Asymmetries in the Euro Area banking profitability

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Abstract

This paper shows how bank-specific, industry-specific, and macroeconomic determinants affect the profitability of 3,046 banks across 19 Euro area countries, from 2006 to 2015. To assess the existence of potentially relevant asymmetries, we split our sample of Euro area banks into peripheral and core countries' banks. Our results reveal that, compared to banks from core countries, the marginal effect of the loan loss provisions burden on profitability is, on average, at least 3 times larger in peripheral banks where a 1 p.p. increase in loan loss provisions reduces return on average assets by 0.6 p.p. Moreover, the impact of loan loss provisions on profitability levels during the 2008-2013 financial crisis period is found to be significantly more severe in peripheral banks. Our results likewise suggest that the improvement of efficiency levels and a more selective asset growth have stronger effects on the returns of peripheral banks. In contrast, the effect of customer deposits suggests that core countries' banks make better use of this source of funding.

JEL Classification: G21, G28

Key Words: Bank profitability, Euro area, peripheral countries, core countries, loan loss provisions

"The lack of profitability is indeed something to worry about, as only banks that make enough profit will be able to support economic growth and continue building up capital buffers."

- *European Central Bank*, Danièle Nouy, Chair of the Supervisory Board of the ECB, "2018 Press Conference on ECB Banking Supervision"

1. Introduction

The process of European financial integration fostered capital flows across the European Union (EU) Member States, initially leading countries with public accounts' surpluses (core countries) to significantly increase their financial exposure to countries with public accounts' deficits (peripheral countries)[1]. However, a decade after its inception, this process exposed meaningful imbalances within the EU financial system, wherein high sovereign debts and fragile banking systems in some countries contributed to a Euro area crisis.

Against this background, the low aggregate profitability of the European banking system and the growing trend of non-performing loans (NPL) emerged as major concerns. Given the interlink with loan loss provisions (LLP), NPL are themselves a powerful constraint on profitability.[2] The difficulty of European banks in getting back to sustainable levels of profits (European Banking Authority, 2016) is even more emphasized by the rather uneven evolution of profitability between banks from peripheral and core countries (henceforward, peripheral banks and core banks).[3] A Single Supervisory Mechanism (SSM) and a Single Resolution

[1] We classify peripheral countries, or financially distressed economies, and core countries, or non-financially distressed economies, in accordance with Constâncio (2014, 2015) and ECB (2017a). This taxonomy includes Ireland, Portugal, Spain, Italy, Greece, Cyprus and Slovenia as financially distressed economies. Non-financially distressed economies include Austria, Belgium, Estonia, Finland, France, Germany, Latvia, Lithuania, Luxembourg, Malta, Netherlands and Slovakia. We consider this distinction relevant, but also more inclusive, in light of the target to achieve a truly European Banking Union.

[2] Agénor and Zilberman (2015) refer to LLP as the expected losses on loans which have been identified as non-performing, while the ECB (2017b) published the guidelines on the application of backstops as a tool to ensure banks are not building up aged NPL with insufficient provision coverage.

[3] For example, from 2006 to 2015, the Return on Average Assets of peripheral banks fell 89%, whereas core banks reached only near one third of that percentage decrease.

Mechanism (SRM) already exist, but these asymmetries constrain the evolution towards a common Deposit Guarantee Scheme (DGS) and, ultimately, to a truly European Banking Union. For policy and decision-makers, it is critical therefore to understand how the profitability of banks in distinct economies sharing the same currency is affected by its various determinants, properly controlling for the underlying disparities between those economies. Given the asymmetries in the Euro area banking profitability, we aim to assess the potential unequal effects of profitability drivers across national banking systems.

By controlling for the potential profitability differences between peripheral and core countries' banking systems, we fill a relevant gap in the literature that, to the best of our knowledge, was only addressed by Agoraki *et al.* (2021). Their study analyses the effects that a group of bank-specific and industry-specific determinants along with the regulatory framework have on bank performance, measured by stock returns, of periphery Eurozone countries (Greece, Italy, Spain and Portugal) and core Eurozone countries (France and Germany). For that purpose, they use a panel of 98 commercial banks over 2007-2016. In our study, we define bank performance using two profitability measures, the ROAA (Return on Average Assets) and ROAE (Return on Average Equity), we resort to a wider database composed of 3.046 commercial banks across 19 Eurozone countries over 2006-2015, and investigate additionally whether the 2008-2013 financial crisis shifted the relationship of LLP and banks' profitability across peripheral and core countries of the Eurozone.

Other previous research on the determinants of the profitability of European banks focus this issue either from a single-country perspective (e.g., Athanasoglou *et al.*, 2006; Iannotta *et al.*, 2007; Mergaerts and Vennet, 2016), or consider Europe as a whole (e.g., Athanasoglou *et al.*, 2008; Chiorazzo *et al.*, 2008; Dietrich and Wanzenried, 2011; Elekdag *et al.*, 2020), ignoring its asymmetries. Alternatively, the asymmetries are investigated, but the focus relies primarily on the effect of a policy change, such as the introduction of the SSM, on bank

profitability, supported on the argument that the price of greater resilience achieved through these reforms imposed a cost on bank profits (Avgeri *et al.*, 2021).

The purpose of our research is threefold. First, we investigate the existence of determinants of banking profitability with asymmetric effects in the Euro area, by comparing peripheral banks to core banks. Second, we contrast the contribution of LLP to the returns in both groups of banks. Lastly, we test whether the relationship between LLP and profitability across peripheral and core banks changed after the 2008 financial crisis. We support the analysis on a data set composed of 3,046 banks from 19 Euro area countries, over the period 2006-2015.

Following Athanasoglou *et al.* (2008), Flamini *et al.* (2009), and García-Herrero *et al.* (2009), we use a dynamic linear model based on a generalized method of moments (GMM) model (Arellano and Bover, 1995; Blundell and Bond, 1998) to estimate the determinants of banks' profitability. The robustness of results is assessed with a fixed-effects model (Ahamed, 2017; Athanasoglou *et al.*; 2006; Demirgüç-Kunt and Huizinga, 2010).

The results show that interest rates and LLP stand out as the major contributors to changes in profitability. However, we find that the marginal contribution of LLP to banks' profitability is, at least, 3 times higher on peripheral banks corresponding to a drop near 0.6 p.p. in return on average assets whenever LLP increase 1 p.p. The negative marginal effect of LLP over the returns of peripheral banks is even more striking during the recent Euro area financial crisis, increasing by 40% during that period, and to some extent confirming the procyclical feature of provisioning policies in periods of economic downturn. Nonetheless, regarding core banks, the effect of LLP on profitability does not seem to be significantly affected by the financial crisis.

Our results likewise suggest that the improvement of efficiency levels increases relatively more the returns of peripheral banks. Conversely, the positive effect of customer deposits on core banks' returns implies they make better use of this type of funding and have greater success in passing the costs to fleet-footed customers. The returns in peripheral banks also reveal

negative effects from faster growth rates of assets, opposite to what we find in core banks, suggesting that such growth rates in the first group of banks are related to lenient credit policies and fragile risk management practices. Finally, interest rate effects on profitability seem to be similar between both groups of banks.

Based on these results, we draw some implications. Overall, the empirical evidence stresses that credit risk exposure continues to be the banks-specific leading source of problems in financial institutions. A more harmonized banking profitability across the Euro area, therefore, requires further actions to closely follow credit risk exposure and solve the NPL issue first and foremost in peripheral banks. Another noteworthy remark is the relatively higher benefits to peripheral banks' returns from improved efficiency levels; the promotion of digitalization and optimization of human resources and branch networks by competent authorities can be a strong incentive to improve efficiency ratios, especially in peripheral banks. From a monetary policy perspective, all banks are likely to boost their profits once removed the unconventional measures carried out by the ECB, such as applying negative key interest rates within the Euro area. Last but not least, the remarkable effect LLP have on bank profitability also bears an important implication in terms of the methodology underlying the measurement of LLP, given the considerable room for management discretion in determining the level of LLP, even within the forthcoming IFRS 9 "expected credit loss model". We contend that banks' own LLP estimates should inclusively be scrutinized by bank supervisors.

The remainder of this paper is structured as follows. Section 2 surveys the literature on the determinants of banks' profitability and defines the hypotheses. Section 3 and 4 describe, respectively, the methodology and the data. Section 5 discusses the results of our empirical analysis, and Section 6 concludes.

2. Literature review

2.1. Challenges of the Banking Union

The process of financial integration following the consolidation of the European and Monetary Union (EMU) lowered the obstacles to cross-border investments in the Euro area debt markets, fostering capital flows across the EU Member States. The large capital flows from countries with account surpluses to countries with account deficits initially stimulated credit granting, but ended up contributing to large imbalances between peripheral and core countries (Beck *et al.*, 2016; Caruana and Avdjiev, 2012).[4]

The global financial crisis of 2008 exposed such imbalances and confirmed that the misjudgment of risks by the banking sector can undermine the financial stability of the entire EU Member States. Programs and financial support measures, such as the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM), were developed as part of a comprehensive policy response. The return to healthy banks' balance sheets and the removal of risks affecting economies under stress, however, came along with a precondition: the creation of the SSM, the first pillar of the Banking Union. Notwithstanding, the Banking Union introduced two more pillars, the SRM and the DGS Directive. The European project for the banking sector with a common supervisor, resolution mechanism, and a safety net is expected to lay the foundation for long-term stability, and reverse the fragmentation of sub-zones of greater or lesser confidence (Goyal *et al*., 2013).

Nowadays, the third pillar of the Banking Union, a common DGS, remains to be raised. In this regard, some literature argues that a common deposit guarantee may diminish the costs of pursuing riskier strategies and encourage excessive risk-taking, thus generating a moral hazard problem (Chan *et al.*, 1992; Ngalawa *et al.*, 2016). To overcome such a problem, a prior

[4] In this regard, Constâncio (2015) notes that the exposures of banks from core to peripheral countries more than quintupled between 1999 and 2008.

condition for a mutualized scheme to work within the Euro area seems to be the existence of more homogeneous national banking sectors, with sustainable profits and contained risks. It is vital therefore to know the determinants of banks' profitability and deeply understand the challenges that Euro area banks face to raise their profitability levels.

2.2. Determinants of bank profitability

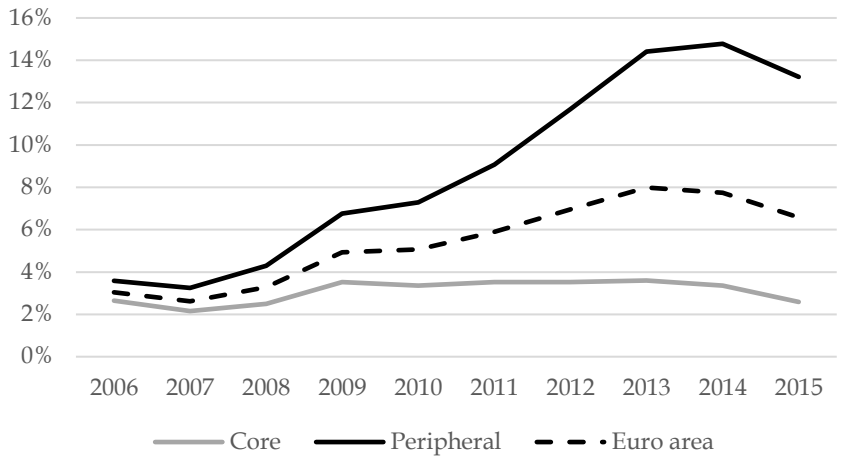
2.2.1 Non-performing loans

The side effects of weak credit risk management are typically reflected in higher levels of NPL, drawing attention to regulatory and supervisory issues concerning impaired assets which, ultimately, weigh on the low aggregate profitability of banks (Constâncio, 2017; Elekdag *et al.*, 2020). Other studies, however, provide empirical evidence that profitable banks have higher NPLs (Ozili, 2020). Relatively to the Euro area banking system, Constâncio (2014) centers the peripheral countries' financial distress at the private financial sector and underlines the opposite directions followed by public and private debt ratios in such countries during the 1999-2008 period. Essentially, except for Greece, the Euro area crisis was first and foremost a banking crisis.

As shown in Figure 1, the evolution of NPL ratios on European banks overall stood at low levels until 2008. However, the behavior between peripheral and core banks is strikingly different from 2009 onwards. While peripheral banks reveal a sharp increase until 2014, peaking at 14.8%, core banks peaked earlier in 2013, at 3.6%. At the end of the period under analysis, the difference in the NPL ratio between both groups was quite high, at about 10.6 p.p. (13.2% for peripheral banks vs 2.6% for core banks). In nominal terms, Constâncio (2017) quantifies the NPL problem as of end-2016 in approximately EUR 1 trillion, or over 9% of the Euro area GDP, and draws attention to the low aggregate profitability of European banks. It is worth mentioning that, with the ECB in the lead for ensuring an effective and consistent

European banking supervision, the observed rising NPL ratios since the inception of the crisis has earned global attention (e.g., ECB, 2015).

Figure 1 - NPL ratio trend for peripheral and core banks



Source: World Bank (2017) and authors' calculations

Given the dissimilar evolution of the NPL ratio between peripheral and core banks after 2009, confirming the imbalances in the countries to which they belong, it seems reasonable to admit that factors explaining banks' profitability may also be different between the Euro area peripheral and core countries. Accordingly, we define the following hypotheses.

Hypothesis #1 – The determinants of banks' profitability differ between peripheral and core countries of the Euro area.

Bearing in mind the period of relatively cheap financing and credit boom in the Euro area, that ultimately lead peripheral countries to financial distress, along with the potential weight of LLP on banks' low aggregate profitability, our second hypothesis is directly linked with the magnitude of LLP effects between peripheral and core countries.

Hypothesis #2 – The marginal effect of LLP on banks' profitability is greater in peripheral banks compared to banks from core countries.

2.2.2 Other determinants of bank profitability

Economic and financial determinants

To curb the decline in interest margins due to increased competition, concentration, and restructuring, banks sought other sources of income besides interests, namely commissions, fees, or trading; the greater is the share of these revenues the more diversified banks became. Chiorazzo *et al.* (2008) state that *income diversification* significantly increases risk-adjusted returns for Italian banks. Similarly, Demirgüç-Kunt and Huizinga (2010) and Elsas *et al.* (2010) show that an expansion into non-interest income-generating activities increases the rate of return of assets.

Bank efficiency generated by the optimization of human resources and advances in financial technologies and digitalization is also pointed as a powerful driver of profitability (e.g., Athanasoglou *et al.*, 2008; Dietrich and Wanzenried, 2011, 2014; Elekdag *et al.*, 2020; Pasiouras and Kosmidou, 2007). Albertazzi and Gambacorta (2009), for instance, state that the cost-to-income ratio has been declining almost everywhere, though at different degrees, and Asimakopoulos *et al.* (2018) show that not only banks in the EMU core economies consistently outperform peripheral banks throughout the period 2005-2012, but also that the financial crisis interrupted a convergence process between the two groups after 2009. More generally, Di Febo and Angelini (2019) find that the effects of digitalization on European banks performance have different behaviors depending on the business model (e.g. commercial banks, cooperative banks).

Some literature (Ahamed, 2017; Demirgüç-Kunt and Huizinga, 2010) reports *asset growth* as having a significant and positive relationship with profitability. However, other research

(Stiroh, 2004) finds a negative relationship, which seems to substantiate the agency problem, according to which bank managers may pursue expansionist policies, taking excessive risk concerning what is accepted by shareholders. In these cases, the rapid business growth is likely to come from an aggressive commercial policy potentially reducing bank margins.

Short (1979) argues that *size* is closely related to capital adequacy since larger banks can easily raise less expensive capital and thus be more profitable. Iannotta *et al*. (2007) refer that "too-big-to-fail" banks benefit from an implicit guarantee that decreases their cost of funding, which allows them to pursue riskier assets. Though larger banks may profit from economies of scale to reduce costs, or economies of scope from the joint provision of related services (Goddard *et al.*, 2004b; Smirlock, 1985), increasingly complex banks might also suffer from finance-specific technologies and potential agency problems (Jensen, 1986), representing the downside of size.

The empirical evidence on the relationship between higher *capitalization levels* and profitability is not clear-cut. For instance, Berger (1995) finds empirical evidence of a positive relationship, which he explains with the expected bankruptcy cost hypothesis that relates higher capital ratios to reduced funding costs. Evidence of such a positive relationship is also given by Athanasoglou *et al.* (2006), Demirgüç-Kunt and Huizinga (1999), Iannotta *et al*. (2007), Mirzaei *et al.* (2013), and Pasiouras and Kosmidou (2007). Conversely, Goddard *et al.* (2004a) detect a negative and statistically significant relationship, while Dietrich and Wanzenried (2011) and Mergaerts and Vennet (2016) find no evidence of such relationships.

The financial crisis exposed the risks of banks' excessive reliance on wholesale money markets. Demirgüç-Kunt and Huizinga (2010) conclude that non-deposit wholesale funding lowers the rate of returns on assets, even though it can reduce risk at lower levels. Similarly, Altunbas *et al.* (2011) show that banks with greater reliance on wholesale funding were more likely to fail during the crisis, and associate strong deposit-based institutions to significantly

reduced risk. García-Herrero *et al.* (2009) find that banks with a relatively larger *share of deposits* tend to be more profitable, whereas Khan *et al.* (2017) provide empirical evidence on the positive relationship between retail deposits and survival rate.

Industry determinant

The overall effect of *market concentration* on profitability is pointed to as an additional determinant of profitability. Maudos and de Guevara (2004) and Demirgüç-Kunt and Huizinga (1999) provide empirical evidence for a positive and statistically significant relationship between bank concentration and profitability. This is in line with the structure-conduct-performance (SCP), or market power paradigm, which asserts that more concentrated industries generate monopoly profits, reflecting non-competitive pricing behavior. Still, there seems to exist also some evidence (Dietrich and Wanzenried, 2014; García-Herrero *et al.*, 2009) sustaining the alternative cost-efficiency theory, or efficient-structure hypothesis (ESS), according to which higher concentration is linked to more operational efficiency, better management, or better production technologies. On the other hand, Athanasoglou *et al.* (2008) inclusively find no evidence supporting SCP and ESS.

Macroeconomic determinants

Favorable economic conditions, characterized by *GDP growth*, improve the solvency of borrowers, thereby reducing the amount of LLP banks need to set aside to cover credit risk but also increase the credit demand. During downturn periods, we typically observe the inverse. Demirgüç-Kunt and Huizinga (2010), Elekdag *et al.* (2020), García-Herrero *et al.* (2009), Iannotta *et al*. (2007), and Mirzaei *et al*. (2013) confirm such positive effect of GDP growth.

The *GDP level* constitutes also a potential determinant of profitability. For example, Dietrich and Wanzenried (2014) show that, depending on the country income category, the effect of GDP in bank profitability is significantly positive (low-income countries) or negative but insignificant (high-income countries). In this respect, Goldberg and Rai (1996) argue that

countries with higher GDP are assumed to have a banking system that operates in a mature environment that, consequently, involves more competitive interest and profit margins.

Inflation is generally associated with higher profitability as long as it is fully anticipated by the bank's management in the adjustment of interest rates (Perry, 1992; Revell, 1979). But even predictable increases in the inflation rate can interfere with the ability of banks to allocate resources effectively (Boyd *et al*., 2001). Since an increase in inflation diminishes the real rate of Return on Assets (ROA) in general, agents have no longer incentives to lend but to borrow. Consequently, credit lending is rationed, resource allocation is less efficient and bank activity diminishes with adverse implications in profitability. Boyd *et al*. (2001) provide empirical evidence of the negative relationship between inflation and bank performance. Other studies, however, find a positive relationship between the two variables (e.g., Athanasoglou *et al*., 2008; Demirgüç-Kunt and Huizinga, 1999; and García-Herrero *et al.*, 2009).

Finally, a low *interest rate* environment together with a flat yield curve and negative premia have been shown to negatively impact banks' profitability. Borio *et al*. (2015) investigate the influence of monetary policy on bank profitability for 109 large international banks over the period 1995-2012; they find a positive and significant relationship between the level of interest rates and bank profitability. Moreover, they conclude that the negative impact of LLP on bank profitability is overcome by the positive impact of the interest rates structure on net interest income and that the effect is stronger the lower the interest rate level. Additional related studies that assess the impact of interest rates and find a positive relationship are Albertazzi and Gambacorta (2009), Demirgüç-Kunt and Huizinga (1999), and Mergaerts and Vennet (2016).

2.3. The cyclical feature of loan loss provisions

The extent to which LLP are procyclical or countercyclical depends on how much banks change their provisions to cope with non-performing loans during economic downturns and do the

opposite during economic booms. The cyclicality of LLP is noted by Olszak *et al.* (2016) to vary from bank to bank, as well as from country to country, implying diversity, despite the same economic factors, Basel minimum requirements, and accounting standards European banks are subject to.

Laeven and Majnoni (2003) draw attention to different cyclical patterns of LLP that prevail according to banks' geographical location. They find evidence that many banks around the world delay provisioning for bad loans until too late, which intensifies its consequences during cyclical downturns, such as amplified losses and harsher capital shocks. Additionally, they find an undesirable negative relation of LLP with loan growth and GDP growth. Beatty and Liao (2009) similarly conclude that, in comparison to timelier financial institutions, banks with less timely LLP recognition are more exposed to capital crunches in recessionary periods.

Olszak *et al.* (2016) draw attention to bank's different risk management approaches and their non-uniform sensitivity to business cycles. They show that LLP are more procyclical in large, publicly-traded, and commercial banks, as well as in banks reporting consolidated statements. More restrictive capital standards and better investor protection, in turn, are linked with the weakened procyclicality of LLP.

European banks are specifically analyzed in some studies (e.g., Bonin and Kosak, 2013; Ozili, 2017) which conclude that the propensity for such banks to manipulate LLP is mostly influenced by procyclical macroeconomic conditions. The literature that studies the behavior of LLP during fluctuating economic conditions generally confirms the procyclicality of LLP, because it exacerbates the state of the economy. As Bouvatier and Lepetit (2008) state, banks take greater risks in economic booms while during cyclical downturns they are excessively pessimistic.

Given the evidence on the cyclical feature of LLP, we test to what extent the financial crisis affected the relationship between LLP and banks' profitability across peripheral and core

countries of the Euro area. By doing so, we expect to contribute with relevant evidence to the discussion on whether the accounting paradigm should be rethought by policymakers in favor of a provisioning system with greater financial stability that smooths LLP cyclicality. Hence, we define the following hypothesis.

Hypothesis #3 – The financial crisis shifted the relationship of LLP and banks' profitability across peripheral and core countries of the Euro area.

3. Modelling banks' profitability

Given the intrinsic and extrinsic factors affecting banks' profits, we model the profitability of bank *i* at time *t*, as a function of loan loss provisions (LLP), a set of bank-level variables (B) and a set of industry-specific and macroeconomic variables (M):

$$y_{it} = \alpha + \beta_1 LLP_{it} + \vec{\beta}_2 B_{it} + \vec{\beta}_3 M_{it} + \gamma_t + \varepsilon_{it} \quad (1)$$

where β_1, $\vec{\beta}_2$ and $\vec{\beta}_3$ denote unknown parameters ($\vec{\beta}_2$ and $\vec{\beta}_3$ are vectors) reflecting the marginal effects of profitability determinants. We express time in years, with time fixed effects denoted as γ_t, and the residual term, ε_{it}, contains the unobserved bank-specific time-invariant effect (η_i) and the idiosyncratic error (v_{it}). To measure profitability (y_{it}), we use either ROAA or ROAE. Both measures are widely accepted in the banking literature, but we follow Athanasoglou *et al*. (2008) and consider ROAA as our key ratio for the evaluation of bank profitability; ROAE stands as a complementary measure that provides an alternative profitability perspective. We compute these profitability measures using the ratios of net income divided by the yearly averages of total assets and equity, respectively.

Eq. (1) isolates LLP due to its relevance to assessing the stability and soundness of a financial system. To measure LLP, we use the ratio of yearly loan loss provisions to total net loans (*Loan loss provisions*). We follow Chiorazzo *et al.* (2008) among others and include the proportion of non-interest income to total income (*Non-interest income share*), which captures revenue

diversification effects on profitability. We also draw from Albertazzi and Gambacorta (2009) to use the cost-to-income ratio (*Cost to income* - computed as total expenses over total income) as a proxy of bank efficiency. Based on previous evidence (Goddard *et al.*, 2004b; Iannotta *et al*., 2007; Short, 1979; Smirlock, 1985), we control for the effects of bank size and business growth on banks' ability to generate profits by using the natural logarithm of total assets (*Size*); we measure as well the effects of total assets growth (*Total assets growth rate*). Additionally, similar toAthanasoglou *et al.* (2006), Berger (1995), Iannotta *et al*. (2007), and Mirzaei *et al.* (2013), we consider bank capitalization (*Capitalization*) by using the ratio of bank equity to total assets. We also analyze the effect of funding structure on banks profitability based on the ratio of customer deposits to total liabilities (*Deposit funding share*), given the greater stability of customers' funding when compared to wholesale funding (Altunbas *et al*., 2011).

Like Maudos and de Guevara (2004), we include bank concentration (*Bank concentration*), measured using the Herfindahl–Hirschman Index (HHIIC) applied to credit institutions' total assets. We control for business cycle fluctuation and economic conditions with the annual growth rate of GDP (*GDP Growth*), in line with Demirgüç-Kunt and Huizinga (2010), and assess the overall level of a country's internal income through the natural logarithm of GDP (*GDP*), as in Dietrich and Wanzenried (2014). The effect of inflation (*Inflation*) on bank profitability is determined using the GDP deflator (Athanasoglou *et al*., 2008; Boyd *et al*., 2001; Demirgüç-Kunt and Huizinga, 1999; García-Herrero *et al.*, 2009). To compute the impact of interest rates (*Interest rates*) on banks' profitability (Borio *et al*., 2015), we select the short-term ECB main refinancing operations rate and calculate its annual average from daily observations.

Finally, we take into account the tendency of banks' profitability to persist over time, signaling that market structure is not perfectly competitive (see, for example, Flamini *et al.*, 2009; Goddard *et al.*, 2004b). According to Berger *et al.* (2000), information opacity,

impediments to market competition and sensitivity to macroeconomic shocks are strong drivers of persistence. Goddard *et al.* (2011) report that the persistence of profitability is weaker for banks in developing than for those in developed countries. If profitability indeed persists, the choice of a dynamic empirical model with a lagged dependent variable is justified. Hence, we follow Athanasoglou *et al.* (2008), Flamini *et al.* (2009), and García-Herrero *et al.* (2009), to adjust Eq. (1) to a dynamic linear model:

$$y_{it} = \alpha + \delta y_{i,t-1} + \beta_1 LLP_{it} + \vec{\beta}_2 B_{it} + \vec{\beta}_3 M_{it} + \gamma_t + \varepsilon_{it} \quad (2)$$

$y_{i,t-1}$ is the one-period lagged profitability and the autoregressive parameter δ measures the speed of adjustment to equilibrium. $\delta = 0$ implies that profitability adjusts immediately, $\delta = 1$ denotes an extremely low adjustment and $\delta \in (0,1)$ suggests that profitability persists but will eventually return to its normal level.

We estimate Eq. (2) using the system GMM proposed by Arellano and Bover (1995) and Blundell and Bond (1998), which is asymptotically more efficient than the GMM of Arellano and Bond (1991). To control for the persistence of bank profitability over time and potential endogeneity problems, we use Windmeijer's (2005) finite-sample corrected standard errors. Following previous literature (e.g., Athanasoglou *et al.*, 2008; García-Herrero *et al.*, 2009; Köhler, 2015), we treat bank-specific regressors as endogenous variables that are instrumented with their lags. We test the validity of instruments through Hansen's *J*-test statistic for overidentifying restrictions. Finally, although first-order autocorrelation (AR(1)) is presumed to exist, higher order autocorrelation is not. Still, to obtain valid statistics, we include the first, second, and third lags of the dependent variable[5]. Industry concentration and macroeconomic variables, in turn, are treated as strictly exogenous.

[5] The choice of the third lag of the dependent variable is supported by the results (not reported) of the Bayesian Information Criteria (BIC).

We test Hypothesis 1 by dividing the sample into two groups, namely between peripheral and core countries' banks. To distinguish banks in both groups we use a dummy ($Periphery = 1$, for peripheral banks, and zero otherwise), which leads us to a disaggregated form of Eq. (2):

$$y_{it} = \alpha_0 + \alpha_1 \cdot Periphery + (\delta_0 + \delta_1 \cdot Periphery) \cdot y_{i,t-1} + (\beta_{10} + \beta_{11} \cdot Periphery) \cdot LLP_{it} + \left(\vec{\beta}_{20} + \vec{\beta}_{21} \cdot Periphery\right) \cdot B_{it} + (\vec{\beta}_{30} + \vec{\beta}_{31} \cdot Periphery) \cdot M_{it} + \gamma_t + \varepsilon_{it} \quad (3)$$

The $Periphery$ dummy interacts with all explanatory variables, allowing us to test for the equality of coefficients within groups. For that purpose, we employ a Wald test to jointly linear restrictions.

To investigate Hypothesis 2, we test each coefficient and assess whether they are individually significant and different between each group. For testing Hypothesis 3, we define another dummy variable. Given that the Euro area banks' profitability registered a sharp decrease from 2008 onwards and the last Euro area GDP's negative annual growth was in 2013, we define this dummy as $Crisis = 1$, for $t \in [2008, 2013]$, and zero otherwise. For each group of banks, we interact LLP with $Crisis$ to get information about the significance of the LLP effect on bank profitability during the crisis period displaying a potential structural shift.

4. Data

4.1. Sample

Our dataset contains panel data on banks and macroeconomic variables from the 19 Euro area countries over the period 2006-2015. The frequency of observations is annual. We focus the analysis on the participating Member States of the SSM, bearing in mind the ultimate responsibility of ECB for the prudential supervision of banks in these States, and its ability to define coherent and effective macro policies to stimulate financial stability in the Eurozone.

We use SNL Financial[6] as the primary source of banks' financial statements and complement with information from Bankscope[7], as SNL Financial is only robust in terms of bank data financials from 2010 onwards. By matching banks in both databases using the Legal Entity Identifier, we obtain a total sample of 4,874 banks, of which 2,117 were still active at the end of the period. Whenever available, consolidated accounts are used. Analogous to Mergaerts and Vennet (2016), we rule out banks with ratios of loans to total assets and deposits to total assets below a 5% threshold. To mitigate the impact of outliers, we follow Köhler (2015) and winsorize all bank-level variables at the 0.5 and 99.5 percentile. After the use of additional quality checks (Table 1), the final dataset is an unbalanced panel with 3,046 banks, corresponding to 21,851 bank-year observations. ECB Statistics and the World Bank database are the sources for industry and macroeconomic indicators. Further details on the yearly and geographical distribution of our sample are shown in Appendix A.

Table 1

Criteria for sample selection.

Criteria	Banks excluded	Final sample
Initial sample		**4,874**
Zero assets during the whole sample period	1,437	3,437
Zero gross loans during the whole sample period	78	3,359
Low relative amount of gross loans (< 5% of total assets)	81	3,278
Zero deposits during the whole sample period	17	3,261
Low relative amount of deposits (< 5% of total assets)	117	3,144
Different activity classification between SNL Financial and Bankscope for the same bank (e.g. commercial bank vs. other banking)	39	3,105
Difference in the value of total assets > 1% between SNL Financial (2016) and Bankscope (2013) for the same bank	59	3,046
Final sample (after filtering and data quality check procedures)	**1,828**	**3,046**

In addition to listed banks, typically considered in previous research on bank profitability (e.g., Demirgüç-Kunt and Huizinga, 2010), our dataset contains unlisted banks as well. This adds comprehensiveness to the empirical findings, as we acknowledge that such banks are the

[6] SNL Financial 2016 – Standard & Poors.
[7] Bankscope - Bureau Van Dijk.

majority in the EU and that many of them have a more retail-oriented business model. We consider only banks that offer similar banking services, such as commercial banks, savings banks, cooperatives banks, and real estate and mortgage banks. Investment banks are disregarded due to their fundamentally different risk characteristics (Köhler, 2015).

4.2. Descriptive statistics

From Table 2, we observe that both indicators of profitability dropped significantly from 2006 to 2015. Such decline is strikingly pronounced in peripheral banks, contrasting with the higher resilience of core banks' profitability to the adverse effects of the crisis. Likewise, the evolution of LLP displays a distinct pattern between peripheral and core banks; while the first group of banks reveals a substantial increase in yearly losses from provisioning (288%), the second eased that burden (-83%). The higher percentage of loans provisioned by peripheral banks suggests relatively lower quality in their credit portfolio. We detect significant differences between the two groups of banks in terms of the measures of profitability, as well as on LLP.

Table 2

Descriptive statistics. Statistics are from the full sample of 21,851 bank-year observations. Δ06-15 denotes the percent change in each variable from 2006 to 2015. Significance levels at the 1%, 5%, and 10% levels are marked with ***, **, and *, respectively. Further variable definitions and data sources are in Appendix B.

	All banks				Peripheral banks				Core banks			
Variables	**2006**	**2015**	**Mean**	**Std. Dev.**	**2006**	**2015**	**Mean**	**Std. Dev.**	**2006**	**2015**	**Mean**	**Std. Dev.**
ROAA (%)	0,6%	0,3%	0,3%	0,6%	0,8%	0,1%	0,3%	1,1%	0,4%	0,3%	0,3%	0,4%
ROAE (%)	7,2%	2,7%	3,7%	8,1%	8,6%	0,4%	2,4%	13,7%	6,6%	3,4%	4,1%	5,8%
Loan loss provisions (%)	0,8%	0,6%	0,6%	1,2%	0,5%	1,9%	1,2%	1,4%	0,9%	0,2%	0,4%	1,0%
Non-interest income share (%)	35,5%	28,9%	28,8%	13,7%	28,1%	40,6%	29,6%	13,8%	39,0%	25,4%	28,5%	13,6%
Cost to income (%)	65,6%	69,0%	68,3%	14,2%	64,0%	66,0%	67,0%	20,0%	66,3%	69,9%	68,8%	12,0%
Total assets growth rate (%)	7,5%	3,0%	5,1%	11,9%	11,7%	0,9%	7,4%	14,5%	5,5%	3,6%	4,3%	10,9%
Size (logarithm)	13,5	13,7	13,6	1,8	13,5	13,8	13,7	2,0	13,5	13,7	13,6	1,7
Capitalization (%)	8,1%	9,5%	8,5%	3,8%	11,0%	10,1%	10,4%	5,6%	6,8%	9,3%	7,8%	3,0%
Deposit funding share (%)	70,2%	77,4%	72,5%	17,5%	63,1%	66,1%	61,3%	16,7%	73,6%	80,8%	76,8%	15,9%
Bank concentration	377,0	477,5	441	402	335,2	599,6	481	276	397,8	417,0	421	450
GDP growth (%)	3,3%	1,6%	0,9%	2,8%	2,6%	1,6%	-0,2%	2,7%	3,7%	1,7%	1,4%	2,7%
GDP (logarithm)	28,3	28,2	28,3	1,0	28,1	27,9	28,1	0,8	28,4	28,3	28,4	1,1
Inflation (%)	1,5%	1,4%	1,4%	1,1%	2,4%	0,7%	1,4%	1,1%	1,0%	1,7%	1,5%	1,1%

The remaining variables also generally exhibit significant differences in means between both groups of banks. Peripheral banks have a substantial increase (44%) of income stemming from other sources than interests; tighter profitability may have forced them to look for alternative revenues to remain sustainable. With a decrease near 35% in the proportion of non-interest income share, core banks, instead, seem to have focused on interest margin optimization. From the cost-to-income ratio, we confirm that efficiency decreases overall, but at a faster pace in core banks.

The higher growth rates observed in the total assets of peripheral banks may result from the significant financial flows from core countries to peripheral countries. However, the disruption on credit granting and the impact of credit losses following the emergence of the financial crisis are most likely behind the much higher slowdown in the growth rate of assets in peripheral banks. This group of banks also seems to be slightly larger on average and possess a higher equity-to-assets ratio; still, the evolution of such ratio is much more favorable in core banks, probably due to their capital increases or income retention. Concerning the funding sources, banks in peripheral countries seem to make higher use of wholesale markets to finance their activities, as can be assessed by the lower share of customer deposits in comparison with banks in core countries (61.3% vs. 76.8%).

Bank concentration in peripheral countries is higher and has a more remarkable evolution, denoting a higher consolidation of the respective banking system in the past decade. Besides, both peripheral and core countries have a negative trend in the GDP growth rate as well as in the logarithm of GDP, in line with the harsh economic and financial conditions faced by Euro area countries during the 2008-2013 financial crisis. The evolution of the inflation rate, instead, reveals a completely different pattern between peripheral and core countries, with an expressive drop in the first contrasting with an increase in the latter. Finally, reflecting the Euro area expansionary monetary policy during the crisis period, the interest rates of ECB's main

refinancing operations present a negative evolution, decreasing from 3% in 2006 to 0.05% in 2015.

5. Empirical analysis

5.1. Dynamic model of profitability

Estimates for the baseline model, as defined in Eq. (2), are in Table 3. Except for inflation, all explanatory variables are significant when either ROAA or ROAE are considered, which is in line with previous literature. Also significant is the persistence of banks' profitability in the first and third lags when ROAA is considered, and the same applies to all lags of ROAE, though at different significance levels. This supports the findings from Flamini *et al.* (2009) that the market structure of the Euro area is not perfectly competitive, with a certain rigidity of banks to change their stance in the industry's performance distribution.

In terms of LLP, we observe a significant negative and a rather strong effect on both profitability measures, in contrast with Agoraki *et al*. (2021) that found a positive effect of LLP on bank performance given by stocks return. In our study, an increase of 1 p.p. in LLP leads to an immediate decrease of approximately 0.21 p.p. in ROAA and 1.94 p.p. in ROAE. Considering the average values of ROAA and ROAE for the sample period, respectively 0.3% and 3.7%, the effect of LLP is quite substantial. The results also confirm a positive and significant impact of a larger share of non-interest income activities, such as fees, commissions, and net trading income. This is consistent with Demirgüç-Kunt and Huizinga (2010) and shows that a move into non-interest income-generating activities increases profitability. In a framework of increased competition and restructuring in the EU banking system, these results signal the proactive behavior of commercial banks and alike to search for alternative sources of income and mitigate the decline in interest margins.

Table 3

Estimates for Eq. (2). The results derive from a system GMM estimator of the effects of bank- and industry-specific and macroeconomic characteristics on bank profitability. The return on average assets (ROAA) and the return on average equity (ROAE) are dependent variables; $(\boldsymbol{t-i})$ denotes lagged values of order $\boldsymbol{i}$ for both variables. Bank-specific variables are treated as endogenous. z_1 and z_2 are Wald tests of the joint significance of the coefficients and the omitted year dummies. AR($\boldsymbol{i}$) is a serial correlation test of order $\boldsymbol{i}$ using residuals in first differences. Hansen test informs about the overidentifying restrictions. Windmeijer finite-sample corrected standard errors are used, *t*-values are in brackets and significance levels at the 1%, 5%, and 10% levels are marked with ***, **, and *, respectively.

Variables	**ROAA**	**ROAE**
ROAA (t-1)	0.173***	-
	(5.07)	
ROAA (t-2)	0.015	-
	(0.82)	
ROAA (t-3)	0.045***	-
	(2.78)	
ROAE (t-1)	-	0.217***
		(4.73)
ROAE (t-2)	-	0.038*
		(1.71)
ROAE (t-3)	-	0.048**
		(2.19)
Loan loss provisions	-0.209***	-1.942***
	(-6.00)	(-3.96)
Non-interest income share	0.008***	0.072*
	(3.14)	(1.96)
Cost to income	-0.011***	-0.038
	(-4.14)	(-0.86)
Total assets growth rate	0.008*	0.214***
	(1.86)	(4.15)
Size	-0.158***	-1.823***
	(-4.36)	(-3.80)
Capitalization	0.001	-0.372***
	(0.10)	(-3.10)
Deposit funding share	0.005***	0.094***
	(2.72)	(3.38)
Bank concentration	0.000***	0.003***
	(3.25)	(2.68)
GDP growth	0.014*	0.310***
	(1.69)	(2.69)
GDP	-0.035**	-0.332
	(-2.14)	(-1.30)
Inflation	0.013	0.110
	(0.67)	(0.41)
Interest rates	2.777***	26.60***
	(3.90)	(2.70)
Observations	14.444	14.444
Nr. of banks	2.570	2.572
Nr. of instruments	52	52
z_1	3.119	1.726
z_2	0,000	0,000
AR(1)	0,000	0,000
AR(2)	0,102	0,203
AR(3)	0,423	0,924
Hansen test	0,199	0,297

In line with our expectations, more efficient banks show higher profitability, as the cost-to-income ratio displays a negative and significant impact on banks' profitability. Athanasoglou *et al.* (2008), Avgeri *et al.* (2021), and Elekdag *et al.* (2020) find similar results, which reinforces the notion that efficient cost management is determinant to increase the profitability of banks in the Euro area. Consistent with Ahamed (2017), Demirgüç-Kunt and Huizinga (2010), and Stiroh (2004), we observe positive effects of the assets growth rate over profitability. As to bank size, similar to Barros *et al*. (2007), we find a negative impact on banks' profitability level, supporting the argument that costs of increasingly complex banks overcome the economies of scale, as hypothesized by Iannotta *et al*. (2007).

Suggesting that holding higher capital ratios induces banks to follow lower risk strategies with lesser payoffs, our results show that better capitalization contributes negatively to returns when ROAE is considered. In this case and supporting the findings of Goddard *et al.* (2004a), the conventional risk-return hypothesis overcomes the reduced funding costs that may arise from better creditworthiness ratios.

As we are focusing the analysis on banks with a more traditional business model, the funding structure in the sample is characterized by a relatively high proportion of customer deposits (72.5%). The coefficient estimates related to the share of this type of funding indicate a positive and significant relationship with banks' profitability, drawing attention to the extent banks can generate positive net interest margins.

Regarding the industry determinant of profitability, the evidence shows that bank concentration has a positive significant effect on ROAA and ROAE. Based on the SCP paradigm, we confirm that market structure drives an important role in the capacity of banks to set up interest rates that directly affect their performance. Substantiating the expectation that greater bank concentration leads to higher bank profitability, the empirical results we obtain are in line with Maudos and de Guevara (2004).

Similar to previous research (e.g., Avgeri *et al.*, 2021; Demirgüç-Kunt and Huizinga, 2010; García-Herrero *et al.*, 2009; Iannotta *et al*., 2007), we find that business cycle fluctuations and favorable economic conditions foster banks' higher returns. The evidence is in the positive and significant relationship between GDP growth and banks' profitability. As to the GDP level, the effect is negative and significantly related to Euro area banks' ROAA. According to Goldberg and Rai (1996), to the extent that the Euro area's banking system has reached a mature stage, the competitive environment might induce tighter interest margins. In line with expectations, another significant macroeconomic determinant of profitability is the interest rate, whose coefficient estimates confirm its positive influence on net interest margins. An equivalent outcome is reported by Borio *et al*. (2015). Inflation, in turn, does not reveal an acceptable significance.

To assess Hypothesis 1, we now estimate the disaggregated model in Eq. (3), which distinguishes between peripheral and core banks through the interaction of the $Periphery$ dummy variable with each profitability determinant. The results are reported in Table 4.

We perform a Wald test to the joint equality of parameters between both groups of banks. For our baseline model with the 12 bank, industry, and macroeconomic determinants of bank profitability, the Wald statistics to the joint equality of parameters between the two groups of banks are $\chi^2(12) = 71.94$ and $\chi^2(12) = 28.28$, respectively when ROAA and ROAE are used as dependents. Such results allow us to reject the null hypothesis of the joint equality of coefficients at the 1% significance level, confirming the existence of differences between the two groups of banks; therefore, we accept our Hypothesis 1.

Subsequently, we test individually the equality of each coefficient, as shown in Table 5, and conclude the degree of heterogeneity between each determinant of profitability in these groups.

The estimates of Eq. (3), as shown in Table 4, confirm that both peripheral and core banks exhibit a negative and significant relationship of LLP with ROAA and ROAE. However, the

LLP coefficients for peripheral banks (-0.63 and -8.64, respectively) are significantly different than what core banks reveal (-0.21 and -5.19, respectively). These differences are validated by the Wald test, as reported in Table 5. Therefore, there is notable evidence that, when compared to core banks, peripheral banks' profitability is significantly more affected by the lower credit quality of loan portfolios. Such evidence confirms Hypothesis 2.

Concerning the effect of non-interest income activities observed in the disaggregated model, we find significance only in peripheral banks. Nevertheless, the Wald test indicates that the difference between the two groups is not significant, which may result from the generalized low aggregate profitability in Euro area banks. A similar conclusion of no significant differences between both groups of banks goes to the negative impact of higher capital ratios on profitability.

The results on the cost-to-income ratio suggest that bank efficiency is mostly an issue for peripheral banks' profitability. Indeed, the evidence points to the rejection of the null hypothesis of the individual Wald test, with a reduction in the inefficiency levels generating a stronger influence on peripheral banks. Even more remarkable, divergent results between peripheral and core banks emerge in the effects of assets growth rate. Specifically, peripheral banks' profitability is negatively affected by higher total assets growth rates. Such an outcome suggests that faster growth rates might be associated with lax credit policies during expansion periods, as advocated by previous research (Asea and Blomberg, 1998). Thus, profitability drawbacks of peripheral banks might be directly related to feeble risk management practices.

Table 4

Estimates for Eq. (3). The results derive from a two-step GMM dynamic panel estimator of the effects of bank- and industry-specific and macroeconomic characteristics on bank profitability. The return on average assets (ROAA) and the return on average equity (ROAE) are dependent variables; $(\boldsymbol{t-i})$ denotes lagged values of order $\boldsymbol{i}$ for both variables. Bank-specific regressors are treated as endogenous. All variables are interacted with a dummy ($\boldsymbol{Periphery = 1}$ for peripheral banks and 0 otherwise) to test for differences between the 2 groups of banks. z_1 and z_2 are Wald tests of the joint significance of the coefficients and the omitted year dummies. AR($\boldsymbol{i}$) is a serial correlation test of order $\boldsymbol{i}$ using residuals in first differences. Hansen test informs about overidentifying restrictions. Windmeijer finite-sample corrected standard errors are used, *t*-values are in brackets and significance levels at the 1%, 5%, and 10% levels are marked with ***, **, and *, respectively.

Dependent variable : ROAA				**Dependent variable : ROAE**			
Panel for Periphery		**Panel for Core**		**Panel for Periphery**		**Panel for Core**	
ROAA (t-1)	-0.046	ROAA (t-1)	0.109	ROAE (t-1)	-0.119	ROAE (t-1)	0.064
	(-0.77)		(1.28)		(-0.48)		(0.33)
ROAA (t-2)	-0.003	ROAA (t-2)	-0.006	ROAE (t-2)	0.001	ROAE (t-2)	0.061
	(-0.12)		(-0.16)		(0.01)		(0.99)
ROAA (t-3)	-0.009	ROAA (t-3)	0.022	ROAE (t-3)	-0.018	ROAE (t-3)	-0.009
	(-0.21)		(0.69)		(-0.20)		(-0.23)
Loan loss provisions	-0.631***	Loan loss provisions	-0.208***	Loan loss provisions	-8.635***	Loan loss provisions	-5.186*
	(-7.00)		(-3.39)		(-2.98)		(-1.72)
Non-interest income share	0.019***	Non-interest income share	0.006	Non-interest income share	0.491*	Non-interest income share	0.143
	(2.77)		(1.09)		(1.84)		(0.79)
Cost to income	-0.043***	Cost to income	-0.007	Cost to income	-0.486**	Cost to income	-0.078
	(-6.56)		(-1.31)		(-2.21)		(-0.40)
Total assets growth rate	-0.018**	Total assets growth rate	0.016**	Total assets growth rate	0.143	Total assets growth rate	0.231
	(-2.23)		(2.12)		(0.67)		(0.95)
Size	-0.273***	Size	-0.032	Size	-12.71**	Size	-0.255
	(-2.97)		(-0.78)		(-2.11)		(-0.12)
Capitalization	-0.014	Capitalization	-0.010	Capitalization	-2.483**	Capitalization	-0.826
	(-0.50)		(-0.59)		(-2.33)		(-1.30)
Deposit funding share	-0.006*	Deposit funding share	0.014**	Deposit funding share	0.009	Deposit funding share	0.248*
	(-1.77)		(2.52)		(0.06)		(1.71)
Bank concentration	0.001***	Bank concentration	0.000138*	Bank concentration	0.041**	Bank concentration	0.001
	(3.07)		(1.88)		(2.09)		(0.51)
GDP growth	0.004	GDP growth	0.010	GDP growth	0.600*	GDP growth	0.429
	(0.38)		(0.82)		(1.77)		(1.63)
GDP	0.185***	GDP	-0.067***	GDP	5.665*	GDP	-1.677**
	(3.08)		(-3.60)		(1.92)		(-2.46)
Inflation	0.077***	Inflation	-0.032	Inflation	1.452*	Inflation	-0.971
	(3.48)		(-0.99)		(1.89)		(-1.64)
Interest rates	1.562**	Interest rates	1.578**	Interest rates	42.30	Interest rates	38.18
	(1.96)		(2.06)		(1.32)		(1.29)
Observations		14.444				14.444	
Nr. of banks		2.570				2.572	
Nr. of instruments		65				49	
z_1		4.263				1.471	
z_2		0,000				0,000	
AR(1)		0,000				0,000	
AR(2)		0,059				0,779	
AR(3)		0,834				0,882	
Hansen test		0,352				0,274	

Table 5

Wald tests. The null hypothesis states the equality of the individual coefficients between peripheral and core banks, on a two-step GMM dynamic panel using ROAA as endogenous.

Variable	Statistic	Variable	Statistic
Loan loss provisions	$\chi^2(1) = 15.00$ p-value $= 0.0001$	Deposit funding share	$\chi^2(1) = 9.92$ p-value $= 0.0016$
Non-interest income share	$\chi^2(1) = 2.25$ p-value $= 0.1338$	Bank concentration	$\chi^2(1) = 6.46$ p-value $= 0.0110$
Cost to income ratio	$\chi^2(1) = 20.72$ p-value $= 0.0000$	GDP growth	$\chi^2(1) = 0.35$ p-value $= 0.5542$
Total assets growth rate	$\chi^2(1) = 9.09$ p-value $= 0.0026$	GDP	$\chi^2(1) = 17.33$ p-value $= 0.0000$
Size	$\chi^2(1) = 6.02$ p-value $= 0.0142$	Inflation	$\chi^2(1) = 7.64$ p-value $= 0.0057$
Capitalization	$\chi^2(1) = 0.01$ p-value $= 0.9038$	Interest rates	$\chi^2(1) = 0.03$ p-value $= 0.8678$

In the same sense, the introduction of the $Periphery$ dummy variable adds evidence of a negative and significant relationship between the deposit funding share and peripheral banks' profitability, as measured by ROAA; this is the opposite to what we observe for core banks. Similar evidence of differences in the effects of customer deposits is given by the Wald test rejection of the null hypothesis of equal coefficients in both groups of banks. A conceivable cause for this evidence lies in the difficulties peripheral banks faced in financing their activities at sustainable borrowing rates on wholesale funding markets, which pressed them to scoop up customer savings through the so-called "deposit war".

Surprisingly, we obtain mixed results for the effects of industry-specific and economic determinants of profitability. Bank concentration has a more meaningful and positive effect in peripheral banks, but for GDP growth we do not find a significant difference in the respective effect on profitability between the two groups. We do not find significant differences either for the impact of interest rates, which implies that the unconventional monetary policy undertaken by the ECB, where rather low interest rates prevailed, conditioned in general the ability of banks to overturn their low aggregate profitability. On the influence of the GDP level and in line with Dietrich and Wanzenried (2011), we observe that peripheral banks are more likely to benefit

from higher domestic income levels. Lastly, when we introduce the $Periphery$ dummy variable and thus disentangle the sample, inflation gains statistical relevance at the 1% level for peripheral banks.

To evaluate the potential effects the 2008-2013 financial crisis may have had on banks' profitability, we estimate the disaggregated model but now including the $Crisis$ dummy. We report selected estimates in Table 6, which confirm a significant shift in the relationship of LLP and peripheral banks' ROAA at the 1% significance level. We note that the 2008-2013 financial crisis worsened the effect on peripheral banks' ROAA, in approximately 0.14% per each 1% increase of LLP. This represents an increase of 40% compared to the marginal effect outside that period. Conversely, in core banks, the effect of LLP on profitability, already lower than that of peripheral banks, seems to have escaped unscathed to the financial crisis, thus supporting the acceptance of Hypothesis 3.

5.2. Fixed effects approach

The previous subsection addresses the problem of endogeneity, introduced by the inertia of profitability persistence over time, using the Arellano and Bover (1995) and Blundell and Bond (1998) GMM. However, with the introduction of $Periphery$, the estimates shown in Table 4 for the disaggregated model given by Eq. (3) do not signal profits' persistence over time. This suggests that potential endogeneity issues could be approached differently. Previous literature (e.g., Demirgüç-Kunt and Huizinga, 2010) analyzes the variation in banks' profitability without considering the inertia of banks' profits, though keeping in mind the problem of endogeneity. Accordingly, we assess the influence of unobserved effects, α_i, that captures all the unobserved and time-constant factors that affect y_{it}, by using alternatively fixed effects models.

We start by estimating two fixed effects models, one with bank fixed effects and another with time fixed effects. These two regressions include respectively bank-specific and time-

specific invariant components which are allowed to be correlated with the explanatory variables, and hence a limited form of endogeneity is permitted. We use the F-test to perform separate tests for bank and time fixed effects of the null hypothesis, in which all time and space dummy variables except for the reference group are jointly zero. The results show that the null hypothesis is rejected in both regressions, indicating that a two-way fixed effects model (with both bank and time fixed effects) may increase the goodness-of-fit and is preferable to the Pooled OLS.

Table 6

Selected estimates for the disaggregated model with the inclusion of the $\boldsymbol{Crisis}$ dummy. The results derive from a two-step GMM dynamic panel estimator of the effects of bank- and industry-specific and macroeconomic characteristics on bank profitability. The return on average assets (ROAA) and the return on average equity (ROAE) are dependent variables; $(\boldsymbol{t-i})$ denotes lagged values of order $\boldsymbol{i}$ for both variables. Bank-specific regressors are treated as endogenous. All variables are interacted with a dummy ($\boldsymbol{Periphery = 1}$ for peripheral banks and 0 otherwise) to test for structural differences between the 2 groups of banks. The $\boldsymbol{Crisis}$ dummy variable represents the 2008-2013 financial crisis period ($\boldsymbol{Crisis = 1}$, for $\boldsymbol{t} \in$ [2008,2013], and zero otherwise). z_1 and z_2 are Wald tests of the joint significance of the coefficients and the omitted year dummies. AR($\boldsymbol{i}$) is a serial correlation test of order $\boldsymbol{i}$ using residuals in first differences. Hansen test informs about overidentifying restrictions. Windmeijer finite-sample corrected standard errors are used, *t*-values are in brackets and significance levels at the 1%, 5%, and 10% levels are marked with ***, **, and *, respectively.

Dependent variable : ROAA				**Dependent variable : ROAE**			
Panel for Periphery		**Panel for Core**		**Panel for Periphery**		**Panel for Core**	
ROAA (t-1)	0.049	ROAA (t-1)	0.147*	ROAE (t-1)	0.064	ROAE (t-1)	0.414*
	(0.89)		(1.95)		(0.34)		(1.71)
ROAA (t-2)	0.011	ROAA (t-2)	-0.017	ROAE (t-2)	0.058	ROAE (t-2)	0.115
	(0.40)		(-0.47)		(1.09)		(1.21)
ROAA (t-3)	0.002	ROAA (t-3)	0.034	ROAE (t-3)	0.048	ROAE (t-3)	0.082
	(0.06)		(1.16)		(0.86)		(1.23)
Loan loss provisions	-0.359***	Loan loss provisions	-0.095	Loan loss provisions	-6.188**	Loan loss provisions	8.586
	(-2.93)		(-1.53)		(-2.51)		(1.15)
Loan loss prov. (Crisis=1)	-0.142***	Loan loss prov. (Crisis=1)	-0.073	Loan loss prov. (Crisis=1)	-1.114	Loan loss prov. (Crisis=1)	-6.136
	(-2.78)		(-1.36)		(-1.17)		(-1.22)
Other controls	Yes		Yes	Other controls	Yes		Yes
Observations	14.444				14.444		
Nr. of banks	2.570				2.572		
Nr. of instruments	69				51		
z_1	4.225				1.488		
z_2	0,000				0,000		
AR(1)	0,000				0,023		
AR(2)	0,065				0,254		
AR(3)	0,887				0,325		
Hansen test	0,131				0,099		

Considering the insights from these tests and according to previous literature (e.g., Ahamed, 2017; Athanasoglou *et al.*, 2006; Demirgüç-Kunt and Huizinga, 2010), we use the following model to check for robustness of results:

$$y_{it} = \alpha + \beta_1 LLP_{it} + \vec{\beta}_2 B_{it} + \vec{\beta}_3 M_{it} + \gamma_t + \alpha_i + \varepsilon_{it} \quad (4)$$

All the specifications already stated for Eq. (1) are maintained and only a bank-specific fixed effect, α_i, is added to the model, in addition to the time fixed effects already considered (γ_t).

To ensure valid results, we also analyze the issue of multicollinearity, based on the Variance Inflation Factor (VIF), and find that all regressors have rather low VIFs (below 1.31), supporting the lack of multicollinearity problems. To test for homoscedasticity, we follow Greene (2000) and conduct a Modified Wald test for group-wise heteroskedasticity in the residuals of a fixed-effects regression model. The null hypothesis of homoscedasticity is rejected, indicating that standard errors of estimates need to be corrected. The same happens when we analyze the problem of serial correlation in the error term, with the Wooldridge (2002) test for serial correlation rejecting the null hypothesis of no first-order autocorrelation at the 1% level.

Therefore, we carry out a fixed-effects model that allows for intragroup correlation. Specifically, we employ a fixed-effects model with bank and year fixed effects and clustered standard errors at the bank-level. In line with Hoechle (2007), this approach allows us to obtain standard error estimates that are robust to disturbances being heteroskedastic and autocorrelated of type AR(1). The estimates for this approach (Table 7) confirm the signal and significance of most explanatory variables, except in what concerns size, bank concentration, and GDP that change the signal of their relationship with banks' profitability. Capitalization and inflation, in turn, retain their signal and gain statistical relevance.

To check the validity of our previous results and allow comparisons, we maintain the same line of reasoning to answer our set of hypotheses. Thus, we include again the $Periphery$ dummy variable with an interaction with all explanatory variables, which leads us to the disaggregated version of Eq. (4) (Table 8). We perform subsequently a Wald test to the joint equality of parameters between peripheral banks and core banks. Results are $F(12, 2117) =$

46.60 and $F(12, 2716) = 29.58$, respectively for the ROAA and ROAE models, documenting again the structural differences between the coefficients in both groups of banks. We further employ an individual Wald test to each coefficient and assess whether they are individually equal between both groups (Table 9). Lastly, we introduce the $Crisis$ dummy variable to test the change of the LLP effect on banks' profitability in each group (Table 10).

Table 7

Estimates for Eq. (4). The results derive from fixed-effects estimations of the effects of bank- and industry-specific and macroeconomics characteristics on bank profitability. The return on average assets (ROAA) and the return on average equity (ROAE) are dependent variables. We follow Paternoster *et al.* (1998) and Clogg *et al.* (1995) in using a corrected statistical test for the equality of regression coefficients for large sample sizes. Robust standard errors are used, *t*-values are in brackets and significance levels at the 1%, 5%, and 10% levels are marked with ***, **, and *, respectively.

Variables	**ROAA**	**ROAE**
Loan loss provisions	-0.230***	-2.955***
	(-23.09)	(-21.88)
Non-interest income share	0.003***	0.059***
	(4.47)	(5.86)
Cost to income	-0.023***	-0.277***
	(-29.36)	(-24.54)
Total assets growth rate	0.002***	0.037***
	(4.02)	(6.58)
Size	0.105**	0.523
	(2.04)	(0.67)
Capitalization	0.024***	0.162**
	(3.77)	(2.18)
Deposit funding share	0.003***	0.00347
	(2.94)	(0.30)
Bank concentration	-0.000139**	-0.0017*
	(-2.03)	(-1.79)
GDP growth	0.032***	0.486***
	(5.23)	(5.70)
GDP	0.773***	2.498
	(3.36)	(0.77)
Inflation	0.0296***	0.484***
	(3.61)	(4.19)
Interest rates	0.039***	0.663***
	(3.42)	(3.90)
Constant	-21.92***	-59.06
	(-3.32)	(-0.64)
Observations	22.049	22.043
Nr. of banks	2.718	2.717
Adjusted R^2	0,536	0,454
Bank dummies	Yes	Yes
Time dummies	Yes	Yes

Table 8

Estimates for the disaggregated version of Eq. (4), with the inclusion of the ***Periphery*** dummy. The results derive from fixed-effects estimations of the effects of bank- and industry-specific and macroeconomics characteristics on bank profitability. The return on average assets (ROAA) and the return on average equity (ROAE) are dependent variables. All variables are interacted with a dummy (***Periphery* = 1** for peripheral banks and 0 otherwise) to test for differences between the 2 groups of banks. Robust standard errors are used, *t*-values are in brackets and significance levels at the 1%, 5%, and 10% levels are marked with ***, **, and *, respectively.

Dependent variable : ROAA				**Dependent variable : ROAE**			
Panel for Periphery		**Panel for Core**		**Panel for Periphery**		**Panel for Core**	
Loan loss provisions	-0.446***	Loan loss provisions	-0.126***	Loan loss provisions	-5.624***	Loan loss provisions	-1.687***
	(-36.23)		(-11.36)		(-28.86)		(-11.95)
Non-interest income share	0.007***	Non-interest income share	0.003***	Non-interest income share	0.109***	Non-interest income share	0.057***
	(6.18)		(2.78)		(7.15)		(3.88)
Cost to income	-0.030***	Cost to income	-0.017***	Cost to income	-0.315***	Cost to income	-0.249***
	(-25.41)		(-13.38)		(-18.44)		(-14.48)
Total assets growth rate	0.002*	Total assets growth rate	0.002***	Total assets growth rate	0.048***	Total assets growth rate	0.026***
	(1.80)		(2.92)		(4.25)		(3.93)
Size	0.194**	Size	0.008	Size	1.416	Size	-0.640
	(2.40)		(0.16)		(0.82)		(-0.81)
Capitalization	0.036***	Capitalization	0.009	Capitalization	0.412***	Capitalization	-0.109
	(3.50)		(1.18)		(3.26)		(-1.27)
Deposit funding share	-0.000	Deposit funding share	0.003***	Deposit funding share	-0.044**	Deposit funding share	0.018
	(-0.26)		(2.63)		(-2.38)		(1.25)
Bank concentration	0.000***	Bank concentration	-0.000***	Bank concentration	0.006***	Bank concentration	-0.003***
	(3.59)		(-2.97)		(2.80)		(-2.68)
GDP growth	0.034***	GDP growth	0.039***	GDP growth	0.460***	GDP growth	0.499***
	(4.75)		(4.79)		(4.21)		(4.43)
GDP	-0.401	GDP	0.093	GDP	-8.683*	GDP	-2.766
	(-1.23)		(0.27)		(-1.87)		(-0.59)
Inflation	0.002	Inflation	0.057***	Inflation	0.460**	Inflation	0.777***
	(0.15)		(5.22)		(2.46)		(5.21)
Interest rates	0.107***	Interest rates	0.018	Interest rates	0.979***	Interest rates	0.347*
	(4.80)		(1.47)		(2.83)		(1.78)
Constant		1.634		Constant		143.5	
		(0.17)				(1.09)	
Observations		22,049				22,043	
Nr. of banks		2,718				2,717	
Adjusted R^2		0.631				0.530	
Bank dummies		Yes				Yes	
Time dummies		Yes				Yes	

The baseline model in Eq. (4), whose estimates are presented in Table 7, seems to explain adequately all Euro area banks' profitability when assessed together. However, Table 8 reports significant differences in the effects from profitability determinants when bank groups are treated separately. In short, our previous results on the differences between peripheral and core countries' banks are robust to loan loss provisions, cost-to-income ratio, deposit funding share, and bank concentration. The alternative approach, based on fixed-effects models, reinforces the significance of the harsher influence of LLP on peripheral banks' profitability during the 2008-

2013 financial crisis period. In line with our previous findings, the results also show that such a negative effect was not tackled by core banks.

Table 9

Wald tests. The null hypothesis states the equality of the individual coefficients between peripheral and core banks, on a fixed-effects model using ROAA as endogenous.

Variable	Statistic	Variable	Statistic
Loan loss provisions	$F(1, 2717) = 363.36$	Deposit funding share	$F(1, 2717) = 4.39$
	p-value $= 0.0001$		p-value $= 0.0363$
Non-interest income share	$F(1, 2717) = 8.60$	Bank concentration	$F(1, 2717) = 22.02$
	p-value $= 0.0034$		p-value $= 0.0000$
Cost to income ratio	$F(1, 2717) = 50.63$	GDP growth	$F(1, 2717) = 1.49$
	p-value $= 0.0000$		p-value $= 0.2224$
Total assets growth rate	$F(1, 2717) = 0.00$	GDP	$F(1, 2717) = 11.77$
	p-value $= 0.9641$		p-value $= 0.0006$
Size	$F(1, 2717) = 4.12$	Inflation	$F(1, 2717) = 10.83$
	p-value $= 0.0425$		p-value $= 0.0010$
Capitalization	$F(1, 2717) = 4.27$	Interest rates	$F(1, 2717) = 25.36$
	p-value $= 0.0389$		p-value $= 0.0000$

Table 10

Selected estimates for the disaggregated version of Eq. (4), with the inclusion of $\boldsymbol{Periphery}$ and $\boldsymbol{Crisis}$ dummies. The results derive from fixed-effects estimations of the effects of bank- and industry-specific and macroeconomics characteristics on bank profitability. The return on average assets (ROAA) and the return on average equity (ROAE) are dependent variables. All variables are interacted with a dummy ($\boldsymbol{Periphery = 1}$ for peripheral banks and 0 otherwise) to test for differences between the 2 groups of banks. The $\boldsymbol{Crisis}$ dummy variable represents the 2008-2013 financial crisis period ($\boldsymbol{Crisis = 1}$, for $\boldsymbol{t} \in$ [2008, 2013], and zero otherwise). Robust standard errors are used, *t*-values are in brackets and significance levels at the 1%, 5%, and 10% levels are marked with ***, **, and *, respectively.

Dependent variable : ROAA				**Dependent variable : ROAE**			
Panel for Periphery		**Panel for Core**		**Panel for Periphery**		**Panel for Core**	
Loan loss provisions	-0.412***	Loan loss provisions	-0.124***	Loan loss provisions	-4.922***	Loan loss provisions	-1.590***
	(-26.11)		(-7.43)		(-22.88)		(-6.94)
Loan loss prov. (Crisis=1)	-0.0565***	Loan loss prov. (Crisis=1)	-0.0026	Loan loss prov. (Crisis=1)	-1.158***	Loan loss prov. (Crisis=1)	-0.106
	(-3.29)		(-0.15)		(-4.80)		(-0.43)
Other controls	Yes		Yes	Other controls	Yes		Yes
Observations		22.049				22.043	
Nr. of banks		2.718				2.717	
Adjusted R^2		0,632				0,533	
Bank dummies		Yes				Yes	
Time dummies		Yes				Yes	

6. Concluding remarks and policy implications

In the aftermath of the 2008 financial crisis, European banks faced both rather low average profitability and significant NPL levels, which triggered a major concern for financial supervisors and policymakers. Knowing and understanding well the key drivers of profitability is therefore paramount for devising effective policy measures. This paper contributes to the research on the determinants of banks' profitability by using a novel framework that accounts for potential relevant asymmetric influences within the Euro area, namely between banks in core countries and peripheral countries. By doing so, we inform on the potential hurdles to converge towards a truly European Banking Union.

First and foremost, once the unconventional measures taken by the ECB, such as the monetary policy easing, which is reflected by a decrease in short-term interest rates and/or flat yield curves, are withdrawn, banks in the Euro area are likely to boost their profits. Against this background, the monetary policy followed by the central bank might provide a crucial contribution to the reversal of Euro area banks' low aggregate profitability situation.

Secondly, from a micro and macroprudential perspective, credit risk exposure continues to be the bank-specific leading source of problems in financial institutions, assuming vital importance in their sustainability. Its impact, however, is not limited to the stability of the financial system as it also has repercussions in the credit-granting process to the real economy. Our results show a remarkable negative effect of LLP on banks' profitability at least 3 times higher on peripheral banks than on core banks. In line with the procyclical nature of provisioning policies, such dissimilarity in LLP effects is even more pronounced during the 2008-2013 financial crisis, mostly because of the higher burden the crisis had on peripheral banks. Therefore, though the economic recovery might play an important role in the NPL resolution, regulatory authorities, in particular, should address the issue of NPL with the appropriate urgency due to their promising benefits on profits throwback.

Consequently, our third consideration brings to light banks' credit granting and management practices. The reasons underlying bank difficulties over the years are not limited to one single factor; however, banking drawbacks continue to be directly related to lax of credit practices, poor portfolio risk management, economic issues, or other factors not properly addressed by banks. Thus, it urges the need for competent authorities to have a keen awareness of banks' sound practices that enable them to identify, measure and monitor credit risk. Despite the cross-cutting nature of this consideration, our findings suggest it to be primarily suitable to peripheral banks.

In light of the above, our fourth consideration goes to the assessment of credit risk management best practices that shall not be disregarded of a sound and adequate provisioning policy. The methodology underlying the measurement of LLP emerges therefore as an important policy implication, due to its broader significance for supervisors, policymakers, and standard setters. Contrary to the prudential perspective set out by Basel III/Capital Requirements Regulation framework, in which capital requirements for credit risk rely on detailed principles and rules, no similar requirements exist in the international accounting standards set by IASB. Even the IFRS 9 "expected credit loss model" falls short of a more detailed measurement methodology. Rather, there is considerable room for management discretion in determining the level of LLP. It seems an opportune moment for bank regulators to make use of their regulatory power and enhance the scrutiny of LLP estimates.

Fifthly, the prosperity of Euro area banks' profitability should not rely exclusively on the low interest rates environment reversal and NPL resolution. Our results point out to asymmetrical effects of some determinants of bank profitability between peripheral and core countries' banks. Importantly, low returns are also driven by lower efficiency levels which might be a result of high costs or over banking. The promotion of digitalization and optimization of human resources and branch networks by competent authorities can be a strong incentive to

improve efficiency ratios. Our considerations envisage, once again, higher benefits on peripheral banks returns.

Finally, though on a smaller scale, our results suggest that bank concentration in peripheral banking systems induces higher banks' profitability. Nevertheless, as far as mergers and acquisitions are fostered, regulators need to be cautious with the "too-big-to-fail" institutions, due to their adverse effects, such as the moral hazard problem.

Beyond the scope of this study, other relevant issues might require further research. In this respect, we highlight the study on whether the introduction of a provisioning counter-cyclical buffer, in the light of the accounting standards, would help on avoiding the severe impact of LLP on banks' profitability during downturn periods as an interesting subject to be included in the research agenda.

Appendix A. Distribution of observations

Table A1

	Year										
Country	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Austria	141	153	142	146	153	158	150	141	73	69	**1,326**
Belgium	18	18	14	15	17	19	16	16	8	8	**149**
Cyprus	7	5	7	7	7	6	8	8	8	7	**70**
Estonia	4	5	5	5	6	6	7	7	7	7	**59**
Finland	4	5	7	8	10	14	16	15	14	15	**108**
France	124	119	121	116	130	130	131	129	122	121	**1,243**
Germany	1,074	1,056	1,044	1,090	1,167	1,344	1,372	1,379	1,335	1,306	**12,167**
Greece	14	14	15	15	17	12	11	9	7	7	**121**
Ireland	9	7	6	5	6	7	6	7	6	6	**65**
Italy	483	502	505	493	480	488	472	457	427	403	**4,710**
Latvia	7	8	6	8	8	11	9	10	11	11	**89**
Lithuania	8	8	8	8	8	7	6	6	5	6	**70**
Luxembourg	7	13	14	15	14	18	21	18	20	17	**157**
Malta	2	2	4	4	4	4	4	4	4	4	**36**
Netherlands	10	10	11	16	16	16	18	19	18	17	**151**
Portugal	12	13	13	15	15	15	15	14	13	11	**136**
Slovakia	9	10	11	11	12	13	13	12	11	10	**112**
Slovenia	13	12	13	14	14	14	14	13	13	12	**132**
Spain	109	99	106	108	107	111	92	85	72	61	**950**
Total	**2,055**	**2,059**	**2,052**	**2,099**	**2,191**	**2,393**	**2,381**	**2,349**	**2,174**	**2,098**	**21,851**

Appendix B. Variable definitions and data sources

Table B1

Variables	Category	Description	Expected effect	Source
Dependent				
ROAA	Bank profitability	Net profits over average total assets (in %)	n.a.	SNL Financial and Bankscope
ROAE	Bank profitability	Net profits over average total equity (in %)	n.a.	SNL Financial and Bankscope
Independent				
Bank-specific determinants				
Loan loss provisions	Asset quality	Loan loss provisions over total net loans (in %)	-	SNL Financial and Bankscope
Non-interest income share	Revenue diversification	Total non-interest income over total income (in %)	+/-	SNL Financial and Bankscope
Cost-to-income ratio	Efficiency	Total expenses over total income (in %)	-	SNL Financial and Bankscope
Total assets growth	Asset structure	Growth of total assets (in %)	+/-	SNL Financial and Bankscope
Log (Total assets)	Size	Logarithm of total assets	+/-	SNL Financial and Bankscope
Capitalization	Capitalization	Equity to total assets (in %)	+/-	SNL Financial and Bankscope
Deposit funding share	Funding diversification	Total customer deposits over total liabilities (in %)	+/-	SNL Financial and Bankscope
Industry-specific and macroeconomic determinants				
Bank concentration	Market structure	Herfindahl index for credit institutions total assets	+/-	ECB Statistical Data Warehouse
GDP growth	Economic development	Growth of GDP (in %)	+	The World Bank Data
Log (GDP)	Economic development	Logarithm of GDP (in US$)	+/-	The World Bank Data
Inflation	Economic development	Inflation GDP deflator (in %)	+/-	The World Bank Data
ECBMRO	Interest rates	Rate of ECB main refinancing operations	+	ECB Statistical Data Warehouse

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