. In an extended version of the cost function, we use the equity ratio (w_{4it}) as an additional input variable.

The corresponding first order condition to Eq. (B.1) reads as

$$p_{it}(Q_t, z_{it}) - \frac{\partial C(q_{it}, W_{it})}{\partial q_{it}} + q_{it}\frac{\partial p_{it}(Q_t, z_t)}{\partial Q_t}\frac{\partial Q_t}{\partial q_j} = 0 \,, \tag{B.2}$$

where $MC_{it} = \frac{\partial C(q_{it}, w_{jit})}{\partial q_{it}}$ refers to marginal cost and $MR_{it} = p_{it}(Q_t, z_t) + q_{it}\frac{\partial p_{it}(Q_t,z_t)}{\partial Q_t}\frac{\partial Q_t}{\partial q_{it}}$ to marginal revenue. The mark-up $q_{it}\frac{\partial p_{it}(Q_t,z_t)}{\partial Q_t}\frac{\partial Q_t}{\partial q_{it}}$, which would be zero under perfect competition (i.e., $MR_{it} = MC_{it}$), can be further broken down into the terms

$$\Theta_{it} = \frac{\partial Q_t/\partial q_{it}}{Q_t/q_{it}} \,, \tag{B.3a}$$

$$\tilde{\epsilon}_{it} = \frac{\partial p_{it}/\partial Q_t}{p_{it}/Q_t} < 0 \,. \tag{B.3b}$$

Θ_{it} is the conjectural elasticity of total industry output with respect to the output of the i^{th} bank at time t. The conjectural elasticity measures the conjectured reaction of the other $n-1$ banks in the market to a change in quantity produced by bank i.[13] The second term $\tilde{\epsilon}_{it}$ is the inverse market demand elasticity to the price.

For estimating Eq. (B.3a) and Eq. (B.3b) separately, we would need to define a supply equation and a demand equation. However, to estimate the bank's overall market power Appelbaum (1982) suggests estimating the ratio $\zeta_{it} = \frac{\Theta_{it}}{\tilde{\epsilon}_{it}}$ in Eq. (B.4),

$$p_{i,t}(Q_t, z) = \frac{\partial C(q_{it}, W_{it})}{\partial q_{it}} - \zeta_{it} \,. \tag{B.4}$$

For the empirical analysis, we follow the literature (Angelini and Cetorelli, 2003; Agoraki et al., 2011; Efthyvoulou and Yildirim, 2014) and assume a translog cost function, which leads to Eq. (2).

Appendix C. Cost and Marginal Revenue Estimation Results

In the banking literature, there is only a limited number of papers that provide estimation output for the standard translog cost function. Table C.13 shows the 3 SLS estimation results for the cost equation, Eq. (1), and the marginal revenue equation, Eq. (2). Our results are comparable to Clark and Speaker (1994) for US bank data and Feldkircher and Sigmund (2017) for Austrian banks and their subsidiaries in Central and South Eastern Europe. The coefficients from the marginal revenue equation are restricted to be equal to the corresponding coefficients in the cost equation. As mentioned earlier, Bresnahan (1989) suggests these restrictions to increase the precision of the estimated coefficients.

To test the validity of our results, we first check the quality of instruments (F-test and p-values) for both equations. Then we use the Hansen system overidentification test for a system of equations (Wooldridge, 2010, p.201) to test whether the instruments are exogenous. The results of the Hansen overidentifica-

[13] Under perfect competition $\Theta_{it} = 0$ and in a monopoly $\Theta_{it} = 1$.

tion test in Table C.13 suggest that 3 SLS is the preferred estimation method. The F-test in the cost equation indicates that all exogenous variables are jointly significant. The F-test in the marginal revenue equation is a test for weak instruments, since all exogenous variables from the cost equation are used as instruments. The test indicates that the instruments are strong.

Table C.13: 3 SLS: Cost and Marginal Revenue Functions

	Cost Equation	Marginal Revenue
log(TA)	1.0124***	
	(0.0057)	
log(interest expenses over TA)	0.0916***	
	(0.0064)	
log(labor costs over TA)	0.2623***	
	(0.0134)	
log(Provision and other expenses over TA)	0.3871***	
	(0.0126)	
log(Tier 1 capital ratio)	0.1554***	
	(0.0105)	
log(TA) squared	−0.0010***	
	(0.0002)	
log(interest expenses over TA) squared	0.0581***	
	(0.0003)	
log(labor costs over TA) squared	0.0537***	
	(0.0007)	
log(Provision and other expenses over TA) squared	0.0618***	
	(0.0011)	
log(Tier 1 capital ratio) squared	0.0008	
	(0.0005)	
log(TA) x log(interest expenses over TA)	0.0087***	
	(0.0003)	
log(TA) x log(labor costs over TA)	−0.0028***	
	(0.0009)	
log(TA) x log(Provision and other expenses over TA)	−0.0051***	
	(0.0007)	
log(TA) x log(Tier 1 ratio)	−0.0108***	
	(0.0006)	
log(interest expenses over TA) x log(labor costs over TA)	−0.0672***	
	(0.0009)	
log(interest expenses over TA) x log(Provision and other expenses over TA)	−0.0759***	
	(0.0009)	
log(labor costs over TA) x log(Provision and other expenses over TA)	−0.0492***	
	(0.0015)	
log(Tier 1 ratio) x log(interest expenses over TA)	0.0090***	
	(0.0008)	
log(Tier 1 ratio) x log(labor costs over TA)	−0.0179***	
	(0.0020)	
log(Tier 1 ratio) x log(Provision and other expenses over TA)	0.0110***	
	(0.0021)	
Total costs over TA		1.0124***
		(0.0057)
total costs over TA x log(TA)		−0.0010***
		(0.0002)
total costs over TA x log(interest expenses over TA)		0.0087***
		(0.0003)
total costs over TA x log(labor costs over TA)		−0.0028***
		(0.0009)
total costs over TA x log(Provision and other expenses over TA)		−0.0051***
		(0.0007)
total costs over TA x log(Tier 1 ratio)		−0.0108***
		(0.0006)
Number of Observations	19,022	19,022
Number of Groups	2,339	2,339
Obs per group: min/avg/max	1/8.13/15	1/8.13/15
McElroy R-squared	0.99	0.99
Hansen overid test statistics/p-value	16.07/0.31	
Weak instruments: F-test: statistics/p-value	648,228/0	901/0

Source: SNL, Own Calculations. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.
This table shows the three stages least squares regression results for Eq. (1) and Eq. (2) simultaneously.
The dependent variable in the column "Cost Equation" is the logarithm of total costs. The dependent variable in the column "Marginal Revenue Equation" is total income divided by total assets (TA).
The translog cost function includes: Logarithm of TA (log(TA)), Logarithm of TA squared (log(TA) squared), the log of interest expenses divided by TA, the log of labor costs divided by TA (log(labor costs over TA)), the log of provisions and other expenses divided by TA (log(Provision and other expenses over TA)), the log of TA times the log of interest expenses divided by TA (log(TA), log(interest expenses over TA)), the log of TA times the log of labor costs divided by TA (log(TA), log(labor costs over TA)), the log of total asset times the log of provisions and other expenses divided by TA (log(TA), log(Provision and other expenses over TA)), the log of interest expenses divided by TA times the log of labor costs divided by TA (log(interest expenses over TA), log(labor costs over TA)), the log of labor costs divided by TA times the log of provisions and other expenses divided by TA (log(labor costs over TA), log(Provision and other expenses over TA)), the log of interest expenses divided by TA squared (log(interest expenses over TA) squared), the log of labor costs divided by TA squared (log(labor costs over TA) squared), the log of provisions and other expenses divided by TA squared (log(Provision and other expenses over TA) squared), the log of Tier 1 capital ratio (log(Tier 1 capital ratio)), the log of Tier 1 capital ratio squared (log(Tier 1 capital ratio) squared), the log of Tier 1 capital ratio times the log of labor costs divided by TA (log(Tier 1), log(labor costs over TA)), the log of Tier 1 capital ratio times the log of labor costs divided by TA (log(Tier 1 ratio), log(labor costs of TA)) and the log of Tier 1 capital ratio times the log of provisions and other expenses divided by TA (log(Tier 1 capital ratio), log(Provision and other expenses over TA)).
The marginal revenue function includes: Total costs of TA (Total costs over TA), total costs divided by TA times log of TA (total costs over TA, log(TA)), total costs divided TA times log of interest expenses divided by TA (total costs over TA, log(interest expenses over TA)), total costs divided by TA times log of labor costs divided by TA (total costs over TA, log(labor costs over TA)), total costs divided by TA times the log of provisions and other expenses divided by TA (total costs over TA, log(Provision and other expenses over TA)) and total costs over TA times the log of Tier 1 capital ratio (total costs over TA, log(Tier 1 ratio)).

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