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Managerial ability as a tool for prudential regulation

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ABSTRACT

The new prudential regulation framework, established by the European Central Bank (ECB) after the financial crisis encompasses supervisory procedures to measure and monitor bank business models, capital requirements, governance arrangements and liquidity risk. However, research on financial stability has revealed that, during financial crises, it would have been essential to monitor the vulnerability of banks by also assessing the value of their intangible assets. We contribute to the extant literature by examining the impact of a specific intangible asset—namely, managerial ability—on bank risk-taking. Given the interest of the regulatory authority in monitoring financial stability, we quantify management ability and document its double effects on bank risk-taking: the indirect effect through franchise value and its direct effect. We examine a sample of listed banks from 15 EU countries over the period 1997–2016. We find that higher managerial ability is associated with higher franchise value, contributing to a decrease in bank risk-taking (indirect effect), particularly for small banks and during financial crisis. Moreover, managerial ability reduces bank risk-taking through its direct effect. Our evidence suggests that managerial ability could be considered a measure (easily estimated) for regulating the disciplinary role of franchise value and, used in combination with current regulatory measures, could lead to supervisors achieving more effective management oversight.

1. Introduction

What role does prudential regulation play in the prevention of banking crises? In the years following the 2008 financial crisis, an important academic and policy debate emerged on the role played by prudential regulation in the prevention of banking crises. To date, lax regulation, excessive reliance on short-term financing, insufficient capital and poor governance have been considered the most important factors explaining the devastating upshot of the financial crisis (Beltratti and Stulz 2012). Correspondingly, the aftermath of the financial crisis engendered a rush in research on the optimal level of bank capital. This strand of literature includes proponents and opponents of higher capital requirements since, during the crisis, well-capitalized banks were also in trouble (Dagher et al., 2016). On the other hand, a notable alternative research topic, which has arisen and is widely discussed, is the analysis of the extent to which risk-taking is influenced by underlying governance structure. This area of the literature predominantly analyses the impact of bank ownership, particularly given regulation measures (Laeven and Levine 2009) and executive compensation (Mehran et al., 2012) on risk-taking.

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Capital requirements have always been the main element of prudential regulation. Following the financial crisis, governance control became a central focus for supervisors since the ECB assumed the duties of supervision in 2014. One of the reasons behind the decision to strengthen the supervision and assessment of bank board members was the weakness in the functioning and composition of bank management bodies. Although steps were taken, the approach proposed by the new prudential regulation framework to control the quality of governance and, by extension, management bodies, is qualitative. In particular, the "fit and proper test" requires an assessment of managers based on qualitative information regarding their experience, reputation, conflicts of interest and independence, time commitment and collective suitability.[1] Specifically, in his speech at the *Banks, Systematic Risk, Measurement and Mitigation* conference, Dr. Ignazio Angeloni (2017), a member of the Supervisory Board of the ECB, explained that to fit a proper analysis constitutes a supervisory tool to ensure the governance of prudent banks: "…the fit and proper analysis, aimed at ensuring that managers and board members satisfy, individually and collectively, the personal and professional criteria that are appropriate for the tasks which they perform and the responsibility which they have in the institution". Based on the important role managers play in the decisions on bank risk-taking, the current study attempts to quantify the managerial ability of banks (an intangible asset) and measure their impact on risk-taking. The final aim of this analysis is to provide supervisors with an additional quantitative tool to be used for management supervision.

The corporate finance literature encompasses interesting prediction models, which highlight the importance of managers and, in particular, their ability in firm performance. The following approaches are those useful in addressing the main goal of the current study: measuring managerial ability and investigating whether manager ability is not only a direct driver of bank risk-taking but also, to what extent it can contribute to the disciplinary role of franchise value on bank risk-taking. Based on the premise that managers make corporate decisions crucially important to firms' economic outcomes (Fama 1980), a large part of the emerging literature in corporate finance highlights that managers are not homogenous in decision-making where managerial idiosyncratic differences affect corporate decisions (Bertrand and Schoar 2003) and, consequently, firm performance.[2] This literature highlights that such differences among managers regarding decision-making are explained by the heterogeneity in managerial ability since better managerial ability often facilitates better corporate decisions, which in turn improves firm performance. On the other hand, traditional predictions of corporate finance models suggest that, although shareholders are protected by limited liability and have incentives to take risk to maximize their option-like payoff (Jensen and Meckling 1976), the risk-taking incentives should be lower for more profitable firms since their shareholders would lose more if downside risks are realized (Keeley 1990). Taking in combination the predictions of both literature streams, this study attempts to measure managerial ability in banking and analyses its direct impact on bank risk-taking and its indirect impact through franchise value. That is, whether managerial ability helps to reduce risk-taking (direct effect) and to what extent managerial ability positively affects franchise value, implying a discipline effect on risk-taking through franchise value (indirect effect).

To address this aim, we adopt the new approach developed by Demerjian et al. (2012) to measure managerial ability in corporate firms and we adjust it to fit banking firms. Based on the idea that the actions of management can add or subtract firm value depending on managerial ability (Lang and Stulz 1994), managerial ability is classed as an intangible asset since it can uphold value for a firm or be decisive in its long-term success or failure. Accordingly, we first analyze the contribution of such intangible assets on bank franchise value.[3]

Finally, we evaluate the direct effect of managerial ability on bank risk-taking and the effect of managerial ability on bank risk-taking incentives through their franchise value.[4] The direct effect grants exploration if managerial ability is a tool to moderate risk-taking, while the effect of franchise value can be considered as the indirect effect managerial ability has on risk-taking. In other terms, the managers' contribution to the disciplinary role of franchise value on risk-taking incentives. The latter will permit us insight into whether the disciplinary role of franchise value on risk-taking (Demsetz et al., 1996) could be regulated through managerial ability. For example, regarding the impact of existing prudential regulation, Blum (1999) demonstrated the indirect effect of such regulation on risk-taking incentives, confirming that, through regulatory policies such as strict capital requirements, the value of deficient banks might decrease and, contrary to what is expected, risk-taking incentives increase. Additionally, Suarez (1994) suggested that the optimal strategy for a central bank is to commit credibly to withdrawing the bank's franchise in the case of bankruptcy.

Our methodology builds on three main ingredients. The first is the measurement of managerial ability for banks. Generally, studies have predominantly relied on proxies such as firm size, past performance, and CEO characteristics to infer managerial ability. In place of such proxies, we resort to the new measure of managerial ability, developed by Demerjian et

[1] The Capital Requirements Directive (CRD) IV sets the relevant requirements at the European level towards achieving a minimum harmonisation directive which needs to be transposed onto the legal framework of member states via national legislation. This makes fit and proper assessments particularly complex.

[2] Decisions such as financial reporting (Demerjian et al. 2013), earnings forecasts (Baik et al. 2011), corporate tax planning (Koester et al. 2016), and corporate payout (Guan et al. 2018) were analysed in this area of the literature.

[3] Hall (2001) empirically estimated the growth in intangible assets within the non-financial sector. He argued that franchise value is increasingly derived from organisational capital. Prescott and Visscher (1980) defined organisational capital based on what the firm knows about the abilities of its personnel and influences the firm value. Hayes and Schaefer (1999), Chatterjee and Hambrick (2007) and Malmendier and Tate (2009) found that high managerial ability can directly increase firm value.

[4] The analysis of the effect of managerial ability on bank risk-taking incentives through their franchise value converges with the study by Hellmann et al. (2000). The authors use the traditional measures of prudential regulation in place of managerial ability.

al. (2012) and based on managers' efficiency relative to their industry peers. While Demerjian et al. (2012) used revenue efficiency to understand how corporate firms transform corporate resources to revenues, in the current study we focus on cost efficiency. Cost efficiency is our preferred economic performance measure since when revenue-generating opportunities are sub-optimal (as it is for the current banking sector where banks are facing a low-interest rate) bank management must develop a business model to sustain its operations and profitability, particularly at that time banks prioritize the optimization of cost-efficiency. To obtain a measurement of managerial ability, we consider how bank managers make decisions based on cost-generating resources. In the banking literature, to our knowledge, there is only one paper which measures managerial ability; however, in the place of cost efficiency, they use profit efficiency from the alternative profit function (Andreou et al., 2016).[5]

The second ingredient is to test how the measure of managerial ability obtained affects bank franchise value measured as bank Tobin's Q. Since the quality of the firm managers has been widely recognized as an important measure of firm quality and a predictor of its future performance (Chemmanur et al., 2009), higher managerial ability is assumed to enhance Tobin's Q. In such a case, higher managerial ability should serve to signal the bank's value more effectively and, thus, reduce information asymmetry. Additionally, Tobin's Q can be interpreted as a measure of intangible assets (i.e., it is a measure of the valuation of all the intangible factors on which the firm earns rent; Lindenberg and Ross 1981). Among these factors are those, which allow a firm to lower its costs relative to those of a competitive or marginally competitive firm. Higher managerial ability represents such factors since more able managers better understand more advanced technology and industry trends, invest in higher-value projects, better monitor loan-granting processes, and manage their employees more efficiently compared with managers who have low managerial ability. Given this, a significant positive effect of managerial ability on Tobin's Q may be considered confirmation our measure of managerial ability is an intangible asset which contributes not only towards explaining Tobin's Q but also increasing it.

The third ingredient is to examine the direct correspondence between managerial ability and bank risk-taking and its indirect effect through franchise value. To address this, our methodology follows the model estimated by Keeley (1990), Gropp and Vesala (2001), and Gonzalez (2005) in considering the potential endogeneity of franchise value. Accordingly, we resort to a two-stage least-squares model. In the first stage, we estimate the relationship between Tobin's Q and managerial ability and, in the second stage, we estimate the relationship between the probability of default of a bank as a proxy measure of bank risk-taking against the managerial ability and predicted value of the Tobin's Q obtained within the first stage.

This paper contributes to the banking literature regarding the drivers of bank risk-taking and the mechanism available to supervisors and regulators to maintain stability (e.g., Saunders et al., 1990; Boyd and De Nicolo 2005; Furlong and Kwan 2005; Altunbas et al., 2009). To the best of our knowledge, this is the first time in the banking literature managerial ability has been measured when considering the most important challenge for a bank (i.e., cost efficiency).[6] Moreover, we contribute to the literature regarding the measurement of intangible assets (i.e., managerial ability; Baik et al., 2011; Demerjian et al., 2012; Bonsall et al., 2016; Guan et al., 2018). Additionally, we align with the recent literature on banking stability, which provides that market-based metrics are more informative indicators of fragility. Recent research has indicated market-based metrics are useful indicators of bank fragility and that such measures can lead to dramatically different conclusions (compared with accounting-based metrics) regarding bank risk-taking (Acharya et al., 2014; Acharya and Steffen 2014). Accordingly, Calomiris and Nissim (2014) indicate that regulators should focus more on market-based metrics when analyzing financial stability as accounting measures do not allow identifying points of vulnerability for banks, many of which are unrelated to balance-sheet book value. Results by Kane and Unal (1990) support the notion that whenever the economic market value of a bank differs from their book value, it is explained via the substantial hidden assets the bank has. Besides the advantages highlighted of using market-based measures, their use helps to address our aim of analyzing the disciplinary role of bank performance on risk-taking. Keeley (1990) and Demsetz et al. (1996) have argued that franchise value—the expected present value of a firm's economic rent—is an effective tool to control moral hazard incentives as it provides banks with a valuable source of monopoly power which they lose upon failure.[7] Therefore, our analysis in the current study is based on market measures of bank value and risk-taking.

We answer our research questions by examining a sample of listed banks from 15 European countries for the period 1997–2016. The results indicate the management of European listed banks is heterogeneous in terms of managerial ability, and that franchise value is explained and enhanced by managerial ability. Results, which may support our metric of managerial ability as an intangible asset, contribute towards explaining franchise value. Moreover, since higher managerial ability enhances franchise value, it seems managerial ability may contribute to moderate risk-taking incentives through the disciplinary role played by franchise value. Specifically, results demonstrate managerial ability directly reduces the probability of default of banks, and higher bank franchise values (driven by managerial ability) are found to provide incentives

[5] Andreou et al. (2016) investigated the impact of managerial ability on bank liquidity creation and risk-taking behaviour using a sample of US banks during the period 1994–2010. We diverge from this study in that we investigate how the disciplinary role of franchise value is affected by managerial ability using a sample of EU banks during the period 1997–2016.

[6] When banks face continued weakness in their profitability, linked with difficulties in increasing revenues in a low nominal growth, a low-interest-rate environment and a relatively flat yield curve mean their priority is to reach higher cost-efficiency.

[7] More specifically, with valuable charters as assets, banks have an incentive not to risk failure since the owner of the bank cannot sell the charter once the bank is declared insolvent. Instead, a bank could be insolvent on a book-value basis but still have a valuable charter which regulators could sell in a purchase and assumption (Keeley 1990).

to banks to reduce their probability of default. Therefore, concerning the new trends in financial regulation which seek to identify risk factors to guide policy-makers regarding changes in financial regulation, our results give insight into the role of bank managers' ability as an essential driver of bank franchise value and the stability of the banking systems. Our results may suggest managerial ability could be a useful quantitative tool for supervisors and regulators towards achieving effective management oversight and to maintain stability as well as lessen the incentive in bank risk-taking.

The paper is organized as follows: Section 2 presents the methodological approach and variables; Section 3 discusses the data and descriptive statistics; Section 4 provides the results of our analysis, while Section 5 outlines a check of robustness of the results obtained; and, finally, Section 6 concludes and provides recommendations for future research directions.

2. Methodological approach and variables

To answer our research questions, our research design was divided into two parts. First, we measured managerial ability by following Demerjian et al. (2012), adapting this approach to the case of banks. Second, we analyzed the influence of managerial ability on a bank's probability of default. Such an effect was analyzed both directly and through bank franchise value, incorporating the effect of managerial ability on bank franchise value by estimating a two-stage least-squares model.

2.1. Estimation of managerial ability

In this study, we estimated the value of managerial ability based on managers efficiency in making the best use of their bank's productive resources. We followed the two-step approach implemented by Demerjian et al. (2012). In the first step, we used the non-parametric data envelopment analysis (DEA) to estimate the Pareto-efficient frontier under the overarching performance goal of cost-minimization (cost-efficient frontier) as well as measured for each bank and year the cost efficiency score (*CE*) as the distance of those banks to the frontier (Charnes et al., 1981; Banker et al., 1984). Cost efficiency measures the proximity of a bank's costs against best practices (or the most efficient banks). Conversely, a bank is cost-efficient if it produces a given volume of output at the least possible cost. The main argument for using DEA in preference to other approaches lies within two key advantages. First, DEA provides an ordinal ranking or relative cost-efficiency compared with the Pareto-efficient frontier (a bank's best-practice benchmark). Second, DEA does not impose an explicit weighting structure to inputs and outputs in the estimation of efficiency scores. This implies that banks using a less-than-optimal input mix to reach the same level of output are valued with an efficiency score with a value of less than one.[8] To identify banking inputs and outputs, we followed the intermediation approach, which was originally developed by Sealey and Lindley (1977).[9] This approach suggests that total loans and other earning assets are outputs, whereas deposits along labour and physical capital are inputs. Specifically, the output variables capture the traditional lending activities of banks (i.e., total loans) and the investment banking activities of banks (i.e., other earning assets), respectively. The input variables used in this study were the cost of labour (i.e., personnel expenses/total assets), costs of deposits (i.e., interest expenses/total deposits) and physical capital (i.e., total non-interest expenses less personnel expenses/total fixed assets). Therefore, this method allows two hypothetical banks, which produce the same output with different mixes of inputs to be considered efficient.

Following Demerjian et al. (2012) in the second step, we estimated managerial ability as the residual portion of a DEA-generated total efficiency measure purged from key firm-specific characteristics, country regulatory variables and time. Specifically, the total firm efficiency score is broken down into two components: one component represents the efficiency associated with a firm's characteristics, and the other component represents the efficiency related to managerial ability.

Previous studies have supported notions these factors may drive firm efficiency aiding or hindering efforts made by management.[10] Therefore, after controlling for the bank characteristics in a Tobit regression model with the total bank cost efficiency score (*CE*) as the dependent variable, we attribute the unexplained portion of bank efficiency (residuals) to management ability.

To capture the efficiency related to bank characteristics, we include five variables. Bank size, proxied by the logarithm of total assets (*Ln(total assets)*), is expected to positively affect bank efficiency through economies of scale. By analyzing a sample of European listed banks over the period 2000–2011, Beccalli et al. (2015) found scale economies were widespread across different size classes of banks and were significantly greater for the largest banks. Therefore, in the current study, we can expect size to have a positive effect on cost efficiency. The same expectations are present for the variable related to the growth rate in assets (*Growth in assets*) as a proxy for growth opportunity. In terms of capitalization, we also control for *Leverage*, which is defined as the ratio of equity-to-total assets. The empirical evidence is mixed. Better capitalized banks may have less moral hazard incentives and are more likely to adopt cost-reducing practices (e.g., shareholders may be more active in controlling bank costs or capital allocation (Fiordelisi et al., 2011)). However, Altunbas et al. (2007) have demonstrated that inefficient European banks appear to hold more capital. Additionally, we control for the business model,

[8] Different from Andreou et al. (2016), who use a stochastic frontier approach to measure profit efficiency.

[9] In the banking literature, there are three alternative approaches to measuring bank outputs and inputs based on the classical microeconomic theory (production, intermediation and user-cost approaches). Based on the intermediate role, which banks play in the economy, we use the intermediation approach, an approach widely used in banking empirical analysis.

[10] The validity of this managerial ability measure has been well established by the authors and used in other papers (Bonsall IV et al. 2016; Guan et al. 2018).

Table 1
Variables description and expected sign.

Variables	Description	Expected sign		
		Eq. (1)	Eq. (2)	Eq. (3)
Management characteristics				
Managerial ability	Residual of the Tobit Regression		+	–
Bank characteristics				
Ln(total assets)	Logarithm of total assets	+	+/-	–
Leverage	Ratio of equity over total assets	+/-	+/-	+/-
Asset diversity	Index measured through the Herfindahl–Hirschman Index	–	–	+
Loans-to-total assets	Ratio of loans over total assets	–	–	–
Growth in assets	Three-year growth rate in total assets	+	–	+
Market share	Ratio of bank total assets over total banking assets in the country	+/-	+	–
Multinational bank	Dummy variable equal to one if the bank operates in more than a country	+/-	+/-	+/-
Regulatory variables				
Financial freedom	Score from 0 to100. Higher values mean less government restrictions	–	–	+
Regulation restrictions	Score from 1 to 5. Lower values mean less regulatory restrictions	–	–	+
Predicted Tobin's Q				–
Dependent variables				
Cost efficiency	Score from 0–1. Higher values mean more cost efficiency			
Tobin's Q	Ratio of the market value of equity plus the book value of debt over the total assets			
Probability of default	Probabity of default measure			

The table reports descriptions of the variables used in the analysis and the expected values in Eqs. (1)–(3).

proxying it either using the *Asset diversity* quantified by the Herfindhal-Hirschman Index of bank assets or *Loans-to-total assets*. Previous literature has supported notions that asset diversification reduces cost efficiency (Rossi et al., 2009), while a business model oriented more towards lending activity may likely support costs related to external events which precipitate in problem loans and additional monitoring costs (Berger and DeYoung 1997; Beccalli et al., 2015). Therefore, we expect a negative sign for both variables.

Finally, we control for bank market share and whether the bank is multinational. *Market share* is defined as the assets held by a bank divided by the assets held by all banks in a country. This variable aims to capture the degree of competition facing the bank. The existence of this link between market share and efficiency has been widely debated and results remain mixed. On the one hand, an increase in market power allows costs to rise as a consequence of slack management (Berger and Hannan 1998), as monopoly power would grant managers a *quiet life* free from competition, thus increasing inefficiency. On the other hand, the *quiet life* hypothesis has been rejected by several studies. For example, Maudos and de Guevara (2007) illustrated a positive effect of market power on efficiency for EU banking. Other studies (e.g., Koetter et al., 2008) have analyzed the Granger casualty and have found evidence showing that increases in market power preceding increases in cost efficiency. *Multinational bank* is a dummy variable equal to one if the bank operates in more than one country. On one hand, being a multinational bank may increase efficiency due to both scale and scope economies and, on the other, inefficiencies tend to increase with the distance between the headquarters of a bank holding company and its subsidiaries, possibly due to increasing agency costs (Berger and DeYoung 2001). Moreover, we include country regulatory factors such as *Financial freedom* and *Regulatory restrictions*, which may influence the efficiency of the bank overall. It has been found that higher regulatory restrictions lower cost efficiency (Pasiouras et al., 2009). Finally, we control for both country- and year-fixed effects (Country FE and Year FE, respectively) and clustered the standard errors at the bank level. All variables lagged by one year to avoid endogeneity. The equation to generate the efficiency related to management (i.e., managerial ability) was given by the residuals produced in the following equation:

$$\begin{aligned} CE_{i,t} = {} & \alpha + \beta_1 Ln(total\ assets)_{t-1} + \beta_2 Leverage_{t-1} + \beta_3 Business\ model_{t-1} + \beta_4 Growth\ in\ assets_{t-1} \\ & + \beta_5 Market\ share_{t-1} + \beta_6 Multinational\ bank_{t-1} + \beta_7 Financial\ Freedom_{t-1} \\ & + \beta_8 Regulatory\ restrictions_{t-1} + Country\ FE + Year\ FE + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where i denotes the bank, t denotes the year. $\varepsilon_{i,t}$ is the error tem and represents $Managerial\,Ability_{i,t}$, ($MA_{i,t}$). Overall, this measure provides a relative estimate of managers' ability of a given bank compared with its banking industry peers, as well as quantifies how high-/low-ability managers engender a higher (lower) level of cost efficiency given a set of firm-specific factors. Moreover, this metric offers (as the main advantage) no requirement for hand-collected or proprietary data—that is, it is not qualitative. All variable definitions and their expected signs are summarized in Table 1.

2.2. The effect of managerial ability on bank risk-taking

Once managerial ability is estimated, we analyze the impact of managerial ability on bank risk-taking. To perform such analysis, we study the direct correspondence between managerial ability and bank risk-taking, as well as their indirect correspondence through their bank franchise value. There are two main reasons for the adoption of this strategy: (i) the aim is to explore whether managerial ability should be considered a metric prudential tool to moderate risk-taking and (ii) to

analyze whether the disciplinary role of franchise value on risk-taking may be regulated through managerial ability (Demsetz et al., 1996). For our analysis, we follow the approach previously used in the banking literature (Keeley 1990; Gropp and Vesala 2001; Gonzalez 2005) based on a two-stage least-squares model. This allows for the incorporation of the effect of managerial ability on both bank franchise value and bank risk-taking while also controlling for bank-specific variables and country regulation variables. Moreover, this procedure explicitly considers the potential endogeneity of franchise value.

In line with the recent literature on banking stability, which suggests bank market values are more useful fragility indicators (Calomiris and Nissim, 2014), in preference to using accounting measures, we base our analysis on market measures of bank franchise value and risk-taking. Therefore, in the first stage, the franchise value is measured through Tobin's Q (*TQ*)—that is, the ratio of the market value of equity plus the book value of debt over the total assets. Following this, it is defined as a function of managerial ability. In the second stage, we incorporate managerial ability (*MA*) and the predicted Tobin's Q values ($\widehat{TQ}$) obtained in the first stage as explanatory variables of risk-taking. Bank risk-taking is proxied by the probability of default (*PoD*).[11] In both equations, we control for bank characteristics, regulatory variables as well as for both country- and year- fixed effect (Country FE and Year FE, respectively). These are included with a one-year lag to address endogeneity problems. The model is given as follows:

1st stage:

$$\begin{aligned} TQ_{i,t} = {} & \alpha + \boldsymbol{\beta}_0 MA_{i,t-1} + \beta_1 Ln(total\ assets)_{t-1} + \beta_2 Leverage_{t-1} + \beta_3 Business\ model_{t-1} + \beta_4 Growth\ in\ assets_{t-1} \\ & + \beta_5 Market\ share_{t-1} + \beta_6 Multinational\ bank_{t-1} + \beta_7 Financial\ Freedom_{t-1} \\ & + \beta_8 Regulatory\ restrictions_{t-1} + Country\ FE + Year\ FE + \varepsilon_{i,t} \end{aligned} \tag{2}$$

2nd stage:

$$\begin{aligned} PoD_{i,t} = {} & \alpha + \boldsymbol{\gamma}\widehat{TQ}_{i,t-1} + \boldsymbol{\beta}_0 MA_{i,t-1} + \beta_1 Ln(total\ assets)_{t-1} + \beta_2 Leverage_{t-1} + \beta_3 Business\ model_{t-1} \\ & + \beta_4 Growth\ in\ assets_{t-1} + \beta_5 Market\ share_{t-1} + \beta_6 Multinational\ bank_{t-1} + \beta_7 Financial\ Freedom_{t-1} \\ & + \beta_8 Regulatory\ restrictions_{t-1} + Country\ FE + Year\ FE + \varepsilon_{i,t} \end{aligned} \tag{3}$$

where *i* denotes the bank and *t* denotes the year. The parameters of our interest are $\boldsymbol{\beta}_0$ from Eq. (2), and $\boldsymbol{\gamma}$ and $\boldsymbol{\beta}_0$ from Eq. (3). Accordingly, we expect managerial ability to have a significantly positive effect on Tobin's Q and a negative effect on probability of default. A significant positive effect of managerial ability on Tobin's Q would not only explain, but also enhance franchise value—that is, it would support the notion that managerial ability is a hidden asset, which may influence the moderation of risk-taking incentives through the disciplinary role played by franchise value. Otherwise, the significant negative value of managerial ability on risk-taking would mean that managerial ability operates as a tool to control risk-taking. The Tobin's Q values predicted from Eq. (2) is expected to have a negative impact on probability of default, as argued in section 1.

In terms of banking characteristic variables, we use the same set of variables included in Eq. (1). The logarithm for total assets (*Ln(total assets)*) is used as a proxy for bank size. The literature investigating the relationship between bank valuation and bank size is sparse and provides mixed evidence. There are some studies which have concluded that bank size is not significant in a regression of Tobin's Q (Boyd and Runkle 1993), while others have demonstrated a positive effect (Laeven and Levine 2007). When estimates of this relationship include the financial crisis or the Too-Big-To-Fail statement, then the effects become negative (Demirgüç-Kunt and Huizinga 2013; Guerry and Wallmeier 2017; Curi and Murgia 2018; Minton et al., 2019). However, the focus of most of these studies is on large banks. Concerning the probability of default, the larger the size of the bank, the lower the probability of default. Based on the prediction of Maksimovic and Phillips (2002), past performance was controlled for by including growth rate in assets over the last three years (*Growth in assets*) as a proxy for opportunity growth, and is expected a negative relationship with Tobin's Q and a positive relationship with the probability of default, as found in previous literature (Laeven and Levine 2007; Curi and Murgia 2018; Minton et al., 2019). *Leverage*, as defined as the ratio of equity-to-total assets, is also controlled for. Because equity represents a buffer against losses but is commonly regarded as expensive, a higher equity ratio is expected to be associated with higher valuations during times of financial distress but with lower valuation during good times (Guerry and Wallmeier 2017; Curi and Murgia 2018). Moreover, well-capitalized banks may have fewer incentives to engage in excessive risk-taking. However, Fiordelisi et al. (2011) did not find a significant relationship with probability of default. As in Eq. (1), the mixture of activities conducted by each bank is controlled for, and we include both the *Asset diversity* and the ratio *Loans-to-total assets* as a proxy for the bank activity index. *Asset diversity* is measured using the Herfindahl–Hirschman Index, where the higher the value of the index, the lower the diversification in assets becomes. The bank activity index is measured as the ratio of loans to total assets, where the higher the value of the index, the higher the specialization of the bank in lending becomes. Including *Asset diversity* is crucial, as previous studies have shown that valuation (and probability of default) is negatively (and positively) affected by diversification business models due to possible diseconomies of scope and/or conflicts of agency (risk diversification; e.g., Gulamhussen et al., 2014). The business orientation, on the other hand, aims to capture the possible effect the lending

[11] The probability of default measure used is defined quantitatively and analyses different covariates which covert among others, market-based bank-specific attributes. The estimations are based on the forward intensity model developed by Duan et al. (2012). Specific information regarding the estimation of probability of default is available in the Credit Research Initiative (2019) white paper.

activity has on bank valuation and risk. Given our sample comprises listed banks, we expect that bank value and probability of default decrease with lending activity, respectively (Minton et al., 2019; DeYoung and Torna 2013).

Market share comprises the assets of a bank divided by the assets of all banks in a country. It measures bank size relative to other national banks. It may be that banks with a large market power potentially have high franchise values, which reduces incentives for risk-taking (Keeley 1990; Hellmann et al., 2000). Finally, we also consider the variable *Multinational bank*, which can act as a dummy variable equal to one if the bank operates in more than one country. On the one hand, being a multinational bank may increase efficiency and shareholder valuation (e.g., Gulamhussen et al., 2017); on the other hand, this higher valuation comes at a cost. Banks, especially the largest, may have a higher expected probability of default (e.g., Gulamhussen et al., 2014). Other authors, however, have found that geographical diversification may reduce some types of risk, such as credit risk (Deng and Elyasiani 2008; Fang and van Lelyveld 2014; Goetz et al., 2013). This remains an empirical question. We also control for the potential impact of regulatory restrictions on bank franchise value and its incentives to apply conservative or more aggressive investment policies in terms of risk-taking. Most of the previous literature suggests that stricter regulation increases bank risk and reduces bank charter value (Barth et al., 2001, 2004; Gonzalez 2005). We include two variables: 1) *Regulatory restrictions* and 2) *Financial freedom*.[12] All variable definitions and their expected signs are summarized in Table 1.

A regression was run for the full sample over the entire period and the analysis was extended to various dimensions. In particular, we re-estimated the baseline specification using different indicators of bank diversity (asset diversity and loans-to-total assets), splitting regressions by sub-period (pre-crises (1997–2007), crises (2008–2012), and post-crises (2013–2016)) and by bank size (small and large banks).

3. Data and descriptive statistics

3.1. Data sources and sample composition

This study relies on several data sources. Bankscope and Orbis Bank were used to obtain a bank balance sheet and other accounting items, Datastream (Thomson Reuters) was used to collect stock market data, IMF dataset was used to collect macroeconomic data, and the Heritage Foundation for the regulatory indexes. The Risk Management Institute Database (National University of Singapore) provided data on probability of default.. We filled in missing data by hand-collecting details from individual bank financial statements from corporate sources and websites. Given the different sources of information used for the empirical exercise, the registers of the four databases were manually matched. The analysis we conducted for this study is based on European listed banks from the fifteen countries of the European Union (EU15) over the period 1997–2016. The sample represented more than 75 percent of bank total assets in EU15 and consisted of 1148 firm-year observations. Our sample was heterogeneous in terms of bank size and business diversification, which implies differences in organisational structure, investment opportunities, the functioning of internal capital markets, and the probability of rescue from governments.

3.2. Sample descriptive statistics

Table 2 reports descriptive statistics for the five sets of variables used in our analyses: (1) banking output and input variables used to estimate the cost efficiency function; (2) bank efficiency estimates in terms of total cost efficiency and managerial ability; (3) variables related to bank valuation and risk metrics (i.e., Tobin's Q and probability of default, respectively); (4) bank-specific characteristics; and (5) country regulation variables. Descriptive statistics are provided for the whole sample as well as for small and large banks. We distinguish large from small banks using the distribution of total assets across banks as a threshold: banks with total assets less than $72bn are classified as small banks and the remainder as large banks. The country GDP deflator (base year 2010) was used to express the data in real terms.

The input and output variable statistics presented in Table 2 suggest significant heterogeneity within the full sample and between small and large banks, especially in terms of their output composition, as the differences in the mean report. On average, the small banks seem to be more active in lending activity, while the large banks are more active in non-traditional activity. In terms of inputs, significant differences are found in the cost of labour: small banks support the higher cost of labour compared with large banks. This may be associated with the reality that small banks are considered to have a superior capacity in processing soft information in the framework of bank-borrower long-term relationships, which is typically available through personal contact and observation (Berger et al., 2005; Berger and Black 2011; Berger et al., 2014).

In terms of cost-efficiency, on average, our bank sample operates at approximately 76%, with small banks less cost-efficient (efficiency score at approximately 73%) compared with large banks (efficiency score at approximately 80%). Managerial ability is the residual-based measure obtained from the estimation of Eq. (1). The sample mean is −0.021 and large banks demonstrate a significantly lower level of managerial ability, meaning small banks are managed by more able managers in terms of the productive use of resources in intermediation production processes.

[12] The former measures the relative openness of a country's banking and financial system by analysing whether foreign banks and financial service firms can operate freely, how difficult it is to open domestic banks and other financial services firms, how heavily regulated the financial system is and, finally, whether banks are free to provide customers with insurance and invest in securities.

Table 2
Descriptive statistics of variables used.

	Full sample			Small banks (≤$72bn)			Large banks (>$72bn)			Test of difference	
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	*t*-statistic
Output variables											
Loans ($bn)	96.35	14.21	173.02	8.212	4.428	10.081	246.530	169.540	212.150	−238.316***	(−33.38)
Other earning assets	119.010	5.231	301.310	3.844	1.625	6.389	315.230	127.820	429.520	−311.384***	(−21.58)
Input variables											
Deposit interests	0.063	0.030	0.596	0.076	0.027	0.751	0.042	0.036	0.026	0.033	(−1.01)
Labour	0.013	0.012	0.007	0.015	0.014	0.008	0.009	0.008	0.004	0.006***	(−17.52)
Physical capital	1.413	0.988	1.992	1.436	1.017	2.185	1.374	0.909	1.612	0.062	(−0.57)
Bank efficiency											
Cost efficiency	0.759	0.751	0.176	0.731	0.716	0.178	0.802	0.799	0.165	−0.0846***	(−8.86)
Managerial ability	−0.021	−0.022	0.154	−0.003	−0.014	0.149	−0.049	−0.035	0.158	0.0323***	(3.70)
Bank valuation and risk metrics											
Tobin's q	1.164	1.016	0.401	1.252	1.042	0.489	1.027	1.005	0.082	0.202***	(9.70)
Probability of default	0.004	0.003	0.005	0.004	0.003	0.004	0.005	0.003	0.006	−0.001**	(−2.59)
Bank Characteristics variables											
Total assets ($bn)	240.06	25.48	477.02	12.936	6.315	16.133	593.100	331.760	613.470	−604.398***	(−27.69)
Growth in assets	0.135	0.036	1.856	0.088	0.043	0.326	0.208	0.018	2.939	−0.122	(−1.20)
Leverage	0.079	0.069	0.043	0.097	0.088	0.044	0.052	0.048	0.019	0.0453***	(19.10)
Asset diversity	0.523	0.506	0.094	0.551	0.537	0.097	0.479	0.468	0.068	0.0726***	(14.73)
Loans-to-total assets	0.593	0.624	0.173	0.648	0.677	0.159	0.507	0.530	0.160	0.142***	(15.90)
Market share	0.076	0.013	0.116	0.013	0.002	0.034	0.173	0.161	0.131	−0.159***	(−34.43)
Multination bank	0.314	0.000	0.464	0.073	0.000	0.260	0.725	1.000	0.447	−0.652***	(−34.52)
Country regulation variables											
Regulation restrictions	2.363	2.400	1.008	2.344	2.400	1.055	2.391	2.400	0.931	−0.0519	(−0.93)
Financial freedom	70.508	70.000	14.477	70.754	70.000	15.189	70.126	70.000	13.301	−0.709	(0.88)

The table reports descriptive statistics of the variables used in our analyses. The last two columns report the differences in mean and relative p-values from *t*-test between large banks (total assets greater than $72bn) and small banks (total assets less than $72bn).

In terms of bank valuation measures, both the average and median of Tobin's Q during our sample period is higher than one, suggesting that European banks are valued at a premium by financial markets. However, our average measures are higher than the average Tobin's Q of previous studies on the US banking sector (Huizinga and Laeven 2012; Minton et al., 2019). Overall, large banks seem to be valued less on average compared with small banks and demonstrate a slightly higher probability of default.

From Table 2, we can observe significant heterogeneity in all bank characteristic variables within the full sample and between small and large banks, except in the variable *Growth in assets*. In terms of *Leverage*, small banks demonstrate a higher value compared with large banks. Regarding the bank business model, small banks are found to have a significantly lower degree of diversification in terms of asset composition and their asset orientation approached a higher composition of *Loans-to-total assets* than large banks. In terms of *Market share*, as expected, large banks have a higher market share within their home country compared with small banks (17% and 1.3%, respectively). No significant difference is found for the country regulation variables.

3.3. The evolution of bank franchise value, probability of default, and managerial ability

It is widely recognized that the franchise value of banks after crises is much lower and that large banks are valued less than small banks (for US banks, see Minton et al., 2019; Calomiris and Nissim 2014; Sarin and Summers 2016). Fig. 1 presents the yearly average Tobin's Q for European banks as a whole sample and splits it into small and large banks. We find that, since 2006, the average Tobin's Q has declined from an average of more than 1.6 pre-crises to approximately 1.05 in 2009 and 1.00 by the end of 2016, recovering slowly between 2013 and 2015. The Tobin's Q values did not improve much from 2009 to 2013 despite small value improvements. The cross-sectional variation in Tobin's Q for small and large banks has narrowed since the beginning of the crises, although small banks have shown higher values. Interestingly, Fig. 1 shows that the Tobin's Q for small banks sharply increase from 2001 to 2006 and then fall during the crisis. In contrast, large banks have observed a steady decrease since 2007 to a level close to one. Although the magnitude of the changes in Tobin's Q is different, the patterns are equal. Our findings suggest small banks are valued more than large banks.

Fig. 2 shows the yearly average probability of default for European banks as a whole sample and is split into small and large banks. We find four spikes, with the highest in 2008 and 2011. Since 2007, we can observe that the average probability of default has increased from an average of approximately 0.2% pre-crises to approximately 0.7% in 2008 and 2011. Furthermore, small banks have observed a lower level of probability of default compared with large banks, except for the years 2000–2001 and from 2012 to 2015.

Fig. 3 shows the yearly average managerial ability for European banks as a whole sample and is split into small and large banks. For the whole sample, we observe an increase since 2005 up to the 2009 financial crisis, and then an increase from the 2011 to 2012. Interestingly, the evolution of managerial ability for small and large banks has observed different

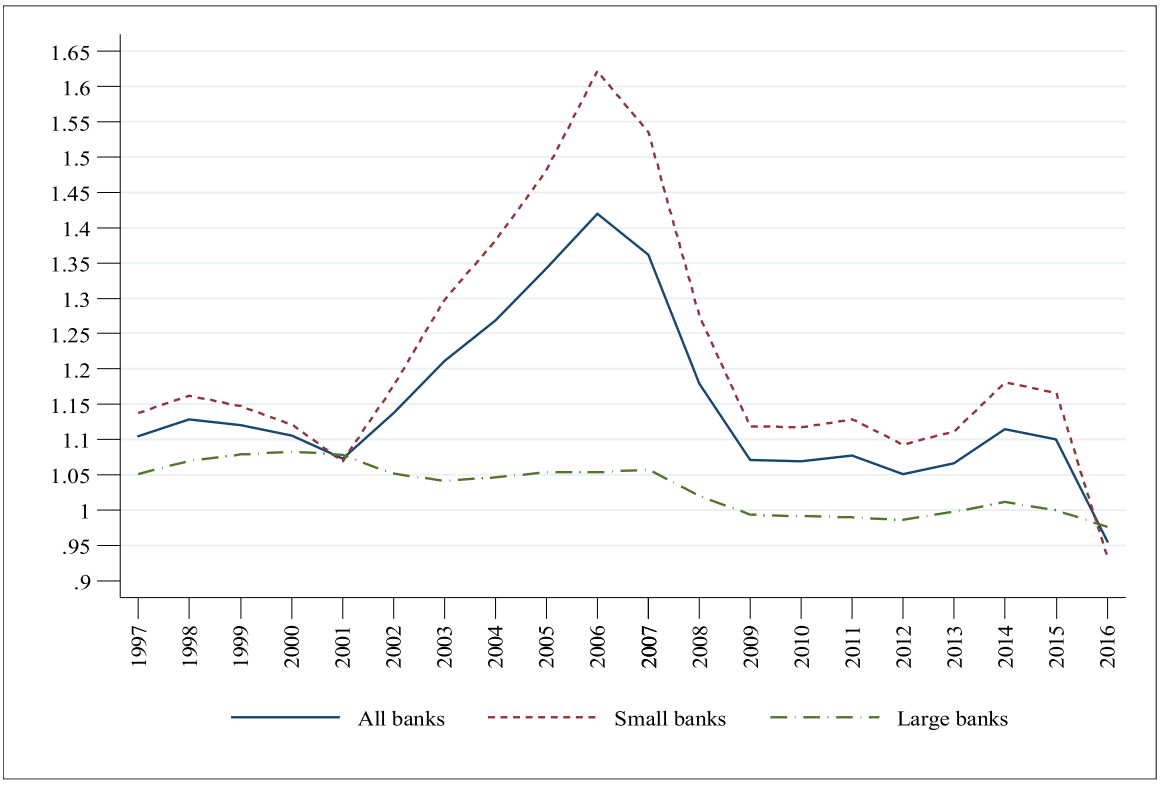

Fig. 1. Evolution of Tobin's Q.
The figure presents the yearly average Tobin's Q for the full sample of banks and for small banks (total assets less than $72 billion) and large banks (total assets greater than $72 billion).

patterns over the entire period. Small banks have continually exhibited a higher level, except for the years 2000, 2009, and 2015–2016 -years when they show the lowest level of Tobin's Q. Large banks have seen two clear patterns of increasing in managerial ability: the first from 2005 to 2009 and the second since 2011.

To assess how managerial ability is related to Tobin's Q and probability of default, we use a battery of regressions. Estimates of our baseline model for the full sample in combination with our further analysis based on splitting the sample into small and large banks as well as into sub-periods are reported in Section 4. In Section 5, we consider additional robustness checks.

4. Empirical results

Before providing an overview of estimates from Eqs. (1) to (3), we first consider the correlation between the dependent and explanatory variables of our multivariate models, which are used to identify possible collinearity issues and to accurately select the explanatory variables to be included in the analysis. Table 3 presents Pearson pairwise sample correlations with the statistically significant coefficient at 5% (presented in bold). This suggests managerial ability has a positive and statistically significant correlation with cost efficiency (0.778), Tobin's Q (0.168) and asset diversity (0.054). The sample correlation between managerial ability and total assets (−0.085) is negative, as it also is with probability of default (−0.097). Banks with higher managerial ability tend to be more cost-efficient, more highly valued and more focus in their business models, while banks with lower managerial ability tend to be larger in total assets with a higher probability of default. Among the controlling variables, market share and multinational bank status demonstrate a strong positive correlation with total assets. Moreover, regulatory restrictions seem to be strongly correlated with financial freedom. For this reason, we exclude the variables market share, multinational bank, and financial freedom from the multivariate analysis.

After the estimation of bank cost efficiency, the first step of our research design is to derive the managerial ability metric from Eq. (1) using the explanatory variables previously selected. Table 4 reports results of the estimation of cost efficiency used to obtain managerial ability: Panel A illustrates the results when the bank business model is proxied by the asset-based Herfindahl-Hirschman Index (*Asset diversity* variable), and Panel B includes the results using in place the loans-to-total assets ratio (*Loans-to-total asset* variable).[13] We find that cost efficiency is driven by several bank-specific characteristics and

[13] We use both asset diversity and loans-to-total assets as a first exercise in the check for robustness.

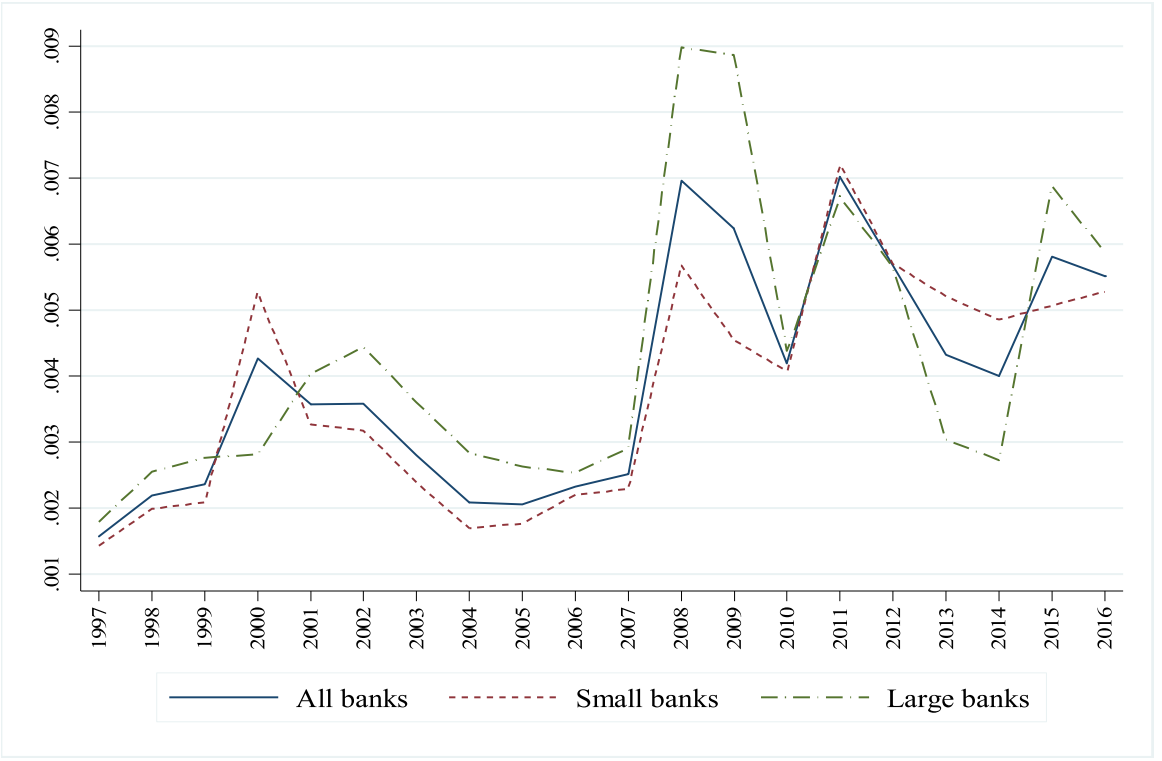

Fig. 2. Evolution of probability of default.
The figure presents the yearly average Probability of default for the full sample of banks and for small banks (total assets less than $72 billion) and large banks (total assets greater than $72 billion).

Fig. 3. Evolution of managerial ability.
The figure presents the yearly average managerial ability for the full sample of banks and for small banks (total assets less than $72 billion) and large banks (total assets greater than $72 billion).

Table 3
Correlations for the main variables.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Ln(total assets)	1.000												
(2) Growth in assets	0.007	1.000											
(3) Tobin's Q	**−0.455***	−0.001	1.000										
(4) Probability of default	0.033	0.018	**−0.168***	1.000									
(5) Cost efficiency	**0.255***	−0.024	**0.121***	**−0.157***	1.000								
(6) Managerial ability	**−0.085***	0.002	**0.168***	**−0.097***	**0.778***	1.000							
(7) Leverage	**−0.534***	−0.015	**0.261***	**−0.090***	**−0.184***	0.036	1.000						
(8) Asset diversity	**−0.284***	−0.026	**−0.098***	0.034	**−0.219***	**0.054***	**0.209***	1.000					
(9) Loans-to-total assets	**−0.383***	−0.028	0.036	−0.004	**−0.323***	−0.018	**0.173***	**0.471***	1.000				
(10) Market share	**0.651***	0.009	**−0.149***	**0.061***	**0.254***	0.012	**−0.382***	**−0.300***	**−0.299***	1.000			
(11) Multinational bank	**0.648***	−0.020	**−0.167***	0.011	**0.258***	**−0.090***	**−0.385***	**−0.364***	**−0.366***	**0.553***	1.000		
(12) Financial freedom	**−0.195***	0.035	**0.488***	0.008	**0.112***	−0.021	**0.079***	**−0.194***	0.010	0.003	−0.002	1.000	
(13) Regulation restrictions	**0.196***	−0.035	**−0.491***	−0.009	**−0.109***	0.023	**−0.080***	**0.197***	−0.008	−0.004	0.002	**−0.999***	1.000

The table presents pairwise correlations of dependent and explanatory variables. Correlation coefficient significant ≥5% are reported in bold.

Table 4
Determinants of bank cost efficiency.

Panel A: Asset diversity

	Full sample (1)	Small banks (2)	Large banks (3)	1997–2007 (4)	2008–2012 (5)	2013–2016 (6)
Ln(total assets)$_{t-1}$	0.033***	0.034***	0.141***	0.027***	0.027***	0.046***
	(0.004)	(0.006)	(0.012)	(0.007)	(0.007)	(0.009)
Leverage$_{t-1}$	0.182	0.868***	−1.482**	−0.242	0.284	0.455
	(0.187)	(0.195)	(0.596)	(0.334)	(0.262)	(0.425)
Asset diversity$_{t-1}$	−0.107	−0.219**	0.719***	−0.120	−0.199	0.086
	(0.079)	(0.091)	(0.129)	(0.108)	(0.128)	(0.200)
Growth in assets$_{t-1}$	0.023*	−0.021	0.129***	0.259***	−0.043	−0.017
	(0.013)	(0.062)	(0.030)	(0.072)	(0.029)	(0.161)
Regulatory restrictions$_{t-1}$	−0.018	0.024	0.022	−0.067***	0.070*	−0.017
	(0.028)	(0.015)	(0.017)	(0.021)	(0.042)	(0.064)
Constant	0.138	0.161	−3.248***	0.573***	0.154	−0.265
	(0.132)	(0.173)	(0.336)	(0.192)	(0.252)	(0.329)
Observations	1148	699	449	466	378	304
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year

Panel B: Loans-to-total assets

	Full sample (1)	Small banks (2)	Large banks (3)	1997–2007 (4)	2008–2012 (5)	2013–2016 (6)
Ln(total assets)$_{t-1}$	0.025***	0.038***	0.125***	0.027***	0.020***	0.025***
	(0.004)	(0.006)	(0.013)	(0.007)	(0.006)	(0.008)
Leverage$_{t-1}$	0.160	0.927***	−1.679***	−0.221	0.265	0.524
	(0.183)	(0.192)	(0.618)	(0.333)	(0.247)	(0.410)
Loans-to-total assets$_{t-1}$	−0.257***	−0.094*	0.005	−0.081	−0.275***	−0.435***
	(0.040)	(0.054)	(0.096)	(0.061)	(0.061)	(0.086)
Growth in assets$_{t-1}$	−0.023	−0.021	0.101***	0.245***	−0.040	−0.136
	(0.028)	(0.062)	(0.032)	(0.073)	(0.028)	(0.157)
Regulatory restrictions$_{t-1}$	0.019	0.021	0.020	−0.070***	0.069*	−0.028
	(0.012)	(0.015)	(0.017)	(0.021)	(0.041)	(0.062)
Constant	0.448***	0.029	−2.549***	0.579***	0.392*	0.565**
	(0.119)	(0.155)	(0.365)	(0.184)	(0.210)	(0.274)
Observations	1148	699	449	466	378	304
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year

The table reports estimates of Eq. (1). Cost efficiency score estimated through the nonparametric data envelopment analysis (DEA) approach is the dependent variable. Panel A presents estimates using asset diversity, while Panel B presents estimates results using loans-to-total assets as proxies of business model. Column 1 shows the baseline estimates for the full sample, while columns 2–3 differentiate between small and large banks. Columns 4–6 present results that split the period in pre-crises (1997–2007), crises (2008–2012), and post-crises (2013–2016) subperiods. All specifications include country-fixed and year-fixed effects, and control variables are lagged one year. Robust standard errors are shown in parentheses and adjusted for clustering at bank level.

* Significant at 10%,.
** significant at 5%.
*** significant at 1%.

Table 5
Managerial ability, franchise value, and probability of default (two-stage analysis).

	Asset diversity			Loans-to-total assets		
	First Stage	Second stage		First Stage	Second stage	
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(total assets)$_{t-1}$	0.018	−0.001	−0.001	0.006	−0.001	−0.001
	(0.018)	(0.000)	(0.000)	(0.014)	(0.000)	(0.000)
Leverage$_{t-1}$	1.837**	−0.005	−0.009	1.721**	−0.004	−0.008
	(0.749)	(0.008)	(0.008)	(0.759)	(0.007)	(0.008)
Asset Diversity$_{t-1}$	0.195	0.001	0.001			
	(0.278)	(0.003)	(0.003)			
Loans-to-total assets$_{t-1}$				−0.149	−0.002	−0.001
				(0.106)	(0.001)	(0.001)
Growth in assets$_{t-1}$	−0.173***	−0.000	0.000	−0.178***	−0.000	0.000
	(0.036)	(0.001)	(0.001)	(0.037)	(0.001)	(0.001)
Regulatory restrictions$_{t-1}$	−0.102***	−0.001***	−0.001**	−0.104***	−0.001***	−0.001***
	(0.023)	(0.000)	(0.000)	(0.022)	(0.000)	(0.000)
Managerial ability$_{t-1}$	0.394***		−0.003**	0.374***		−0.003*
	(0.080)		(0.001)	(0.084)		(0.001)
$\widehat{TQ_{t-1}}$		−0.011***	−0.008***		−0.012***	−0.009***
		(0.002)	(0.002)		(0.002)	(0.002)
Constant	0.711	0.018***	0.015**	1.187***	0.023***	0.020***
	(0.524)	(0.007)	(0.006)	(0.380)	(0.006)	(0.005)
Observations	1041	917	917	1041	917	917
R-squared	0.680	0.246	0.251	0.677	0.248	0.253
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year

The Table reports estimates of the two-stage analysis (Eqs. (2) and (3)). Tobin's Q is the dependent variable of the first equation while probability of default the dependent variable of the second equation. Control variables include the natural logarithm of assets, leverage, growth in assets, asset diversity, loans-to-assets, regulatory restrictions, and managerial ability. Columns 1–3 present results when asset diversity is included, while columns 4–6 present results when loans-to-total assets is included. Columns 1 and 4 report the first stage estimates, while columns 2–3 and 5–6 second stage estimates. All specifications include country-fixed and year-fixed effects, and control variables are lagged one year. Robust standard errors are shown in parentheses and adjusted for clustering at bank level.

* Significant at 10%.
** significant at 5%.
*** significant at 1%.

macroeconomic variables, which are not related to the driver of manager-specific efficiency. More specifically, bank size affects cost efficiency positively with respect to the independence of splitting (or not) the sample into small and large banks versus time periods. However, the importance of other characteristics is found to vary between bank size (leverage and business model) and along time (regulation). In this regard, for small banks, higher leverage is associated with higher cost efficiency, while the opposite is found for large banks. Furthermore, the higher the diversification, the higher the cost efficiency for small banks, while the opposite is found to be true for large banks. When we consider the business orientation, it is revealed the higher the loans-to-total asset ratio, the lower the cost efficiency, which means that lending activity, seems to be the more important source of cost inefficiency.[14] In terms of regulatory restrictions, it seems cost efficiency is negatively affected pre-financial crises while it is positively affected during the crises. These effects, however, vanish after 2012. In particular, growth of assets is found to only positively affect larger banks and the full sample when asset diversity was accounted for.

In Table 5, we present the results corresponding to the second step of our research design: the estimation results of Eq. (2) and 3. Our baseline model provides the estimation of both equations by using the full bank sample. The results when the asset diversity variable is used are reported in columns 1–3, while the results when the ratio of loans-to-total assets is used are reported in columns 4–6. We apply a two-stage least-squares model to analyze the influence of managerial ability on probability of default, where managerial ability is directly related to probability of default and indirectly to incorporating bank franchise value, which is proxied by Tobin's Q (depending on managerial ability). While this approach allows us to address the potential endogeneity of franchise value, it is also useful to give some insight into whether the disciplinary role of franchise value on risk-taking may be restrained by managerial ability.

[14] These results confirm that, on average, larger banks are more cost-efficient but, when the business model is mostly based on traditional lending activity, a higher level of inefficiency can be observed. Our results are consistent with findings that large banks benefit from higher efficiency due to several factors related to their size (e.g., lower cost of managing credit and liquidity risk; lower overhead costs, especially those associated with information technology; and lower cost of funding due to the Too-Big-To-Fail in the case of extraordinarily large banks), which outweigh the agency costs (for European bank, see Beccalli et al. (2015) and for US banks, see Wheelock and Wilson (2012); Hughes and Mester (2013); Davies and Tracey (2014)). Moreover, our results align with Beccalli et al. (2015), which show that higher cost efficiency benefits are realized by banks with an emphasis on investment-banking activity rather than predominantly commercial banking.

Following the methodological strategy, in the first step, the Tobin's Q is regressed depending on managerial ability and other bank-characteristic variables.[15] The results are similar for both measures of the bank business model (i.e., asset diversity and loans-to-total assets). In both columns (i.e., 1 and 4), it can be seen managerial ability is significantly and positively associated with Tobin's Q (0.394 and 0.374), confirming our expectation that intangible assets (measured by managerial ability) have a positive and highly significant effect on bank franchise value. This result is consistent with the thesis that Tobin's Q measures the value of intangible assets (e.g., Lindenberg and Ross 1981; Bond et al., 2000) and, in particular, that management ability (among other intangible assets) is a predictor of the future performance of a firm (Chemmanur et al., 2009). Given this, the results obtained regarding the high impact of managerial ability on Tobin's Q is economically important, reinforcing the idea that having able managers is likely an efficient way of increasing the franchise value premium. Additionally, the statistically significant impact of managerial ability with Tobin's Q could explain Calomiris and Nissim's (2014) appreciation that the projection of a bank's investment is a better indicator of financial fragility because the market value of a bank (franchise value) incorporates hidden assets. Overall, three implications may be extracted from these results: (i) managerial ability is a quantitative metric which incorporates information about manager actions which affect a bank's outcome; (ii) since managerial ability highly affects Tobin's Q, it is a good predictor of the future performance of a bank (i.e., a hidden assets); and (iii) based on the positive effects found, it seems managerial ability may cope with risk-taking incentives through franchise value.

Through support that the quantitative measure of managerial ability strongly affects Tobin's Q and given that franchise value plays a disciplinary role in risk-taking incentives, such findings verify, to some extent, the relevance of the next analysis which is performed in this study (i.e., investigating whether managerial ability not only contributes to risk-taking through the disciplinary role of franchise value on risk-taking incentives but also as a direct tool capable of *controlling* risk-taking—that is, bank probability of default). Table 5 (columns 2 and 5) shows the mitigating effect of franchise value on bank probability of default given the negative coefficient of the forecasted values of Tobin's Q from the first stage. The results are in line with previous empirical evidence on the disciplinary role of franchise value on risk-taking. For example, Demsetz et al. (1996) provide empirical evidence on the disciplinary role of franchise value. Interestingly in our case, managerial ability explains part of the disciplinary role of franchise value on risk-taking since managerial ability from the first step is found to decisively explain franchise value. Accordingly, since managerial ability enhances franchise value, and franchise value is known to play a disciplinary role in risk-taking incentives, it appears managerial ability contributes to risk-taking incentives. Therefore, since loss of the franchise value may act as a disciplinary device against risk-taking, the results suggest that franchise value may be regulated through managerial ability since high manager ability helps to exert higher franchise value.

The importance of managerial ability on franchise value and its indirect effect on bank risk-taking through franchise value lead us to analyze to what extent managerial ability can be considered a direct driver of bank risk-taking. Accordingly, when the managerial ability variable is introduced directly in Eq. (3) (columns 3 and 6), it demonstrates a significantly negative effect on the probability of default—specifically, the higher the managerial ability, the lower the probability of default. Combined, the results presented in Table 5 are consistent with managerial ability reducing probability of default, which builds on previous research documenting a positive association between managerial ability and financial stability (Andreou et al., 2016; Bonsall et al., 2016).[16] More specifically, managers with higher ability are more likely to deliver not only higher franchise value, but also lower bank probability of default. Interestingly, however, when the direct and indirect effects (through franchise value) of managerial ability on bank risk-taking are taken into account, the results show that the mitigating effect of franchise value on bank probability of default still hold but at a lower magnitude. Therefore, these results suggest that not only high managerial ability can be considered a tool to moderate bank risk-taking, but also that the disciplinary role of franchise value on risk-taking can be regulated through managerial ability. This supports the notion that intangible assets such as managerial ability represent valuable quantitative tools to be used in combination with qualitative tools by supervisors for effective management oversight.

As further analysis (presented in Table 6), we test the differential impact of managerial ability over different periods and whether during years of financial crises it plays a larger role. With these specifications, the results for the managerial ability coefficient consistently have a positive and statistically significant impact on Tobin's Q, with higher estimates during normal years (0.361 and 0.292 pre- and post-crises, respectively). In the second stage (directly or indirectly), managerial ability is found to affect probability of default across all periods: before and after the crises through franchise value while directly during the crises.

As presented in Table 7, we also test the differential impact of managerial ability in small and large banks. In this case, the results for the managerial ability coefficient consistently have a positive and statistically significant impact on Tobin's Q, with higher impacts for small banks. However, while for small banks managerial ability seems to be a tool to correct risk via the direct effect and through its disciplinary role embedded in franchise value, for large banks, manager ability does not seem to have a direct effect on risk-taking.

[15] Estimation results of Eq. (2) are presented in Table 5 (columns 1 and 4).

[16] Indirectly, our findings are consistent with results by Fiordelisi et al. (2011) and Fiordelisi and Mare (2013), where it was found a higher efficiency level in terms of cost minimisation caused higher probability of default.

Table 6
Managerial ability, franchise value, and probability of default (two-stage analysis) by subperiod.

Panel A: Asset diversity

	1997–2007		2008–2012		2013–2016	
	First stage (1)	Second stage (2)	First stage (3)	Second stage (4)	First stage (5)	Second stage (6)
Ln(total assets)$_{t-1}$	−0.016	0.001**	0.011	−0.000	0.047	0.001
	(0.011)	(0.000)	(0.016)	(0.000)	(0.032)	(0.001)
Leverage $_{t-1}$	2.650***	0.006*	0.931	−0.022	1.864	−0.025
	(0.525)	(0.003)	(0.675)	(0.013)	(1.254)	(0.030)
Asset diversity$_{t-1}$	−0.269	0.001	0.130	−0.002	0.590	0.007
	(0.171)	(0.001)	(0.274)	(0.005)	(0.703)	(0.012)
Growth in assets$_{t-1}$	0.004	0.001	−0.138***	0.002**	0.222	0.007
	(0.143)	(0.001)	(0.022)	(0.001)	(0.171)	(0.009)
Regulatory restrictions$_{t-1}$	−0.204***	−0.001	0.014	−0.004***	0.055	0.002
	(0.035)	(0.001)	(0.014)	(0.001)	(0.095)	(0.004)
Managerial ability$_{t-1}$	0.361***	−0.001	0.177**	−0.006**	0.292**	0.005
	(0.091)	(0.001)	(0.075)	(0.002)	(0.123)	(0.004)
$\widehat{TQ_{t-11}}$		−0.004***		−0.003		−0.029**
		(0.001)		(0.007)		(0.013)
Constant	1.886***	0.004*	0.608	0.025**	−0.690	0.016
	(0.313)	(0.002)	(0.547)	(0.012)	(1.335)	(0.017)
Observations	392	298	299	209	202	136
R-squared	0.783	0.426	0.667	0.478	0.694	0.416
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year

Panel B: Loans-to-total assets

	1997–2007		2008–2012		2013–2016	
	First stage	Second stage	First stage	Second stage	First stage	Second stage
Ln(total assets)$_{t-1}$	−0.025	0.000	0.003	−0.001	0.031	0.001
	(0.022)	(0.000)	(0.012)	(0.001)	(0.020)	(0.001)
Leverage $_{t-1}$	2.703***	0.006*	0.795	−0.020*	1.785	−0.022
	(0.949)	(0.003)	(0.632)	(0.012)	(1.216)	(0.030)
Loans-to-assets$_{t-1}$	−0.360*	−0.001	−0.090	−0.000	−0.033	0.001
	(0.181)	(0.001)	(0.093)	(0.002)	(0.109)	(0.004)
Growth in assets$_{t-1}$	−0.011	0.001	−0.140***	0.002**	0.199	0.008
	(0.364)	(0.001)	(0.026)	(0.001)	(0.167)	(0.009)
Regulatory restrictions$_{t-1}$	−0.212***	−0.000	0.012	−0.004***	0.062	0.001
	(0.047)	(0.000)	(0.013)	(0.001)	(0.084)	(0.004)
Managerial ability$_{t-1}$	0.360***	−0.000	0.158**	−0.006**	0.308**	0.006
	(0.112)	(0.001)	(0.077)	(0.002)	(0.154)	(0.005)
$\widehat{TQ_{t-1}}$		−0.004***		−0.003		−0.032**
		(0.001)		(0.007)		(0.014)
Constant	2.199***	0.007*	0.948***	0.023**	0.013	0.024*
	(0.569)	(0.004)	(0.347)	(0.011)	(0.702)	(0.014)
Observations	392	298	299	209	202	136
R-squared	0.789	0.424	0.665	0.480	0.683	0.416
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year

The table reports estimates of the two-stage analysis (Eqs. (2) and (3)). Tobin's Q is the dependent variable of the first equation while probability of default the dependent variable of the second equation. Control variables include the natural logarithm of assets, leverage, growth in assets, asset diversity, loans-to-assets, regulatory restrictions, and managerial ability. Panel A presents results using asset diversity, while Panel B presents results using loans-to-total assets. We present results for the three subperiods: pre-crises (columns 1–2), crises (columns 3–4), and post-crises (columns 5–6). Columns 1, 3, 5 show the first stage estimates, while columns 2, 4 and 6 show the second stage estimates. All specifications include country-fixed and year-fixed effects, and control variables are lagged one year. Robust standard errors are shown in parentheses and adjusted for clustering at bank level.

* Significant at 10%.
** significant at 5%.
*** significant at 1%.

5. Additional robustness analyses

5.1. Diversification and managerial ability

While there continues to be considerable debate regarding the value of diversification, there seems to be a consensus that managing a diversified firm is a difficult task. In banking, managing a more diversified bank is difficult, and it involves

Table 7
Managerial ability, franchise value, and default probability (two-stage analysis) for small and large banks.

	Small banks				Large banks			
	Asset diversity		Loans-to-total assets		Asset diversity		Loans-to-total assets	
	First Stage (1)	Second Stage (2)	First Stage (3)	Second Stage (4)	First Stage (5)	Second Stage (6)	First Stage (7)	Second Stage (8)
Ln(total assets)$_{t-1}$	0.045*	−0.001***	0.019	−0.001***	0.002	−0.000	−0.001	−0.000
	(0.026)	(0.000)	(0.023)	(0.000)	(0.006)	(0.000)	(0.006)	(0.000)
Leverage$_{t-1}$	3.065***	−0.024***	2.525**	−0.019**	0.455	−0.057*	0.517	−0.061*
	(0.944)	(0.008)	(1.009)	(0.008)	(0.300)	(0.030)	(0.331)	(0.031)
Asset Diversity$_{t-1}$	1.009**	0.001			−0.007	0.003		
	(0.381)	(0.003)			(0.052)	(0.002)		
Loans-to-assets$_{t-1}$			0.161	0.003			−0.037	0.003
			(0.245)	(0.002)			(0.033)	(0.003)
Growth in assets$_{t-1}$	−0.159	−0.004	−0.160	−0.004	−0.077***	−0.000	−0.079***	−0.000
	(0.292)	(0.004)	(0.265)	(0.004)	(0.006)	(0.002)	(0.006)	(0.002)
Regulatory restrictions$_{t-1}$	−0.207***	−0.000	−0.191***	−0.000*	−0.011**	−0.001	−0.012**	−0.001*
	(0.040)	(0.000)	(0.040)	(0.000)	(0.005)	(0.001)	(0.005)	(0.001)
Managerial Ability$_{t-1}$	0.566***	−0.004***	0.520***	−0.004***	0.055**	−0.004	0.047**	−0.003
	(0.107)	(0.001)	(0.097)	(0.001)	(0.022)	(0.003)	(0.020)	(0.003)
$\widehat{TQ_{t-1}}$		−0.004***		−0.005***		−0.044*		−0.049*
		(0.001)		(0.001)		(0.025)		(0.028)
Constant	−0.076	0.030***	0.881	0.030***	1.042***	0.062**	1.123***	0.063*
	(0.763)	(0.008)	(0.655)	(0.006)	(0.152)	(0.028)	(0.174)	(0.031)
Observations	617	530	617	530	412	365	412	365
R-squared	0.753	0.396	0.730	0.397	0.719	0.320	0.718	0.321
Fixed effects	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year	Country, Year

The table reports estimates of the two-stage analysis (Eqs. (2) and 3). Tobin's Q is the dependent variable of the first equation while probability of default the dependent variable of the second equation. Control variables include the natural logarithm of assets, leverage, growth in assets, asset diversity, loans-to-assets, regulatory restrictions, and managerial ability. Panel A presents results using asset diversity, while Panel B presents results using loans-to-total assets. We present results for small banks (columns 1–4) and large banks (columns 5–8). Columns 1, 3, 5, and 7 show the first stage estimates, while columns 2, 4, 6, and 8 the second stage estimates. All specifications include country-fixed and year-fixed effects, and control variables are lagged one year. Robust standard errors are shown in parentheses and adjusted for clustering at bank level.

* Significant at 10%.
** significant at 5%.
*** significant at 1%.

managing a diverse business of lines,[17] which requires deploying a broad variety of resources, realising potential synergies across business segments, and conducting more interactions with more regulators. Moreover, as diversification and size often go hand in hand, diversified banks are large banks, which operate internal capital markets through the reallocation of their capital between their headquarters and their different foreign affiliates. If the scope of the bank affects the challenge and complexity of the managerial task, as implied by the strategic management literature, we expect that managerial ability should vary with the extent of diversification. On the one hand, diversified banks are worth less than specialised banks (Laeven and Levine 2007) because diversification intensifies agency problems between corporate insiders and small shareholders; on the other hand, it may indeed reduce the probability of default of an individual bank. It follows that managerial ability in more diversified banks may affect Tobin's Q less, though diversified banks may require managers that are more able. In this section, we outline our control for the possible impact of managerial ability on bank Tobin's Q depending on the level of diversification (and business orientation), and whether these controls may alter our main results. More specifically, we assess whether banks may benefit more (or less) from their managerial ability depending on their diversification level and business orientation.

We construct three dummy variables by splitting the bank asset diversification distribution index into four quartiles. The most focused banks are used as a reference group (namely, banks with the asset diversification index in the range of 75–100% of the distribution). The other groups are classified as follows: Q1-Asset diversity is equal to one if the asset diversification index is lower than 25% of the distribution; Q2-Asset diversity is equal to one if the asset diversification index is in the range of 25–50% of the distribution; Q3-Asset diversity is equal to one if the asset diversification index is in the range of 50–75% of the distribution. Similarly, we build three dummy variables for the business orientation variables. The most focused banks on lending activity (namely, banks with the loans-to-assets variable in the range of 75–100% of the distribution) are used as a reference group. The results of this robustness check are presented in Table 8. Our results show

[17] Combining deposit-taking with loan-making activities, securities and insurance underwriting, venture capital, securities trading, asset management, securities brokerage, and M&A advising.

Table 8
Diversification and managerial ability.

	Asset diversity		Loans-to-total assets	
	First stage (1)	Second stage (2)	First stage (3)	Second stage (4)
Ln(total assets)$_{t-1}$	0.026	−0.000	0.016	−0.000
	(0.018)	(0.000)	(0.016)	(0.000)
Leverage$_{t-1}$	1.995***	−0.009	1.710**	−0.010
	(0.713)	(0.007)	(0.684)	(0.006)
Q3-Asset diversity $_{t-1}$	−0.023	−0.000		
	(0.052)	(0.000)		
Q2- Asset diversity $_{t-1}$	−0.114	−0.000		
	(0.072)	(0.001)		
Q1-Asset diversity $_{t-1}$	−0.090	−0.000		
	(0.073)	(0.001)		
Managerial ability $_{t-1}$	0.759***	−0.001	0.762***	−0.002
	(0.219)	(0.002)	(0.244)	(0.002)
Q3-Asset diversity* Managerial ability $_{t-1}$	−0.152	−0.002		
	(0.202)	(0.002)		
Q2-Asset diversity* Managerial ability $_{t-1}$	−0.559**	−0.002		
	(0.242)	(0.003)		
Q1-Asset diversity* Managerial ability $_{t-1}$	−0.668***	−0.002		
	(0.234)	(0.003)		
Q3-Loans-to-total assets $_{t-1}$			−0.029	−0.000
			(0.041)	(0.000)
Q2-Loans-to-total assets $_{t-1}$			−0.096	−0.000
			(0.064)	(0.001)
Q1-Loans-to-total assets $_{t-1}$			0.004	0.000
			(0.059)	(0.001)
Q3- Loans-to-total assets * Managerial ability $_{t-1}$			−0.019	−0.005
			(0.269)	(0.003)
Q2- Loans-to-total assets* Managerial ability $_{t-1}$			−0.699**	0.001
			(0.276)	(0.003)
Q1- Loans-to-total assets* Managerial ability $_{t-1}$			−0.649**	0.001
			(0.255)	(0.003)
Regulatory restrictions $_{t-1}$	−0.099***	−0.001**	−0.108***	−0.001**
	(0.022)	(0.000)	(0.022)	(0.000)
Growth in assets $_{t-1}$	−0.184***	0.000	−0.174***	0.000
	(0.039)	(0.001)	(0.038)	(0.001)
$\widehat{TQ_{t-1}}$		−0.008***		−0.007***
		(0.003)		(0.002)
Constant	0.671*	0.016***	0.905***	0.017***
	(0.359)	(0.005)	(0.339)	(0.004)
Observations	1041	917	1041	917
R-squared	0.697	0.256	0.698	0.266
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year

The table reports estimates of the two-stage analysis (Eqs. (2) and 3). Tobin's Q is the dependent variable of the first equation while probability of default the dependent variable of the second equation. Control variables include the natural logarithm of assets, leverage, growth in assets, asset diversity, loans-to-assets, regulatory restrictions, and managerial ability. Dummy variables associated to asset diversification and business orientation distributions are included. Columns (1–2) present results using asset diversity, while Columns (3–4) present results using loans-to-total assets .Columns (1–3) show the first stage estimates, while columns (2–3) the second stage estimates. All specifications include country-fixed and year-fixed effects, and control variables are lagged one year. Robust standard errors are shown in parentheses and adjusted for clustering at bank level.

* Significant at 10%.
** significant at 5%.
*** significant at 1%.

that the effect of managerial ability on market valuation is positive and statistically significant in both regressions (Table 8; columns 1 and 3). Interestingly, we find that the more diversified banks benefit less from managerial ability than do focused banks. Specifically, managerial ability impacts franchise value, where it decreases with increases in diversification. In terms of business orientation, banks more focused on non-traditional activities benefit less from managerial ability than do banks focused on lending activity.

5.2. Regulation and franchise value

Differences in bank regulation across countries may affect bank-risk taking incentives through the influence on franchise value. On the one hand, higher regulatory restrictions may limit activities which banks could engage in and induce them

Table 9
Bank regulation and managerial ability.

	Asset diversity		Loans-to-total assets	
	First stage (1)	Second stage (2)	First stage (3)	Second stage (4)
Ln(total assets)$_{t-1}$	0.018	−0.000	0.006	−0.000
	(0.018)	(0.000)	(0.014)	(0.000)
Leverage$_{t-1}$	1.837**	−0.009	1.721**	−0.009
	(0.749)	(0.009)	(0.759)	(0.008)
Asset diversity$_{t-1}$	0.195	0.001		
	(0.278)	(0.002)		
Loans-to-total assets $_{t-1}$			−0.149	−0.001
			(0.106)	(0.001)
Growth in assets$_{t-1}$	−0.173***	0.000	−0.178***	0.000
	(0.036)	(0.001)	(0.037)	(0.001)
Regulatory restrictions$_{t-1}$	−0.102***	−0.002	−0.104***	−0.001
	(0.023)	(0.001)	(0.022)	(0.001)
Managerial ability$_{t-1}$	0.394***	−0.003**	0.374***	−0.003*
	(0.080)	(0.001)	(0.084)	(0.001)
$\widehat{TQ_{t-1}}$		−0.009***		−0.010***
		(0.002)		(0.002)
$\widehat{TQ_{t-1}}$*Regulatory restrictions $_{t-1}$		0.001		0.000
		(0.001)		(0.001)
Constant	0.711	0.017**	1.187***	0.021***
	(0.524)	(0.007)	(0.380)	(0.006)
Observations	1041	917	1041	917
R-squared	0.680	0.251	0.677	0.253
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year

The table reports estimates of the two-stage analysis (Eqs. (2) and 3). Tobin's Q is the dependent variable of the first equation while probability of default the dependent variable of the second equation. Control variables include the natural logarithm of assets, leverage, growth in assets, asset diversity, loans-to-assets, regulatory restrictions, and managerial ability. Columns (1–2) present results using asset diversity, while columns (3–4) present results using the loans-to-total assets .Columns (1–3) show the first stage estimates, while columns (2–3) the second stage estimates. All specifications include country-fixed and year-fixed effects, and control variables are lagged one year. Robust standard errors are shown in parentheses and adjusted for clustering at bank level.

* Significant at 10%.
** significant at 5%.
*** significant at 1%.

to take more risk; on the other, relaxing restrictions may encourage bank risk-taking by increasing opportunities for bank diversification, thereby reducing risk-taking. The effect of regulation on risk-taking, however, could interact with the risk-shifting incentives created by franchise value. More specifically, the influence of the franchise value of banks on risk-taking may vary with the degree of regulation. Following Gonzalez (2005), in this section, we provide an outline of our control for the effect of regulatory restrictions on bank risk-taking and consider whether adding this component of risk-shifting may alter our main results. Therefore, in the second stage of our analysis, we incorporate the interaction term of the predicted value of Tobin's Q with regulatory restrictions to capture the potentially different influence of franchise value on banks in countries with stricter restrictions. The results of this robustness check are presented in Table 9. Our results reveal the effect of managerial ability on probability of default is negative and statistically significant for both regressions (Table 9; columns 1 and 3) and a differential in incentives towards a more prudential behaviour is found.

5.3. Funding strategies and probability of default

It is well-known that banks which rely on customer deposits are less risky compared with banks which primarily fund their activities through wholesale funding (e.g., Demirgüç-Kunt and Huizinga 2010). Accordingly, customer deposits are considered a more stable source of funding (Song and Thakor 2007; Shleifer and Vishny 2010), as this appears to be relatively more effective in reducing distress. We test the robustness of our main results by controlling for the mixture of funding. Towards this aim, we include both the *liability diversity* index and the ratio *deposits-to-total liabilities.* Following Curi et al. (2015), liability diversity was measured with the Herfindahl-Hirschman Index , where the higher the value of the index, the lower the diversification in liabilities. The funding index was measured as the ratio of deposits-to-total liabilities, where the higher the value of the index, the higher the bank specialization in deposit-taking. The results of this robustness check are presented in Table 10. Our results show that the effect of managerial ability on probability of default is negative and statistically significant in both regressions (Table 10; columns 1 and 3). Furthermore, we find that, while the higher the level

Table 10
Funding strategy and managerial ability.

	Asset Diversity		Loans-to-total assets	
	First stage (1)	Second stage (2)	First stage (3)	Second stage (4)
Ln(total assets)$_{t-1}$	0.020	−0.000	0.011	−0.000
	(0.017)	(0.000)	(0.013)	(0.000)
Leverage$_{t-1}$	1.842**	−0.011	1.603**	−0.008
	(0.745)	(0.008)	(0.753)	(0.007)
Asset diversity$_{t-1}$	0.181	0.002		
	(0.282)	(0.002)		
Loans-to-total assetst-1			−0.197*	−0.001
			(0.111)	(0.001)
Growth in assets$_{t-1}$	−0.174***	0.000	−0.180***	0.000
	(0.036)	(0.001)	(0.037)	(0.001)
Regulatory restrictions$_{t-1}$	−0.102***	−0.001**	−0.103***	−0.001***
	(0.023)	(0.000)	(0.021)	(0.000)
Managerial ability$_{t-1}$	0.393***	−0.003**	0.373***	−0.003*
	(0.080)	(0.001)	(0.082)	(0.001)
$\widehat{TQ_{t-1}}$		−0.007***		−0.009***
		(0.002)		(0.002)
Liability diversity$_{t-1}$	0.048	−0.003**		
	(0.061)	(0.001)		
Deposits-to-total liabilities $_{t-1}$			0.161**	−0.000
			(0.070)	(0.002)
Constant	0.649	0.019***	0.969***	0.020***
	(0.510)	(0.007)	(0.334)	(0.006)
Observations	1041	917	1041	917
R-squared	0.680	0.258	0.680	0.254
Fixed Effects	Country, Year	Country, Year	Country, Year	Country, Year

The table reports estimates of the two-stage analysis (Eqs. (2) and 3). Tobin's Q is the dependent variable of the first equation while default probability the dependent variable of the second equation. Control variables include the natural logarithm of assets, leverage, growth in assets, asset diversity, loans-to-assets, regulatory restrictions, and managerial ability. We also include liability diversity and the ratio deposits-to-total liabilities. Columns (1–2) present results using asset diversity, while columns (3–4) present results using the ratio loans-to-total assets .Columns (1–3) show the first stage estimates, while columns (2–3) the second stage estimates. All specifications include country-fixed and year-fixed effects, and control variables are lagged one year. Robust standard errors are shown in parentheses and adjusted for clustering at bank level.

* Significant at 10%.
** significant at 5%.
*** significant at 1%.

of diversification in liabilities reduces the probability of default, the deposits-to-total liabilities index seems not to affect the probability of default but it does on the franchise value.

6. Conclusions

After the financial crisis, the ECB assumed supervisory duties by conducting a supervisory process covering all prudential instruments considered by laws at a national level. Two important factors highlight this new framework for the supervisory process: (i) the supervisory assessment of banks is based on the banks' balance sheets only, particularly on the asset quality and their resilience to shocks; and (ii) the supervisory evaluation process was developed around four main elements (i.e., business model, capital requirements, governance control and liquidity risk). However, there exist conclusive results revealing the value of intangible assets was neglected in the evaluation of financial fragility during the crisis by regulators and supervisors (Calomiris and Nissim 2014), suggesting that market value (rather than accounting value) provides greater insight into potential drivers of banks system stability.

The motivation for this study was twofold: (i) to measure a specific intangible asset, managerial ability; and (ii) to analyse its effect on bank risk-taking—specifically, to analyse whether manager ability is a driver of bank risk-taking and to what extent it may adjust the disciplinary role of franchise value on bank risk-taking. In our study, we attempt to fill a gap in the literature regarding the drivers of bank risk-taking and the mechanism available to supervisors and regulators to maintain stability using market value.

To address our goal, we adopt the new approach developed by Demerjian et al. (2012) to measure managerial ability in non-financial firms and we adjust it to the case of banks. Specifically, we develop a metric of managerial ability considering the most important challenge for a bank (i.e., cost efficiency). Cost efficiency is one source of a more general objective for banks. Based on the notion that actions taken by management, such as choices regarding funding sources, wholesale versus retail orientation, diversified versus specialised models, directly affect the value of intangible assets, managerial ability can be viewed as an intangible asset. We analyse the impact of this intangible asset on bank franchise value. The use of a market-based performance measure (franchise value) and not a bank accounting outcome measures (profits from bank

income statements), enables us to analyse the disciplinary role of bank performance on risk-taking behaviour using the long-term concept of bank rent, which captures expectations for future growth and how managerial ability affects this relationship.

Finally, we evaluate the direct effect of managerial ability on bank risk-taking and the effect of managerial ability on banks' risk-taking incentives through their franchise value. The direct effect allows for exploration of managerial ability as a tool for moderating risk-taking, while the indirect effect through the franchise value permits insight into whether the disciplinary role of franchise value on risk-taking may be regulated through managerial ability.

Our results show that managerial ability is significantly positively associated with franchise value. Therefore, it seems that market-based performance metrics reflect the value of managerial ability and its positive contribution. Our findings also support previous empirical results on the disciplinary role of bank value and risk-taking decisions, namely the reality that loss of franchise value may act as a disciplinary device against risk-taking. However, we further provide evidence that the disciplinary role of franchise value on bank risk-taking should be regulated through managerial ability. Moreover, by investigating the direct effect of managerial ability on bank risk-taking, the results show that managerial ability has a significant negative effect on probability of default. Interestedly, when the direct and indirect effect through the franchise value of managerial ability on bank risk-taking are taken into account, the results illustrate that the mitigating effect of franchise value on bank probability of default still hold. Results hold when different control variables are introduced into the estimation, providing a check of robustness.

The current study presents a measurement of managerial ability, which regarding the proposition of prudential regulation, can be considered a driver of risk-taking, and contributes to the disciplinary role on risk-taking incentives exerted by franchise value. Overall, the study develop a quantitative tool that could complement the current qualitative tool in the supervision and assessment of banks' board members.

We are aware the measure of managerial ability contains limitations. Managerial ability generated by a cost-minimisation perspective is unable to capture some other management characteristics. For example, it does not measure how management can exploit revenue-generating capacity from diversification and relationship-specific advantages of more specialised banks. However, the minimisation of costs can be seen as a necessary condition management has to pursue for survival under high competition, particularly in a low-interest-rate environment, which means additional challenges for banks. Despite these limitations, our measure of managerial ability exhibits an economically significant manager-specific component which plays a role in the stability of the banking sector.

Future research may consider questions such as whether better managers execute higher-quality bank restructuring (M&As, divestiture, spin-offs) or manage government subsidies, from loan guarantees to direct injection of public funds into banks (in a superior or way); whether they can gauge their ability; and, also, whether the board of directors and the market accurately price managerial ability (through compensation and stock price). It may also be worthwhile investigating the main driver of bank managerial ability (e.g., education, experience, or social connections).

Overall, a better understanding of managerial ability in the banking sector extends our knowledge of the direct role of management towards the efficient allocation of resources and, indirectly, towards the financial stability of the sector.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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