Ownership structure and bank performance in EU-15 countries

Carlo Migliardo and Antonio Fabio Forgione

Abstract

Purpose – *The purpose of this paper is to investigate the impact of ownership structure on bank performance in EU-15 countries. Specifically, it examines to what extent shareholder type and the degree of shareholder concentration affect the banks' profitability, risk and technical efficiency.*

Design/methodology/approach – *This study uses a sample of 1,459 banks operating in EU-15 countries from 2011 to 2015. It constructs a set of continuous variables capturing the ownership nature, the concentration and their interactions, and estimates an instrumental variable random effect (IV-RE) model. In addition, a panel data stochastic frontier analysis is conducted to estimate the time-varying technical efficiency for profitability and costs.*

Findings – *The empirical analysis shows that bank performance is affected by shareholder type. When regressed against the entrenchment behavior of the controlling owner hypothesis, banks with large-block shareholders are more profitable, less risky and more profit efficient. Further, ownership concentration reverts the negative effect related to the institutional, bank and industry ownership.*

Research limitations/implications – *The results support the hypothesis that concentrated ownership helps to overcome agency problems. They also confirm that managerial involvement in banks' capital enhances a bank's profit and its volatility.*

Originality/value – *To the best of the authors' knowledge, this is the first study to consider the ownership nature, the concentration and their interaction using continuous variables, which allows for more precise inferences. The results provide new evidence that bank profitability, cost efficiency and risk are affected by the type of direct shareholders.*

Keywords *Ownership concentration, Bank performance, Ownership nature, Panel data stochastic frontier analysis*

Paper type *Research paper*

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1. Introduction

Bank distress can induce systemic effects (Stulz, 2015): banks played a central role in the 2007-2009 global financial crisis, too often failing in their mission to allocate resources efficiently and attenuate systemic risk[1]. This crisis, along with the consequences of the Eurozone crisis, brought about a surge in empirical research investigating its causes and effects, including the role of ownership and shareholding structure[2]. Indeed, scholars generally agree that the recession was partly due the shortcomings of the banking sector, and that banks' excessive risk-taking before the crisis is related to their respective corporate governance mechanisms (Brunnermeier, 2009; De Young and Torna, 2013). Furthermore, Peni and Vähämaa (2012) document that US bank holdings with better corporate governance practices performed better during the 2007-2009 financial crisis.

In support, Berger *et al.* (2016) provide evidence that, during the downturn in the USA, banks' ownership structures play a substantial role in explaining the likelihood of bank failure: failure dramatically increases with the shareholding by lower-level managers, due to their moral hazard incentives.

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In the light of this framework, this paper aims to use new data and methods to reconsider two particular pitfalls present in the literature, both extensively reported in Section 2: the impact of ownership concentration and its nature on bank performance, with a special consideration of the channel of banks' technical efficiency. The literature mainly focuses on the impact of the nature of the ultimate shareholders and their concentration (dispersed vs concentrated) by adopting dummy variables related to the ownership structure. Against this background, the present paper provides further insights that contribute to the literature in three significant ways.

First, this paper is the first to study how different types of shareholders and ownership concentrations affect banks' profitability, technical efficiency and risk aptitude, using continuous variables that precisely and extensively express the participation of each type of shareholder (government institutions, banks, institutional investors, industrial companies, families and managers). This empirical strategy enables the authors to capture the marginal effect of each type of shareholder on bank performance more accurately than with qualitative analysis; it also clarifies the interaction effect between ownership type and concentration.

Second, the present study is the first to evaluate the impact of corporate governance profiles after the 2007-2009 financial crisis, using a broad data set of more than 1,450 European banks. Unlike previous research that focuses only on commercial banks, this data set covers almost all bank specializations. This is an important point, as the causes and consequences of the financial crisis also involved non-traditional banks. Moreover, this analysis is based on a multi-country data set. Indeed, European banks constitute a valid laboratory for the present research as they operate in an integrated and interconnected market, which increases competitive pressure over time and exposes the banks to global shocks more often (Camilla *et al.*, 2013).

Finally, the present paper belongs to a very small corporate governance literature that assesses technical efficiency using panel stochastic frontier analysis (SFA). Moreover, none of the previous work in this area deals with the correlation between this sophisticated index of efficiency and almost all the type of shareholders and their concentration. Overall, the present study aims to provide substantial knowledge for bank stakeholders and enhance the guidelines for bank policy reform. Specifically, this analysis evaluates if the nature of the banks' capital providers is an element of vulnerability during financial storms.

The remainder of the paper is organized into the following sections. Section 2 reviews the literature on the corporate governance profiles investigated in this study. Section 3 describes the empirical methodology and presents the sample and the summary statistics. Section 4 reports and discusses the main results. Section 5 presents some concluding remarks.

2. Literature review

This section reviews previous studies regarding the relationship between banks' financial performance and the two main corporate governance profiles investigated in the present analysis, that is, shareholder concentration and shareholder nature.

2.1 Shareholder concentration

The literature regarding the impact of ownership dispersion on bank performance provides mixed results. On one hand, some studies find that a larger ultimate shareholder exerts a positive impact on bank risk taking, specifically resulting in fewer insolvency risk measures, fewer non-performing loans and a better asset allocation policy (Iannotta *et al.*, 2007; Shehzad *et al.*, 2010; Forssbaeck, 2011)[3], whereas concentration does not affect, or only slightly affects, bank profitability (Grove *et al.*, 2011). Focusing on Asian banks,

Chalermchatvichien *et al.* (2014) find a positive relationship between ownership concentration and the risk-taking behavior of banking institutions, in terms of both capital adequacy and liquidity. Moreover, for Chinese banks, Dong *et al.* (2017) find some evidence that concentrated block shareholders positively affect both profit and cost efficiency.

On the other hand, when banks' ownership is less dispersed, the managers can act to the advantage of controlling shareholders, meaning conflicts of interest can arise between controlling and minority shareholders. In this regard, Bouvatier *et al.* (2014) find that banks with more concentrated ownership show a tendency to adopt a loan loss provision (LLP) policy to smooth their income. This opportunistic behavior (an entrenchment effect) is particularly strong in countries with a less stringent regulation environment. To sum up, these studies predict that banks with a more concentrated ownership structure tend to take more risk[4] (Laeven and Levine, 2009; Erkens *et al.*, 2012; Beltratti and Stulz, 2012) and show lower performance, weaker cost efficiency and higher return volatility (Haw *et al.*, 2010)[5]. Interestingly, Gropp and Köhler (2010) find that ownership concentration increases both the return on equity (ROE) and its volatility. Conversely, Bian and Deng (2017), for the Chinese banking sector, corroborate the hypothesis that large shareholder dispersion is associated with better bank profitability and risk.

In addition, in banks with a dispersed ownership structure, agency conflicts arise between managers and non-controlling shareholders, as managers have incentives to maximize their own benefits at the cost of shareholders. More specifically, the managers do not maximize stockholder value as a conservative risk-taking behavior (Sullivan and Spong, 2007)[6]. Indeed, this type of agency problem gets worse when the ownership is dispersed because of related burdensome agency costs, such as monitoring and signaling; as a consequence, dispersed shareholders do not have incentives to monitor managers (Shleifer and Vishny, 1986). Equally, the presence of a controlling shareholder offsets the impact of the separation between ownership and control (Shleifer and Vishny, 1997).

2.2 Shareholder nature

A broad strand of literature investigates the relation between shareholder nature and corporate performance, mainly focusing on non-financial firms, so the findings are less relevant to the banking sector[7]. In this respect, Mehran *et al.* (2011) show that the governance of banks differs from that of non-financial firms: there is a monitoring gap between the non-financial firms' debtholders and the banks' debtholders (e.g. depositors), which may act as free riders in bank governance due to the deposit insurance (Demirgüç-Kunt and Detragiache, 2002; Demirgüç-Kunt and Huizinga, 2004).

Actually, most of the financial-firm governance literature relies on the role of shareholder nature in bearing bank profitability and discerning risk in very few categories[8]. In this regard, one line of research focuses on the divergences in terms of performance between state-owned and privately owned banks (see, among others, Iannotta *et al.*, 2007; Berger *et al.*, 2008), showing that state-owned banks tend to underperform (i.e. be less profitable while having lower margins and higher costs) than their private counterparts[9]. These studies argue that governmental ownership reduces bank performance for two main reasons: their social role of addressing market failure and thus contributing to economic development (Stiglitz, 1993); and lending strategies driven by personal political interest (Micco *et al.*, 2007; Iannotta *et al.*, 2013). However, it can be extremely hard to identify this confounding effect (Levy-Yeyati *et al.*, 2004; Rodrik, 2005).

Another stream of the literature documents the importance of managerial ownership (and/or appropriate manager compensation) to align the stakes of managers and stockholders (Himmelberg *et al.*, 1999; Laeven and Levine, 2009; Cornett *et al.*, 2010; Barry *et al.*, 2011). Moreover, some studies (Fahlenbrach and Stulz, 2011; Beltratti and Stulz, 2012) show a

negative correlation between a higher share of manager participation and profitability and the stock returns of US banks, during the 2007-2009 financial crisis. Similarly, Gropp and Köhler (2010), for the OECD countries, find that equity owner-controlled banks experienced higher profits before the crisis and larger losses during the crisis, compared to manager-controlled banks. Some other studies suggest a positive attitude toward risk-taking behavior for equity management (Laeven and Levine, 2009; Cornett *et al.*, 2010; Barry *et al.*, 2011). In sum, the aforementioned literature points out that Type I agency problems (between shareholders and managers) can be mitigated by the presence of managerial ownership. This condition, similar to manager equity-based compensation, tends to look like the risk-return profile of the above two stakeholders (Cornett *et al.*, 2010).

Managers and institutional investors may form alliances, in which insider interests take priority over the maximization of firm value. Nevertheless, institutional shareholders may play an important role in bank results, as they should bring about a competitive advantage thanks to their high-level skills, expertise, and information advantages (Pound, 1988). Extant studies provide conflicting empirical evidence. Institutional owners of financial firms are known to curtail firm risk, advance firm performance and reduce their cost of debt (see Elyasiani and Jia, 2008 for the US BHC; see Cheng *et al.*, 2011 for the insurance companies). However, other empirical work suggests that firms with higher institutional ownership experienced worse stock returns during the 2007-2009 financial crisis and took more risk prior to the crisis, which resulted in larger shareholder losses during the crisis period (Beltratti and Stulz, 2012; Erkens *et al.*, 2012). Finally, Berger and Bouwman (2017) include institutional block ownership, bank holding company membership and foreign ownership as control variables in their models of bank survival and market share. They do not find strong, consistent results for any of these variables.

To sum up, there is a diverse literature regarding the impact of bank ownership nature on bank performance, mostly based on the aggregation and the contraposition of the shareholders into a few categories (e.g. state vs private; managerial vs non-managerial; and institutional vs other owners). This empirical strategy could induce an aggregation bias into the estimates because the category of private owner is very heterogeneous along the risk-return aptitude and/or holding period. For instance, the risk-return profile of a non-financial investor not only differs from that of an institutional shareholder, but there is also significant heterogeneity among non-financial investors (e.g. between family and industrial ownership). In addition, the empirical regularities might be sensitive both to the specialization and/or to the country in which the bank operates.

Interestingly, very few studies make extensive inferences on the importance of shareholders' nature in the banking industry. More specifically, Barry *et al.* (2011) argue that individual/family owners adopt a conservative risk strategy, because they hold less diversified portfolios than institutional investors. Saghi-Zedek and Tarazi (2015) find limited evidence between bank performance and a set of dummy variables associated with the type of the largest ultimate shareholder (bank, family, state, institutional, industry and foundation). Conversely, the authors document the importance of excessive control of shareholders in deteriorating bank performance during the financial crisis, an effect particularly strong in family-owned banks. On the contrary, Saghi-Zedek (2016) shows that banks controlled by particular categories of shareholders (institutional investors, other banks or industrial companies) benefit from better diversification, thanks to their additional skills and expertise, with respect to banks owned by families and states or banks that have no controlling shareholder. Conversely, when banks have widely held ownership, the activity of diversification yields diseconomies (i.e. earnings volatility and higher default risk).

Similarly, an increasing body of literature has provided evidence that bank ownership structure affects efficiency. These studies have mainly focused on the effect of agency issues on technical efficiency under a few specific ownership nature classifications, such as contraposing the state versus private owners (Altunbas *et al.*, 2001; Dong *et al.*, 2017).

Specifically, Altunbas *et al.* (2001) find that public and mutual German banks have slight cost and profit advantages in private commercial banking, likely due to their lower cost of funds. Dong *et al.* (2017) find that Chinese state-owned banks are more efficient than their private-owned counterparts only in terms of cost, whereas the authors do not find difference for profit efficiency and risk. Similarly, Akhigbe *et al.* (2017) find that pre-crisis profit efficiency is slightly higher for privately held than for publicly traded banks among US BHCs, but this small difference vanished during the financial crisis. More extensively, Girardone *et al.* (2009) compare the cost efficiency of commercial, saving and co-operative banks for the EU-15 countries between 1998 and 2003. They show that mutual banking institutions present a cost-efficient advantage over the privately owned banks.

Finally, some studies have analyzed the banking industry in developing counties, examining the effect of bank deregulation on efficiency across the three distinct ownership types present in that county, namely, privately owned, state-owned and foreign-owned (Mercan *et al.*, 2003; Berger *et al.*, 2009; Karas *et al.*, 2010; Casu *et al.*, 2013; Mamonov and Vernikov, 2017; Badunenko and Kumbhakar, 2017). This body of literature does not find a uniquely efficient owner category, suggesting that efficiency is likely contingent on the country system (e.g. the political corruption level and the government's participation in the banking industry) as well as the sample period considered. Nevertheless, these studies agree in affirming that deregulation has helped inefficient owners catch up to efficient ones.

3. Econometric methodology and data

This section describes the econometric specification and presents the data used to infer bank performance.

3.1 Econometric model and variables

The study is conducted on a panel data set through an instrumental variable random effect (IV-RE) estimator. In particular, we estimate the following equation of interest:

$$y_{it} = x_{it}^{'}\beta + u_{it} \text{ with } i = 1, \ldots, N; t = 1, \ldots, T_i; u_{it} = \alpha_i + v_{it}$$

The variable y_{it} denotes the continuous variable capturing the bank's performance, in a broad sense, for country i in year t. The panel data set is unbalanced, such that t runs from 1 to T_i, depending on the bank. The model also includes a vector of explanatory variables, x_{it} and an erratic component, u_{it}, which in turn can be decomposed into an individual effect α_i and a random error v_{it}. The random-effects estimator assumes that the individual effects are distributed as random effects, that is, y_{it} is conditionally independent given the values of the random effects (i.e. α_i). Moreover, bank ownership changes very little in a short period (Bertrand *et al.*, 2002), and in this case, it did not vary at all; thus, it was not feasible to use the FE estimator[10].

In addition, we control for the endogeneity of some explicative variables. Similarly to Barry *et al.* (2011), this study assesses potential endogeneity problems of the ownership variables and other control variables. In particular, the participation of shareholders is simultaneously correlated with bank performance. For instance, the literature suggests that large shareholders are better able to affect risk-taking, but an increase in risk induces a reduction in the concentration of ownership. This last effect is strong as large shareholders are less diversified than minority shareholders (Laeven and Levine, 2009; Gropp and Köhler, 2010). In addition, as the other covariates presented below could be affected by potential endogeneity, we apply the IV-RE estimator and then evaluate the orthogonality conditions that confirm the validity (using a Sargan–Hansen statistic test) of the set of instruments.

More specifically, the selection of explanatory variables is conducted by following the literature on bank governance cited above, but taking into account a different measure of bank ownership. The specification is as follows:

$$Y_{it} = \beta_0 + \sum_{j=1}^{8} \gamma_j OS_{ji} + \beta_1 Herf_i + \beta_2 EffCost_{it} + \sum_{k=1}^{K} \varphi_k C_{kit} + \varepsilon_{it} \quad (1)$$

where Y_{it} measures bank performance across three different profiles. The first profile captures profitability aspects, namely, *Profit* (the ratio of net operating profit to total assets) and *Income* (the ratio of operating income to total assets)[11]. The second profile captures the risk management performance through the *Z-Score* and *Risk*. The latter is a measure of earnings volatility, that is, the standard deviation of the return on assets (*ROA*), while the *Z-Score* is defined as $z = (k + \mu)/\sigma$, where k is the equity capital as a percentage of assets, μ is the *ROA* and σ is its standard deviation (Boyd and Runkle, 1993). The *Z-Score* is a measure of bank solvency, with higher values implying a lower probability of insolvency.

The last profile evaluates efficiency performance by considering two time-varying efficiency scores (i.e. *Eff Prof* and *Eff Cost*), yielded by using Battese and Coelli's (1995) stochastic frontier model as detailed in Appendix. We consider these two additional performance variables because the efficiency of banks measured by accounting ratios is unstable and therefore may be unsuitable to determine the productive efficiency of banks (Maudos *et al.*, 2002). Deriving efficiency from production frontier techniques helps overcome this drawback because "frontier analysis provides an overall, objectively determined, numerical efficiency value and ranking of firms" (Berger and Humphrey, 1997, p. 2). In sum, in this step, we also evaluate profit efficiency on the revenue side (*Eff prof*), which captures either the wrong choice of output or the mispricing of output and, as a consequence, constitutes a richer source of information that the partial vision offered by analyzing cost efficiency. In fact, the limited evidence available now shows that there are higher levels of profit inefficiency than of cost inefficiency (Maudos *et al.*, 2002).

With regards to the explicative variables, OS_{ji} is the vector of the ownership variables related to the bank's shareholder nature. Following Barry *et al.* (2011), Saghi-Zedek and Tarazi (2015) and Saghi-Zedek (2016), the owners who may affect bank performance are grouped together, using the following classification: *Institutional, Bank*, *Industry*, *Family*, *State*, *Other*, *Wide held* and *Manager*. These variables are the results of the product of a set of dummy variables[12] multiplied by *Share* (i.e. the total sum of the direct percentage participation held in the i_{th} bank at time *t* by each type of shareholder), so the proportion of direct participation held by each category of owner should be considered, instead of only using dummy variables. The owner categories considered in this analysis are similar to those of Saghi-Zedek (2016) except for the last three categories[13], while Barry *et al.* (2011) also exclude banks owned by a government or foundation, because their sample contains very few observations.

Unlike previous studies (Barry *et al.*, 2011; Saghi-Zedek and Tarazi, 2015; Saghi-Zedek, 2016), this study does not use a benchmark owner category against which the coefficient of the other groups is evaluated[14]. In fact, the continuous structure of our ownership variables, jointly with the use of the shareholder direct participation, allows us to overcome the dummy variable trap, so the specification includes all the categories of owners. Overall, given the empirical insight mentioned in Section 2, we expect to find large differences between the shareholder categories in terms of risk, profitability and efficiency performance.

Herf is the variable that captures the effect of concentration of ownership on bank performance. Similarly to Barry *et al.* (2011) and Bouvatier *et al.* (2014), *Herf* is estimated by applying the Herfindahl index[15]. However, while Barry *et al.* (2011) calculate the

Herfindahl index for each owner category, this study follows Bouvatier *et al.* (2014) by having *Herf* measure the direct shareholder concentration at the bank level. Some empirical work (Micco *et al.*, 2007; Athanasoglou *et al.*, 2008; Demirgüç-Kunt and Huizinga, 2010; Shehzad *et al.*, 2010; Barry *et al.*, 2011; Saghi-Zedek and Tarazi, 2015; Berger *et al.*, 2016) shows that operating costs negatively affect both bank performance and bank soundness. However, these studies capture the management skills in controlling the operating costs through raw measures of costs. Conversely, we consider the time-varying cost efficiency score (*Eff Cost*), which should represent a better proxy measure for cost efficiency.

The vector of the control variables C_{kit} includes five variables capturing important determinants of bank performance, namely, *Ecap*, its square $Ecap^2$, *Loan to Deposit, Loan Loss* and *NNII. Ecap*, calculated as the percentage of the bank equity in total assets, represents the capital adequacy of the bank. Its effect on financial performance cannot be univocally defined in terms of sign and linearity. On one hand, a higher level of capital should be associated with lower bank default risk (Cole and White, 2012; Jiménez *et al.*, 2013), and at the same time positively related to financial performance measures (Grove *et al.*, 2011; Chan-Lau *et al.*, 2015). In fact, an optimal level of capitalization allows the bank to adopt fundraising at a lower cost (Berger *et al.*, 1995; Iannotta *et al.*, 2007). In addition, other studies note that during financial crises moral hazard behavior would be discouraged if banks operated with more capital because overcapitalization enhances monitoring activities and in turn induces banks to adopt safer investment policies (Acharya *et al.*, 2011; Admati *et al.*, 2011; Hart and Zingales, 2011; Beltratti and Stulz, 2012; Berger and Bouwman, 2017). On the other hand, a higher equity ratio could also have a negative impact on bank efficiency, even jeopardizing the bank's profitability and soundness. In this regard, Berger and Di Patti (2006) find a significant hump-shaped effect of capital on bank profitability and agency costs of external debt. They argue that when leverage becomes relatively high, further increases may generate significant agency costs of outside debt that result in higher expected operational costs. To capture the nonlinear effects of the equity ratio on bank performance, the study also introduces into the specification the quadratic term of this ratio ($Ecap^2$)[16].

Loan to Deposits is the ratio of loans to deposits in short-term funding. It controls both funding policy, which determines bank liquidity, and the business model, at the bank level. Banks generally face a trade-off between liquidity and profitability. A higher loan-to-deposit ratio could increase bank profitability and thus increase a bank's soundness over time; however, overstated values could determine illiquidity and increase the probability of the bank's failure. In this regard, recent empirical literature provides results that are sensitive to the profitability measure. For instance, Chan-Lau *et al.* (2015) find a negative significant effect of the ratio on bank equity return, whereas Bian and Deng (2017) find a positive and significant effect of this ratio on the return on assets. Moreover, Dong *et al.* (2017) find that the ratio of loans to deposits significantly and negatively affects profit efficiency, whereas it positively affects cost efficiency. Instead, they did not find evidence that *Loan to Deposits* affects risk, as expressed by the amount of non-performing loans.

LLP is calculated as the ratio of LLP to total loans. It is, first of all, a forward-looking measure of loan quality made by the bank, therefore expressing the bank's hedging policies against future losses (Mergaerts and Vander Vennet, 2016). LLPs can, however, be used to smooth income (Laeven and Majnoni, 2003) and may be distorted by forbearance, especially during a financial crisis. This provision may also shrink banks by reducing interest income revenue and by increasing the provision costs (Kosmidou, 2008). Mergaerts and Vander Vennet (2016) find that higher LLP is associated with lower profitability and higher risk in the long run. The latter study suggests that banks smoothed their income via LLPs more intensively during the crisis, which is consistent with findings by Manganaris *et al.* (2017) and Curcio *et al.* (2017) for the euro area and El Sood (2012) for the USA. Some studies also show that cost-inefficient banks have more impairment loans (Berger and De Young, 1997; Xiang *et al.*, 2015).

NNII is the ratio of non-interest income to operating revenues. It can be considered as a proxy measure of a bank's aptitude in selling non-financial services, and its capacity to diversify its business models. Even if non-interest activities are often high added-value services, banks more reliant on non-interest-bearing activities are exposed to greater risk (Lepetit *et al.*, 2008; Brunnermeier *et al.*, 2012; Saghi-Zedek and Tarazi, 2015; Williams, 2016), which could also induce a detrimental effect on bank cost efficiency (Saghi-Zedek and Tarazi, 2015).

The specification for *Profit* and *Income* also includes a dummy variable (*Listed*) controlling for banks listed on a stock market[17]. Studies provide conflicting results regarding the impact of market forces on bank performance. Some studies find that publicly held banks display better performance (Barry *et al.*, 2011) or are more efficient in mitigating the diseconomy of diversification (Saghi-Zedek, 2016), but only when the effect is jointly considered with owner nature variables. These studies find that market forces crowd out the differences regarding risks among the categories of owners. Conversely, Saghi-Zedek and Tarazi (2015) find that listed banks are more profitable and risky than privately owned banks. The present study accounts for bank specialization by introducing a set of 12 dummy variables in accordance with the BvD Orbis classification[18]. Finally, to account for differences in the economic environment in which banks operate, the specifications include a set of country dummies, and to control for the time effect they contain year dummies.

This study takes the analysis a step further by checking whether concentration reinforces or weakens the peculiarity of each shareholder type. For this purpose, equation (1) is expanded by interacting each ownership category (OS) with the concentration variable (*Herf*)[19]:

$$Y_{it} = \beta_0 + \sum_{j=1}^{8} \gamma_j OS_{ji} + \beta_1 Herf_i + \beta_2 EffCost_{it} + \sum_{j=1}^{8} \delta_j OS_{ji} \times Herf_i + \sum_{k=1}^{K} \varphi_k C_{kit} + \varepsilon_{it} \quad (2)$$

Furthermore, the D-W-H test confirms our prior on the potential endogeneity issue of the explicative covariates. Specifically, the D-W-H results suggest instrumenting *Herf* for all specifications; *Ecap* and $Ecap^2$ for both the risk equations (i.e. *Z-Score* and *Risk*); *Loan to Deposit* for the *Profit* specification and *LLP* and *NNII* for the *Income* equation. Therefore, we adopt a set of valid instruments for these variables[20].

In support of this, the D-W-H test for endogeneity suggests instrumenting *Herf*, which we control with a set of a valid instruments, such as the dummy equal to one for banks listed in the stock market, a set of dummies related to the level of Bureau van Dijk independence indicator. Finally, the study checks that multicollinearity among the explicative variables is not a problem by computing the variance inflation factor (VIF). In this case, the highest VIF value is 4.48 and its mean is 1.71.

3.2 Sample and summary statistics

This study's empirical analysis is carried out using a sample composed of a large set of banks established in the 15 European Union countries[21]. The sample period spans from 2011 to 2015. Both account and ownership data are obtained from BvD Orbis and exclude banks that do not report direct shareholder participation. The panel data set contains about 5,130 observations corresponding to 1,459 active banks. All the continuous variables are Winsorized at the upper and lower 5 per cent levels to reduce the possible impact of outliers and the heterogeneity of the sample regarding the bank specialization type[22].

Table I reports, at the country level, the ratio between the total assets of the sample and the sum of the total assets of all the banks in BvD Orbis.

Table I Sample representativeness

Countries	*Sample total assets on total assets of all banks in BvD Orbis (%)*
Austria	89
Belgium	85
Denmark	92
Finland	74
France	68
Germany	49
Greece	93
Ireland	95
Italy	87
Luxembourg	35
The Netherlands	75
Portugal	99
Spain	88
Sweden	96
UK	87
Average	80

The reported ratios can be considered to be a raw measure of the representativeness of the data set, with mean data coverage of 80 per cent. Table II reports the summary statistics of the variables.

The statistics of the dependent variables show strong heterogeneity among banks regarding profitability, risk and in particular risk indicators. The heterogeneity of the sample is also confirmed by the distributions of the equity proportions of each owner category (except *Wide held*) in the interval (0-100 per cent). The descriptive statistics of the ownership variables show that other banking institutions are the major shareholder category; they directly hold an average of 35.01 per cent of the equity. Institutional investors and industrial companies are also significant direct shareholders; they hold equity of

Table II Summary statistics

Variable	*Mean*	*SD*	*Min*	*Max*
Income	5.05	8.82	0.11	91.55
Cost	3.75	7.61	0.03	74.92
Profit	0.63	1.51	−6.69	15.06
Z-Score	85.85	125.80	−0.11	901.10
Risk	52.82	93.39	0.58	1262.45
Bank	35.30	43.90	0	100
Institutional	12.11	27.40	0	100
Industry	13.16	29.55	0	100
State	1.03	8.84	0	100
Family	3.30	14.76	0	100
Other	5.31	19.96	0	100
Wide held	0.34	4.33	0	84.5
Herf	66.53	39.78	0	100
Loanloss	1.45	6.19	−3.17	190.01
Ecap	11.42	10.31	1.19	95.84
Loans	54.35	24.84	0.08	99.00
Deposit	70.49	20.38	0.46	95.66
NNII	44.65	26.13	−105.54	127.41
CIR	68.56	22.77	−135.19	205.85
Listed	0.13	0.34	0	1
Manager	0.02	0.15	0	1
Specialization	4.91	4.15	1.00	14.00

11.82 and 12.93 per cent, respectively. The concentration index (*Herf*) denotes a very low degree of ownership dispersion with an average equity concentration of 65.72 per cent. The large heterogeneity of the sample induces us to run a panel data analysis, which is a very efficient tool, as it allows us to account for the unobservable heterogeneity, that is, each bank's specific characteristics (Hsiao, 2007).

4. Results

This section discusses the empirical findings regarding the bank performance measures. More specifically, Tables III and IV report the results of specifications (1) and (2), respectively. Table V shows the IV-RE estimates considering the two efficiency scores of the SFA analysis.

Our findings are partially consistent with the first strand of literature reported in Section 2.1. A large-block shareholder, regardless of the nature of investors, is associated with less vulnerability, both in terms of the *Z-Score* and of less earning volatility (Iannotta *et al.*, 2007; Shehzad *et al.*, 2010; Forssbaeck, 2011). In contrast to the empirical literature (Laeven and Levine, 2009; Haw *et al.*, 2010; Barry *et al.*, 2011; Grove *et al.*, 2011; Bian and Deng, 2017), this study's results show that being controlled by a concentrated ownership structure contributes to improving bank profitability (Gropp and Köhler, 2010). Consequently, the entrenchment view hypothesis is rejected. On the contrary, this result may support the hypothesis that less dispersed ownership overcomes agency problems by increasing monitoring (Aghion and Tirole, 1997); specifically, large shareholders can exert pressure on the bank management to maximize the bank's value.

Furthermore, the result confirms that ownership nature appears to be a significant factor in explaining bank performance. Before discussing these results, a premise is needed. Earlier studies evaluate the performance of ownership categories in relative terms, namely, against a benchmark owner[23], whereas our empirical strategy enables us to consider the effect of each owner category standing alone and against the other types of investors.

Table III IV random effects estimates

Variable	*Profit*	*Income*	*Z-Score*	*Risk*
Institutional	−0.0061** (0.002)	−0.0223** (0.011)	−1.2534*** (0.395)	0.0098** (0.004)
Bank	−0.0051* (0.003)	−0.0298** (0.013)	−1.1975*** (0.468)	0.0105** (0.005)
Industry	−0.0050* (0.003)	−0.0111 (0.013)	−1.1827*** (0.408)	0.0100*** (0.004)
State	−0.0123*** (0.004)	−0.0498** (0.023)	0.2448 (0.769)	0.0084* (0.005)
Family	−0.0034 (0.004)	−0.0134 (0.010)	−0.1017 (0.365)	−0.0016 (0.003)
Other	−0.0042* (0.002)	−0.0299*** (0.010)	−0.7916** (0.399)	0.0080** (0.004)
Wide held	0.0008 (0.004)	−0.0215 (0.024)	0.2216 (1.087)	0.0068* (0.004)
Manager	0.0030 (0.003)	0.0055* (0.003)	0.0193 (0.035)	0.0008 (0.001)
Herf	0.0092** (0.004)	0.0333* (0.018)	1.8801*** (0.664)	−0.0165** (0.007)
Cost efficiency	0.0761** (0.035)	0.7443*** (0.150)	−6.1927*** (1.355)	0.0645*** (0.022)
Ecap	0.0711*** (0.012)	0.2327*** (0.062)	4.7684*** (1.248)	0.0465*** (0.015)
Ecap^2	−0.0008** (0.000)	−0.0023 (0.001)	−0.0795* (0.048)	0.0011 (0.001)
Loan to Deposit	0.4306** (0.183)	0.5051*** (0.044)	−1.0483* (0.600)	−0.0234** (0.012)
LLP	−0.0604*** (0.0124)	−0.3529** (0.175)	−0.3566*** (0.134)	0.0003 (0.002)
NNII	0.0047** (0.002)	0.1039*** (0.025)	−0.0848* (0.046)	−0.0009 (0.001)
Cons	1.3992*** (0.181)	11.5024*** (1.433)	257.3144*** (36.631)	−0.3227 (0.530)
Durbin–Wu Hausman	$\chi^2(2) = 10.34$ 0.00%	$\chi^2(3) = 13.59$ 0.00%	$\chi^2(3) = 24.03$ 0.00%	$\chi^2(3) = 7.63$ 5.43%
Sargan–Hansen	$\chi^2(6) = 5.96$ 42.77%	$\chi^2(8) = 6.31$ 61.32%	$\chi^2(4) = 3.45$ 48.57%	$\chi^2(10) = 9.99$ 44.10%
R^2 (%)	18.18	31.19	14.45	12.88
No. obs. (*No.* of *Banks*)	5,130 (1,459)	5,130 (1,459)	5,077 (1,412)	5,087 (1,416)

Notes: Robust standard errors in parenthesis; ***, **, *indicate statistical significant at the 1, 5 and 10 per cent level, respectively; all specifications include countries and times dummies

Table IV IV random effects estimates with interaction terms

Variable	*Profit*	*Income*	*Z-Score*	*Risk*
Institutional	−0.0004 (0.002)	−0.0079 (0.011)	−0.7217*** (0.255)	0.0053* (0.003)
Bank	−0.0027 (0.002)	−0.0255** (0.011)	−0.7893** (0.357)	0.0069* (0.004)
Industry	−0.0030 (0.002)	−0.0089 (0.011)	−0.5147** (0.250)	0.0045** (0.002)
State	−0.0068 (0.005)	−0.0189 (0.030)	1.6169* (0.855)	0.0001 (0.004)
Family	−0.0026 (0.005)	−0.0134 (0.013)	0.0954 (0.389)	−0.0052 (0.005)
Other	−0.0007 (0.002)	−0.0295*** (0.008)	−0.3769 (0.308)	0.0044* (0.003)
Wide held	0.0009 (0.007)	−0.0339* (0.020)	1.6643 (1.037)	−0.0006 (0.005)
Managerial	0.0054 (0.004)	0.0009 (0.006)	0.0589 (0.038)	−0.0006 (0.001)
Herf	0.0054** (0.003)	0.0256* (0.014)	1.4889*** (0.544)	−0.0142** (0.007)
Institutional × Herf	−0.0098* (0.005)	−0.0369 (0.028)	1.0245* (0.554)	−0.0114** (0.005)
Bank × Herf	0.0103** (0.005)	0.0211 (0.024)	1.6228** (0.763)	−0.0160* (0.009)
Industry × Herf	0.0110** (0.005)	0.0300 (0.028)	0.2786 (0.531)	−0.0053 (0.004)
State × Herf	−0.0043 (0.014)	−0.1056 (0.103)	−2.7714 (3.044)	0.0057 (0.014)
Family × Herf	0.0001 (0.010)	−0.0189 (0.027)	−0.1018 (0.749)	−0.0096 (0.011)
Other × Herf	0.0013 (0.006)	0.0432* (0.023)	1.5840* (0.933)	−0.0155** (0.007)
Wide held × Herf	−0.0310 (0.046)	−0.1740 (0.106)	10.9018* (6.506)	−0.0256 (0.047)
Managerial × Herf	0.0080 (0.009)	−0.0123 (0.012)	0.1104 (0.110)	−0.0017 (0.002)
Cost efficiency	0.0715** (0.034)	0.7373*** (0.149)	−6.3826*** (1.345)	0.0319** (0.016)
Ecap	0.0719*** (0.011)	0.2335*** (0.062)	4.6618*** (1.239)	0.0288*** (0.008)
Ecap^2	−0.0007** (0.000)	−0.0023 (0.002)	−0.0722 (0.047)	0.0017 (0.001)
Loan to Deposit	0.4145** (0.182)	0.5042*** (0.045)	−1.0098* (0.599)	−0.0141** (0.007)
LLP	−0.0604*** (0.012)	−0.3568** (0.178)	−0.3491*** (0.130)	0.0002 (0.002)
NNII	0.0046*** (0.002)	0.1033*** (0.025)	−0.0895* (0.046)	−0.0015 (0.001)
Durbin–Wu Hausman	χ^2 (2) = 8.48	χ^2 (3) = 16.07	χ^2 (3) = 21.23	χ^2 (3) = 7.62
	0.01%	0.00%	0.00%	5.46%
Cons	1.0868***	9.5945***	159.8588***	0.3313
	(0.202)	(1.034)	(21.649)	(0.232)
Sargan–Hansen	χ^2 (6) = 7.26	χ^2 (8) = 7.36	χ^2 (4) = 3.29	χ^2 (11) = 10.76
	29.70%	49.87%	51.11%	42.32%
R^2 (%)	20.48	31.78	17.92	14.42

Notes: Standard errors in parentheses *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; ownership variables and their interaction terms are expressed in % terms

Turning to the results, unlike Saghi-Zedek (2016), large shareholder involvement by *Institutional*, *Bank* or *Industry* is negatively related with all the bank performance measures. Those shareholder categories may suffer more than other investors from the effect of a financial crisis (Beltratti and Stulz, 2012; Erkens *et al.*, 2012). In line with earlier studies, banks with larger portion of stock held by *State* tend to be less profitable (Iannotta *et al.*, 2007; Micco *et al.*, 2007; Berger *et al.*, 2008). Contrasting to Iannotta *et al.* (2007), government banks do not present a higher insolvency risk than other types of banks. Given the structure of the *Z-Score*, which is calculated as the ratio between the buffer against bank losses (capital and profitability) and the ROA volatility, and given that government banks are less profitable and volatile, a possible explanation could be that such banks are better capitalized than other types of bank categories. In contrast with Barry *et al.* (2011), the coefficient for *Family* is not significant across all performance profiles; thus, family investors may not follow more conservative risk-return profiles compared to other kinds of investors.

Equity management is associated with higher bank returns in terms of income, without altering the bank's vulnerability or its profits. This result presents a weak statistical significance. Finally, *Wide held* participation denotes an increase in the earning volatility. This kind of ownership structure likely presents fewer incentives to monitor management, and it is also consistent with the hypothesis that widely held banks are less able to implement an efficient activity diversification (Saghi-Zedek, 2016).

Table V IV random effects estimates

Variable	*Profit efficiency*	*Cost efficiency*	*Profit efficiency*	*Cost efficiency*
Institutional	−0.0577*** (0.018)	0.0109** (0.005)	−0.0415*** (0.012)	0.0034* (0.002)
Bank	−0.0486** (0.021)	0.0131** (0.006)	−0.0474*** (0.018)	0.0039** (0.002)
Industry	−0.0399** (0.019)	0.0093* (0.005)	−0.0288** (0.013)	0.0007 (0.002)
State	−0.0210 (0.025)	0.0084 (0.010)	−0.0002 (0.027)	0.0026 (0.006)
Family	−0.0013 (0.015)	−0.0049* (0.003)	−0.0025 (0.017)	−0.0055*** (0.002)
Other	−0.0511*** (0.017)	0.0087 (0.006)	−0.0484*** (0.013)	0.0005 (0.002)
Wide held	0.0072 (0.033)	−0.0069 (0.011)	0.0435 (0.037)	−0.0071 (0.011)
Manager	−0.0053 (0.006)	−0.0006 (0.001)	0.0233*** (0.007)	0.0023*** (0.001)
Herf	0.0668** (0.034)	−0.0220** (0.011)	0.0769** (0.031)	−0.0045* (0.003)
Institutional × *Herf*			0.0123 (0.028)	−0.0003 (0.005)
Bank × *Herf*			0.0758* (0.042)	−0.0006 (0.004)
Industry × *Herf*			0.0370 (0.031)	0.0044 (0.005)
State × *Herf*			−0.0014 (0.093)	−0.0094 (0.022)
Family × *Herf*			−0.0350 (0.039)	0.0027 (0.005)
Other × *Herf*			0.0850** (0.039)	0.0028 (0.005)
Wide held × *Herf*			0.2358 (0.246)	0.0519 (0.044)
Manager × *Herf*			0.0788*** (0.019)	0.0080*** (0.003)
Loan to deposit	0.1820** (0.092)	0.0277* (0.017)	0.1811** (0.092)	0.0280* (0.017)
Loanloss	−0.2381 (0.717)	−0.0829 (0.090)	−0.1511 (0.731)	−0.0682 (0.094)
NNII	−0.0535*** (0.007)	−0.0047*** (0.001)	−0.0532*** (0.007)	−0.0045*** (0.001)
Cons	39.9682*** (2.319)	94.8430*** (0.358)	38.5906*** (2.582)	94.1526*** (0.132)
Durbin–Wu Hausman	χ^2 (1) = 3.80	χ^2 (1) = 3.98	χ^2 (1) = 4.83	χ^2 (1) = 5.68
	5.12%	4.61%	2.79%	1.72%
Sargan–Hansen	χ^2 (1) = 1.39	χ^2 (1) = 2.43	χ^2 (1) = 0.35	χ^2 (2) = 2.77
	23.80%	11.91%	55.20%	24.96%
R^2 (%)	14.43	9.24	14.37	16.78
N. obs.(*N.* of Banks)	5,134 (1,460)	5,130 (1,459)	5,130 (1,460)	5,130 (1,459)

Notes: Standard errors in parentheses *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table IV shows the results of specification (2), which accounts for a possible interaction effect between ownership nature and concentration. It is necessary to keep in mind that this study examines both ownership nature and concentration variables and then computes the interaction term and estimates the model[24]. Interestingly, the results show a non-trivial effect of concentration on bank owners, as the degree of shareholder concentration often reverts the effects deriving from equation (1). This effect is particularly strong for banks owned by other banks. A less dispersed bank owner is associated with higher profitability, better bank soundness (higher *Z-Score*) and less earning volatility. Similarly, a concentrated shareholding participation by industrial companies increases bank profitability. Moreover, less dispersed institutional owners and wide held ownership are both associated with less bank vulnerability (higher *Z-Score*). In sum, the degree of ownership concentration overcomes the effect related to shareholder nature in terms of profitability for *Bank* and *Industry*, and in terms of the *Z-Score* for *Banks*, *Institutional, Wide held* and *State*. In addition, family owner concentration does not alter bank performance.

Table V reports the estimates regarding the two measures of technical efficiency. At first glance, the coefficients for profit and cost efficiency regarding the ownership variables take the opposite sign across all the categories of shareholders and their concentration[25]. In detail, the coefficient associated with *Herf* is positive for profit and negative for cost efficiency. Therefore, the presence of a block holder induces the management to mainly use their resources in generating income from the banking services, even if that means using them inefficiently (Girardone *et al.*, 2004). Overall, managers compensate for cost inefficiency by using a different composition in the mix of production or by benefiting from greater market power in pricing derived from their specialization (Maudos *et al.*, 2002). Remarkably, on the cost efficiency side, an institutional, bank or industry owner is related to better cost efficiency. This effect is reinforced when the *Bank* shareholding is less

dispersed. Moreover, banks owned by family investors are inefficient from the cost side. Specifically, banks using institutional, bank or industrial investors exhibit cost efficiency, but in turn they fail to generate profit efficiency. To address this issue, Berger *et al.* (2009) and Dong *et al.* (2017) believe that profit efficiency is a more suitable proxy of the quality of bank management compared to cost efficiency, as profit efficiency includes both cost and revenue performance. Going further in the analysis, the profit efficiency coefficients are consistent with the profitability measures ones, except for *Manager*. Specifically, the results confirm that concentrated managerial involvement in bank capital matters for the efficiency measures. When the managerial ownership becomes less dispersed, it is correlated with an increasing technical efficiency.

Turning to the control variables, most of them are significant and carry the expected signs, as in the empirical literature. *Equity ratio* appears to be an important factor for banks' financial performance; an adequate capital structure enhances both bank profitability and bank soundness (*Z-Score*). However, equity shows a nonlinear impact on bank performance; that is, the coefficient of *Ecap* is positive and that of its square is negative. This hump-shaped effect implies that, when the bank capital reaches too high a value, it spoils the bank's financial results[26]. The nonlinearity effect of *Ecap* on bank profitability is rather stable across the profitability indicators used.

Consistent with Bian and Deng (2017), the *Loans to Deposits* ratio is positively related to bank profitability; conversely, a higher ratio exposes banks to funding liquidity risk and in turn makes the bank more vulnerable and risky. The results also show a direct relationship between this ratio and the technical efficiency of the bank, as *Loans to Deposits* ratio reflects a bank's ability to transform deposits to loans (Dietsch and Lozano-Vivas, 2000; Carvallo and Kasman, 2005; Xiang *et al.*, 2015).

In line with our expectations, *LLP* decreases bank profitability and induces risk insolvency. This evidence implies that after the crisis, bank risk managers implemented wide provision policies to face the increasing amount of substandard loans[27]. Moreover, we do not find a significant link between efficiency and *LLP*. The finding for *NNII* confirms the precedents supplied by the literature that an expansion into non-traditional activities leads to higher profitability and risk (Lepetit *et al.*, 2008; Saghi-Zedek and Tarazi, 2015). Moreover, non-interest-bearing activities also deteriorate the two measures of efficiency; this could imply the presence of diseconomies of scope in the banking industry (Laeven and Levine, 2007; Köhler, 2014). Finally, the dummy accounts for listed banks do not report statistical significance in terms of both profitability and efficiency, while in the other performance variables, it has been used as an instrument for ownership concentration.

As a robustness check, we re-estimate all the specifications while considering two new variables. The first variable controlled for the capital adequacy of the banks given the Tier 1 capital ratio, replacing *Ecap* and $Ecap^2$. Overall, the results are consistent with *Ecap* and its square, both in terms of sign and significance. The second variable controls for the credit portfolio risk, that is the non-performing loan on gross loan and its statistical significance in the *Profit* (negative effect) and *Risk* specifications (positive effect). However, the use of these two variables reduced the sample to 815 banks and 2,837 observations.

5. Conclusion

This paper aims to provide an innovative contribution to the current literature on corporate governance by determining bank performance from different perspectives. First, with respect to earlier studies this paper's approach is novel, as it considers both the ownership nature and concentration, as well as their interaction, using continuous variables. Specifically, we distinguish eight categories of shareholder, which should be characterized by specific return-risk profiles consequence of their institutional roles and incentives. We use the proportion of each shareholder type participation to investigate how a change in

ownership structure is related to bank performance. In this way, our analysis allows more precise inference in the data, attenuating both the aggregation bias among heterogeneous owners and the possible distortion in adopting a binary variable. Second, the empirical model provides new evidence on the above-described ownership structure along the profile of time-varying technical efficiency measures, controlling for random bank effect (bank heterogeneity).

Third, the study provides new evidence that is not univocally in line with the literature. The most striking result is that block shareholding can constitute an optimal governance mechanism, but its effect on bank performance is also sensitive to the type of shareholders. Consequently, the entrenchment view hypothesis is rejected. However, the literature uses different measures of concentration, mainly based on a qualitative concentration measure or at least a continuous concentration variable within each shareholder category. Instead, this study uses a variable that measures the direct shareholder concentration at the bank level.

Further, the empirical results provide evidence that concentrated equity management involvement boosts bank efficiency. On the contrary, this result may support the hypothesis that a strength control overcomes agency problems by increasing monitoring (Aghion and Tirole, 1997); specifically, large shareholders can exert pressure on the bank management to maximize the bank's performance, not only in terms of profitability but also in terms of its financial resilience and profit efficiency. Equally significant is the effect of shareholding nature on bank performance. Interestingly, the analysis contradicts the literature on the effect of ownership categories on bank performance, because it finds that banks owned by institutional investors, other banks and industry report comparatively bad performance results among the considered profiles. However, this negative effect is reversed when the ownership is less dispersed. This would imply that a strength control allows better bank governance.

It is worth noting that both profitability measures show consistent results except for state-owned banks. On one hand, government-owned banks may act in the social interest, by compensating for credit market failures, providing lending to credit-constrained borrowers and acting less pro-cyclically than private banks (Bertay *et al.*, 2015). As a consequence, they present negative performance only with respect to the profitability profiles. On the other hand, state shareholding denotes less bank vulnerability and, more importantly, there is no gap in terms of profit and cost efficiency. Therefore, earlier studies likely bias their inferences, if they are based on row accounting efficiency measures.

Our findings also have various policy implications. Bank authorities and regulators should consider in their monitoring activity the ownership structure of the banks characterized by diseconomies, or those with a risk profile that could preclude the stability of the financial system. Bank supervisors should also undertake a close examination of the interaction effect of ownership nature and concentration. In addition, this study suggests encouraging the participation of managers in bank capital to improve performance.

Overall, bank management should focus more on profit efficiency and should adopt cautious policies. Policy makers should have in view particular policies to regulate these types of institutions. Moreover, the authorities should strongly encourage better asset governance for the ownership concentration activity of cooperative and savings banks, as they promote long-term lending strategies. Finally, even though several bank reforms have been implemented over the past decade with the aim of increasing the capital requirement, the study confirms that an optimal bank capital threshold exists, beyond which the insolvency probability increases.

The researchers suggest further analysis focusing on the impact of ownership structure and bank failure, through an empirical strategy similar to the present study. In particular, the key challenge for future research is to understand if, and under what conditions, our empirical findings are robust to the other developed counties, and/or if our model is suitable for emerging economies.

Notes

1. Manganaris *et al.* (2017) reveal the detrimental consequences of the crisis on European banks. During the crisis period, EU-15 banks experienced a dramatic downturn in earning, cash flow and liquidity. As a consequence, banks constrained their lending. The authors show an increase in accounting transparency in terms of timelier "bad news" recognition. In this respect, Curcio *et al.* (2017) show that Euro Area commercial banks were more aggressively involved in income smoothing after the financial crisis broke out, resorting to a wider discretionary use of loan loss provisions to enhance the market perception of their risk.
2. Banks constitute a significant strand of the corporate governance literature because of their unique characteristics, such as their high leverage level and maturity transformation, heavy regulation and the opacity of their assets. See de Haan and Vlahu (2016) and John *et al.* (2016) for a broad review of the literature.
3. These findings are associated with a strong minority shareholders' protection regime.
4. This relationship influences the way in which bank regulation affects banks' risk-taking.
5. In developing countries, the effect is stronger due to a lack of shareholder protection and/or poor legal systems.
6. In fact, the hired managers are mainly aware of the negative effects of bad corporate performance on their reputation and human capital investments, whereas diversified shareholders are principally interested in high-performance results (Jensen and Meckling, 1976). The literature on the financial firms confirms that banks with concentrated ownership show higher risk-taking behavior than banks with small shareholdings (Saunders *et al.*, 1990).
7. The empirical literature regarding the impact of institutional investors on firm performance shows mixed results. On one hand, this kind of shareholders enhance managerial monitoring, which in turn improves financial performance (Tsai and Gu, 2007; Dimitropoulos and Tsagkanos, 2012). On the other hand, Shin-Ping and Tsung-Hsien (2009) show that institutional investors do not reduce agency conflicts by monitoring managerial action, despite their expertise and resources. In addition, Rose (2007) finds that institutional owners do not always solve the principal agent problem; indeed, very large institutional ownership has a significant negative impact on firm performance.
8. In this regard, Barry *et al.* (2011) shed light on the limited influence of ownership concentration/dispersion on bank performance, while stressing the role of shareholder nature in bearing bank profitability and risk.
9. These findings are particularly strong for banks located in developing countries (Micco *et al.*, 2007).
10. We reject the fixed-effect estimator for two reasons. First, we are interested in an account of time-invariant characteristics, and the empirical literature shows that ownership structure is rather stable over time, so the FE estimates would be driven by variations in a few bank-year observations (Lafontaine and Shaw, 2005; Benson and Davidson, 2009; Ampenberger *et al.*, 2013). Second, the Hausman test results support this choice for all the specifications. Finally, the diagnostic statistics provided by the Lagrange multiplier test for random effects developed by Breusch and Pagan (1980) confirm the presence of a random effect, which indirectly suggests that OLS estimates could be biased.
11. While Barry *et al.* (2011), Saghi-Zedek and Tarazi (2015) and Saghi-Zedek (2016) all adopt the ROE and/or ROA as a measure of profitability, consistent with Iannotta *et al.* (2007), this study analyzes profitability using both the net operating profit and the operating revenue measure. Operating income is equal to the operating revenues, while the operating profit is the operating revenues net of total operating expenses (i.e. the total impairment charges and the other operating expenses). Operating profit is robust to the bias from extraordinary operation, the tax system (which differs across countries) and impairment charges.
12. The dummies are equal to one if the direct shareholder is one of the following: a financial company, hedge fund, insurance company, mutual and pension fund, etc.; a bank; an industrial company; a family or individual shareholder; a state or government; a private equity firm; a venture capital firm, a foundation/research institute, other unnamed shareholders or self-ownership; or a public company.
13. More specifically, Saghi-Zedek (2016) uses wide held ownership as a residual category, consisting of banks with no controlling shareholder, while in this analysis, *Other* is the residual category and *Wide held includes only public companies.*

14. Barry *et al.* (2011) use the institutional investor (*Institutional*) as the benchmark owner category, against which the coefficient of the other groups is evaluated. Conversely, Saghi-Zedek and Tarazi (2015) and Saghi-Zedek (2016) use wide held ownership as a reference category to capture the effect of the shift from dispersed ownership to concentrated shareholders on bank performance.

15. This study computes the Herfindahl index for each bank as $\sum_{j=1}^{n} Share_j^2$, where *Share* is the ratio of the equity held directly by each shareholder to the total of the equity held by all the direct shareholders.

16. This study affords the collinearity between *Ecap* and its square term by centering the linear term on its sample mean before creating the power (Aiken *et al.*, 1991; Bryk and Raudenbush, 2002). Note that the interpretation remains the same.

17. In the other estimations *Listed* has been used as instrument for the endogenous variables.

18. *In detail, the Specialization categories are bank holdings and holding companies; commercial banks; cooperative banks; finance companies; group finance companies; investment and trust corporations; investment banks; other non-banking credit institutions; private banking and asset management companies; real estate and mortgage banks; savings banks; and securities firms. We owe this improvement to an anonymous referee.*

19. To address the collinearity between the variables and the interaction terms, the variable *Herf* and the *OS* vector are demeaned and then multiplied by each other to obtain the interaction. Note that the interpretation remains the same.

20. In detail, *Herf has been instrumented using the dummy Listed, jointly with a set of dummies related to the level of the Bureau van Dijk independence indicator, and* also a dummy related to firm dimension. *The instruments used for Ecap and* $Ecap^2$ *depend on the specification: for the Z-Score estimates the instruments are the amount of bank deposits, its square and the level of the total assets, whereas for the Risk regression, the instruments are both the amount of the bank deposits and loans. The endogeneity of Loan to Deposit has been instrumented with the amount of the bank deposit, the level of loans and total assets. LLP also adopts both the amount of total bank loans and deposits. Finally, NNII has been instrumented with the time dummies jointly with the amount of the bank deposits. Overall*, Table III and IV report the Sargan–Hansen test, which confirms the relevance and the exogeneity conditions of the instrumental variables used.

21. The banks in the sample have their headquarters in cities in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK.

22. Contrary to the literature that studies only commercial banks, this study's sample includes all the Orbis BvD bank specialization categories, excluding only the following ones: central banks, multi-lateral governmental banks, micro-financing institutions, Islamic banks, specialized government credit institutions and clearing and custody institutions.

23. For instance, Barry *et al.* (2011) adopt the institutional shareholder as the reference category.

24. This empirical strategy offers two advantages: first, multicollinearity is attenuated; second, it makes the interpretation of the coefficients straightforward. In fact, the coefficients of the main effects represent the effect of the main variable when the other interacting variable is at its average value. For instance, the coefficient associated with *Institutional*, in the *Z-Score* equation, is equal to 0.7217. It represents the effect of a larger institutional shareholder involvement on the *Z*-score performance, when *Herf* is at its mean value (65.72 per cent). Moreover, the overall effect is given by the sum of the coefficient of the main effect (−0.7217) and the interaction effect (1.0245); that is, the overall effect of institutional ownership is equal to 0.3028.

25. In this regard, Berger and Mester (1997) show that cost and revenue efficiency may be negatively correlated.

26. The turning point is calculated as follows: $-\beta_1/2\beta_2$, where β_1 and β_2 are the coefficients of *Ecap* and $Ecap^2$, respectively. In detail, the turning point is equal to 44.43 per cent for *Profit* and 29.98 per cent for *Z*-Score, respectively. Beyond this value, the equity ratio deteriorates the solvency of the bank.

27. In this regard, some studies (Curcio *et al.*, 2017; Manganaris *et al.*, 2017) provide evidence that European banks dramatically increased the recourse to loan loss provision during the crisis.

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Appendix

Kumbhakar *et al.* (2015) defines SFA as an econometric technique that estimates cost or profit frontiers, and efficiency relative to those frontiers. For cost efficiency, the frontier is defined by the potential minimum cost, and the actual cost lies above the minimum frontier owing to inefficiency. Similarly, the profit frontier is defined in terms of the maximum possible profit, and profit efficiency is defined as the ratio of actual to maximum possible. Therefore, the frontier is unobserved and is defined by the optimal level (i.e. maximum level for profit, and minimum level for cost). As this frontier is unobserved, it has to be estimated, considering the following production frontier model. More specifically, in a world without error or inefficiency, the i^{th} bank would produce:

$$y_{i,t} = f(x_{i,t}, \beta)$$

However, this method assumes that each bank potentially produces less than it might due to a degree of inefficiency. Specifically:

$$y_{i,t} = f(x_{i,t}, \beta)\xi_{i,t}$$

where $\xi_{i,t}$ is the technical efficiency score for bank i and it lies in the interval (0;1). If $\xi_{i,t} = 1$, the bank is achieving the optimal output with the technology embodied in the production function $f(x_{i,t}, \beta)$. When $\xi_{i,t} < 1$, the bank is inefficiently using the inputs x_i given the technology of the production function $f(x_{i,t}, \beta)$. As the output is assumed to be strictly positive (that is, $y_{i,t} > 0$), the degree of technical efficiency is assumed to be strictly positive (that is, $\xi_{i,t} > 0$). Finally, SFA considers that output is also subject to random shocks, that is:

$$y_{i,t} = f(x_{i,t}, \beta)\xi_i \exp(v_{i,t})$$

Taking the natural log of both sides and re-expressing $\ln(\xi_{i,t})$ equal to $u_{i,t}$ yields:

$$\ln(y_{i,t}) = \ln\{f(x_{i,t}, \beta)\} + u_{i,t} + v_{i,t}$$

where $u_{i,t}$ is the firm- and time-specific idiosyncratic and stochastic part of the frontier, while $v_{i,t}$ is a random variable which is assumed to be independent and identically distributed (i.i.d.) $N(0, \sigma^2_v)$ and independent of $u_{i,t}$.

In our analysis, the technology of a bank is modeled by translog functional form, with three output and three input (Battaglia *et al.*, 2010) equations, which are:

$$\ln(performance)_{i,t} = a_0 + \sum_{i=1}^{3} b_i \ln Y_{i,t} + \sum_{j=1}^{3} c_i \ln P_{j,t} + e_1 \ln E_{i,t} + t_1 T$$

$$+ \frac{1}{2}\left[\sum_{i=1}^{3}\sum_{j=1}^{3} \delta_{i,j} \ln Y_{i,j,t} + \sum_{i=1}^{3}\sum_{j=1}^{3} \gamma_{i,j} \ln P_{i,j,t} + e_{11} \ln E_{i,t} \ln E_{i,t} + t_{11} T^2\right]$$

$$+ \sum_{i=1}^{3}\sum_{j=1}^{3} \varphi_{i,j} \ln Y_{i,t} \ln P_{j,t} + \sum_{i=1}^{3} \mu_i \ln Y_{i,t} \ln E_{i,t} + \sum_{i=1}^{3} \psi_i \ln Y_{i,t} T$$

$$+ \sum_{j=1}^{3} \theta_j \ln P_{j,t} \ln E_{i,t} + \sum_{j=1}^{3} \lambda_j \ln P_{j,t} T + \omega T \ln E_{i,t} + v_{i,t} + u_{i,t}$$

where *Performance* is, in the first model, *TC* (i.e. the logarithm of the total production cost), and in the second model it is *TP* (i.e. the logarithm of the total profit); Y_i ($i = 1, 2, 3$) is the output quantities (bank loans, other earning assets, and deposit and short-term funds), P_j ($j = 1, 2, 3$) is the input prices (personal expenses on total assets; other operating expenses on total assets; interest expenses on total funds), ln*E* is the natural logarithm of total equity capital, and *T* is the time trend to account for possible changes in technology during the observed period. The methodology requires applying the following constraints:

1. the symmetry restriction: $\delta_{ij} = \delta_{ji}$ and $\gamma_{ij} = \gamma_{ji}$; and
2. linear restriction of the cost function (i.e. $\sum_{j=1}^{3} cj = 1$; $\sum_{j=1}^{3} \gamma ji = 0$; $\sum_{j=1}^{3} \varphi ji = 0$; $\sum_{j=1}^{3} \theta j = 0$ and $\sum_{j=1}^{3} \lambda j = 0$).

Finally, following Battaglia *et al.* (2010), we include equity as a netput, specifying interaction terms with both output quantities and input prices.

As rightly pointed out by Greene (2008), the frontier function model is essentially a regression model that is fit with the recognition of the theoretical constraint that all observations lie within the theoretical extreme. Measurement of efficiency is, then, the empirical estimation of the extent to which observed agents achieve the theoretical ideal. The estimated model of production, cost or profit is the means to the objective of measuring efficiency.

Finally, the time-varying technical efficiency score for bank *i* at time *t* can be defined as follows:

$$\xi_{i,t} = E\{\exp - (su_{i,t}) | \varepsilon_{i,t}\}$$

where ε is equal to $v_{i,t} + u_{i,t}$ and *s* is equal to 1 for profit efficiency, and to −1 for cost efficiency.

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