Regulations, Market Power and Bank Efficiency in European Countries

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ABSTRACT

This paper investigates whether different types of regulation may have a direct or indirect (through market power) impact on bank's efficiency. We use a set of data containing European banks to consider the impact of regulations related to capital requirements, official supervisory power, restrictions on bank activities, and private monitoring on bank efficiency. Our results suggest that official supervisory power increase bank efficiency, activity restrictions and private monitoring reduce bank efficiency in general, but for banks with more market power these effects are all significantly positive. While stricter capital requirements in combination with more market power has a negative impact on bank efficiency. Our results also find a non-linear relationship between market power and bank efficiencies. Besides, the evidence of subsamples suggests that regulations will have different effect on bank efficiency in developed or developing countries.

Keywords: Regulations, Market Power, Efficiency, European Banks

JEL Classification: G21, G28

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1. Introduction

Banks are frequently very heavily regulated. Because of the importance of banks in the economy, because of the opacity of bank assets and activities, and because banks are a ready source of fiscal revenue, governments impose an elaborate array of regulations on banks (Levine, 2004). Over the last two decades prior to the credit crisis that started in late 2007, European banks have responded to the changing competitive environment by expanding through generated growth or merger and acquisition. Growth might enable banks to realize scale and scope economies, reduce labor and other costs, and reduce or eliminate operational inefficiencies (Goddard, Molyneux, Wilson and Tavakoli, 2007). The pro-competitive deregulation process has increased the level of competition (Cetorelli, 2004, Fiordelisi, Marques-Ibanez and Molyneux, 2011), particularly in non-traditional and non-interest bearing areas of banking activity (Goddard, Molyneux and Wilson, 2001). It was expected that increased competition would in turn foster efficiency by providing incentives to managers to cut costs in order to remain profitable (Casu and Girardone, 2006).

As a result of this process, research in banking regulations and their effect on bank's efficiency has long attracted both theoretical and empirical interest. (e.g., Barth, Caprio and Levine, 2004; 2006; 2008; Barth, Lin, Ma, Seade and Song, 2013; Chortareas, Girardone and Ventouri, 2012; Lozano-Vivas and Pasiouras, 2010 and Pasiouras, Tanna and Zopounidis, 2009). Most results of these literatures were found that strengthening official supervisory powers and private monitoring in terms of more financial transparency can improve the efficient operations of banks. Stricter capital requirements can improve bank efficiency but may reduce profit efficiency in some studies (Pasiouras et al., 2009; Lozano-Vivas and Pasiouras, 2010), while restrictions on bank activities have the opposite effect, reducing banks' efficiency in most literatures but may improving profit efficiency in some papers (Pasiouras et al., 2009; Lozano-Vivas and Pasiouras, 2010).

Besides, a growing literature analyzes how regulation affects the relationship between competition and stability, in particular, risk taking. From a theoretical perspective, Matutes and Vives (2000) and Cordella and Yeyati (2002) examine the impact of deposit insurance on bank competition and risk-taking incentives in a context where banks are subject to limit liability and their failure implies social cost. An alternative way to restore prudent behavior is to introduce capital requirements. Hellmann, Murdock, and Stiglitz (2000) and Repullo (2004) analyze the relationship between competition for deposit, risk taking, and capital requirement in a dynamic framework where banks choose privately their asset risk and compete for deposits. From an empirical perspective, Claessens and Laeven (2004) confirm that contestability determines effective competition especially by allowing foreign bank entry and reducing activity restrictions on banks. Berger, Klapper and Turk-Ariss (2009) take account of the endogeneity of market power, and find that activity restrictions have a negative impact on market power. Recently, Beck, De Jonghe and Schepens (2013) show that an increase in competition will have a larger impact on bank's fragility in countries with stricter activity restrictions.

Furthermore, market power is associated with higher levels of market concentration, it can limit financial deepening and the development of more efficient banking sectors (Rojas-Suarez, 2007). There are some general hypotheses that provide conflict predictions. According to the quiet life hypothesis, monopoly power allows managers a quiet life free from competition and therefore increased concentration should bring about a decrease in efficiency (Casu and Girardone, 2006; Turk-Ariss, 2010). However, based on the efficient structure hypothesis, more efficient firms have lower costs, which in turn lead to higher profits (Casu and Girardone, 2006). Under the traditional competition-fragility hypothesis, more bank competition erodes market power, decreases profit margins, and results in reduced franchise value that encourages bank risk taking (Berger et al., 2009). Existing evidence suggest that increased competition has forced banks to become more efficient (Casu and

Girardone, 2006), while Casu and Girardone (2009) and Turk-Ariss (2010) find that positive causation between bank market power and efficiency if market power enables banks to operate at lower costs, and their findings provide evidence against the quiet life hypothesis. Further, as banks gain market power, they also benefit from greater firm stability and reduced risk potential. Their result support the traditional view that increased competition may undermine bank stability. Williams (2012) examine the relationship between bank efficiency and market power to test the quiet life hypothesis for a sample of 419 Latin American commercial banks between 1985 and 2010 and his evidence suggest that bank restructuring has promoted competition at the expense of market power and yield efficiency gains at banks under conditions of monopolistic competition.

Yet, researchers have not examined empirically whether and how national regulations such as capital requirements, supervisory power, restriction on activities and private monitoring, interact with market power in bank's efficiency. This can have important policy implications as different types of regulation may have a direct or indirect (through market power) impact on bank's efficiency. In other words, the same regulations have different effects on bank's efficiency depending on the comparative market power of the banks. To our knowledge, this is a first study to extend our knowledge on the regulation, market power and efficiency nexus towards this direction and provide some important repercussions for the current regulatory reform debate.

We use information from the World Bank database on bank regulations and supervision (Barth et al., 2006; 2008) to construct indices are related to restrictions on banks' activities and the three pillars of Basel II, namely capital requirements (Pillar 1), official supervisory power (Pillar 2), private monitoring (Pillar 3) and restriction on activities. These indices are more informative than the dummy variables which were used by previously literatures (e.g., Keeley, 1990; Salas and Saurina, 2003) and allow us to consider a more balance measure that is of particular importance in a cross-country setting. In addition, we employ the Battese and

Coelli (1995) stochastic frontier approach (SFA) technique to obtain banks' efficiency scores. Bank efficiencies measure how well a bank is predicted to perform relative to other banks in a particular sample. We use SFA since that it is the most popular parametric method used to estimate cost functions, and it can distinguish between inefficiency and other stochastic shocks in the estimation of efficiency scores rather than data envelopment analysis (DEA) (Pasiouras et al., 2009). In this paper, we not only consider cost efficiency, a wider concept in most studies, and profit efficiency, combine both revenues and costs in the efficiency measurement but also include revenue efficiency as robustness test since banks' revenue is also important information. Finally, we use bank-level Lerner index as proxy for bank market power in line with recent studies (e.g., Berger et al., 2009; Turk-Ariss, 2010; Williams, 2012), and it is a better measurement based on the deviation between price and marginal costs, is preferred over nationwide proxies such as traditional concentration ratios or the Panzar and Rosse (PR, 1987) H-statistic (Turk-Ariss, 2010).

Our study adds to the literature in four ways. First, this is the first study that considers these regulatory indices to examine the relationship among regulations, market power, and efficiency. Second, we employ the operational efficiency that has been used comparatively more recently (e.g., Barth et al., 2013; Chortareas et al., 2012; Fiordelisi et al., 2011; Lozano-Vivas and Pasiouras, 2010; Pasiouras et al., 2009), different with other measures of bank performance such as stock returns or accounting ratios (e.g., Beltratti and Stulz, 2012). In addition, we mostly focus on cost efficiency and profit efficiency in line with previous studies (e.g., Pasiouras et al., 2009; Turk-Ariss, 2010), and also include a robustness check with revenue efficiency. Third, according to Turk-Ariss (2010) and Agoraki, Delis and Pasiouras (2011), that the competitive conditions and the regulatory efforts are different between developed countries and developing countries, we also split our full sample into developed and developing countries to compare the results. Finally, we also consider a potential non-linear relationship between market power and efficiency (e.g., Turk-Ariss,

2010).

The empirical results suggest that in general official supervisory power will increase bank efficiency, but activity restrictions and private monitoring will decrease bank efficiency, which are in line with the results of Barth et al., (2013) and Chortareas et al., (2012). However, the indirect effects through market power of the three regulations are all significantly positive. Surprisingly, capital requirements will reduce efficiency for banks with market power, which may result from more costs of excessive capital undertaken by banks if such rules do not truly reflect the banks' risk. We also find evidence of negative relationship between market power and bank efficiency, which is measured by cost efficiency; however, a positive relationship between each other when we using profit efficiency. These results are as the same as findings from Turk-Ariss (2010). After that, we provide a more detailed non-linear relationship between market power and efficiencies. The results show a negative coefficient with cost efficiency, indicating that the estimated function is a downward oriented or reverse parabola; while a positive coefficient with profit efficiency, indicating it is an upward oriented parabola. Finally, we show clearly differences between developed and developing countries, which are in line with the view of Turk-Ariss (2010) and Agoraki et al. (2011),that capital markets in developing countries are relatively underdeveloped, and banks represent the main providers of credit to the economy. Under such different institutional settings of countries banks will behave differently. Therefore, we suggest that regulations will have different effect on bank efficiency in different countries.

The rest of the paper is constructed as follows. Section 2 provides background discussions of the impact of different regulations on bank efficiency depending on market power of banks. Section 3 presents our measures of bank efficiency, market power, bank regulation and supervision, and market monitoring variables. It also discusses our data sources and provides summary statistics for our variables. Section 4 discusses the empirical results, and Section 5 concludes the paper.

2. The relevant literature discussion

In the following subsections, we discuss some theoretical and empirical studies that examine the impact of four types of bank regulation and the relationship with market power and efficiency.

2.1. Capital requirements

The capital requirement is intended to prevent banks from engaging in higher risk activities, requesting banks to serve capital as a buffer against losses. However, the stricter capital standards may increase the cost of raising bank capital, reduce total loans and substitute with alternative forms of assets, and then it finally influence the return on assets and efficiency (VanHoose, 2007). In addition, Blum (2008) considers that the optimal capital regulation may include a risk-independent leverage ratio restriction to induce banks to report their risks truthfully. But Fonseca and Gonzalez (2010) said that a forced reduction in leverage reduces a bank's expected returns and lead bank owners to undertake investments with higher return and higher risk. According to empirical literatures, the capital regulation can improve efficiency of banks (e.g., Pasiouras, 2008; Pasiouras et al., 2009; Fiordelisi et al., 2011; Chortareas et al., 2012; Barth et al., 2013), which could be explained by two reasons. First, higher capital requirements may reduce the probability of bankruptcy, improving the information availability, which in turn increase the efficient operation of banks. Second, higher capital requirements increase the cost of raising bank capital, but this may be offset by the fact that capital does not bear interest payments. However, Pasiouras et al. (2009) also find that capital requirements lead to lower profit efficiency, it may be due to the fact that banks substitute loans with less risky assets, the risk-return hypothesis suggests lower profit efficiency. Agoraki et al. (2011) provide evidence that capital requirements may increase insolvency risk when a bank has high market power. Therefore this regulation may have

different effects on efficiency depending on the bank market power.

2.2. Official supervisory power

The official supervisory process is intended not only to ensure that banks have adequate capital to support all the risks in their business, but to encourage banks to develop and use better risk management techniques in monitoring and managing their risks. Besides, powerful supervision can improve the corporate governance of banks, reduces corruption in bank lending, and then improves the efficiency of banks (Beck, Demirguc-Kunt and Levine, 2006; Pasiouras et al., 2009; Chortareas et al., 2012). The results of Chortareas et al. (2012) showed that strengthening official supervisory powers can improve the efficient operations of banks. Pasiouras (2008) and Pasiouras et al. (2009) indicate that both cost and profit efficiency were influenced positively by higher official supervisory power. Barth et al. (2013) find that strengthening official supervisory power is positively associated with bank efficiency only in countries with independent supervisory authorities. On the other hand, the results of Lozano-Vivas and Pasiouras (2010) show that granting broad powers to supervisors has a positive impact on cost inefficiency, and explain that powerful supervision may impede bank operations. Barth et al. (2008) suggests that official supervision will not improve bank stability and efficiency, where the efficiency is measured as net interest margin.

2.3. Restrictions on bank activities

The restrictions on bank activities can complement deposit insurance and capital requirements, limit banks to engage in some activities, and reduce the risk-taking of bank (e.g., Matutes and Vives, 2000). In the Claessens and Laeven (2004), the more restrictions on bank activities lead to less market competition, and the market power of banks would become larger. Yet, literatures suggest that restrictions on engaging in securities, insurance or real

estate activities will reduce the efficiency of bank operations without a corresponding benefit in terms of other measures of bank performance (Barth et al., 2004; 2013; Chortareas et al., 2012). According to the empirical studies, Barth et al. (2004) find a negative relationship between restrictions on bank activities and banking sector development and stability. Chortareas et al. (2012) and Barth et al. (2013) find evidence that tighter restrictions on bank activities are negatively associated with bank efficiency. Pasiouras et al. (2009) find that restrictions will lead to lower cost efficiency, indicating that more restrictions on bank activities violate the utilization of economies of scale and scope. But they also find that restrictions lead to higher profit efficiency, and explain that banks may trade-off cost inefficiencies associated with higher restrictions by acquiring greater expertise and specialization in specific market segments, and hence become more profit efficient. Pasiouras (2008) finds no significant association with technical efficiency. Although most of the empirical results show that regulatory restrictions will decrease the efficiency of banks, it may have different effects depending on the bank market power.

2.4. Private monitoring

The *private monitoring approach* suggests that requirements related to disclosure of accurate information to the public will allow private agents to overcome information and transaction costs and monitor banks more effectively (Pasiouras et al., 2009; Lozano-Vivas and Pasiouras, 2010). This regulation can also exert corporate governance over banks and boost their development and efficiency (Levine, 2004; 2005). However, the additional disclosures of information will produce direct costs of banks, such as additional time and effort to prepare formal disclosure documents and the costs of maintaining investor relations department (Duarte, Han, Harford and Young, 2008; Chortareas et al., 2012). The results of Barth et al. (2004) provide that private monitoring has a positive impact on banks'

performance. Beck et al. (2006) find that empowering private monitoring tends to lower the degree of corruption of bank officials, and exert a beneficial effect on the integrity of bank lending. Pasiouras et al. (2009) and Lozano-Vivas and Pasiouras (2010) indicate the market discipline mechanisms will increase both profit and cost efficiency. Barth et al. (2013) find that market-based monitoring of banks in terms of more financial transparency is positively associated with bank efficiency. However, Chortareas et al. (2012) find a negative relationship between private monitoring and efficiency, and explain that banks' effort to produce this information has clearly costs that count negatively in their efficiency assessment.

3. Methodology and Variable Selection

We run several cross-sectional regressions following the empirical model to investigate the relationship between bank efficiency, competition and regulation:

$$EFF_{i,k} = b_0 + b_1 L_{i,k} + b_2 S_{i,t} + b_3 L_{i,k} \times S_{i,t} + b_4 B_{i,k} + b_5 C_i + YEAR_t + \varepsilon_{i,k} \quad (1)$$

where i refers to country i, k indexes bank k, L is the market power for each bank k in country i, S is a vector of bank regulatory and supervisory indicators in country i, B is a vector of bank-specific characteristics for each bank k in country i, C is a vector of country-specific control variables in country i, YEAR is a yearly dummy variable and ε is the error term. The dependent variable EFF is the technical efficiency for each bank.

3.1. Bank efficiency

In this study, we estimate bank efficiency using the Battese and Coelli (1995) stochastic frontier approach (SFA) to generate efficiency scores for each bank in the sample countries. The stochastic frontier function assumes the existence of technical inefficiencies of firms involved in producing a particular output. Finally, the efficiency scores in our all cases will be

between 0 and 1, with values closer to 1 indicating a higher level of efficiency.

We estimate three models by using this approach, namely cost, profit and revenue efficiency. Following Lozano-Vivas and Pasiouras (2010), we assume that banks have three outputs, namely loans (Q1), other earning assets (Q2) and non-interest income (Q3) in all models. And we use three input prices consistent with most previous studies are: cost of borrowed funds (W1), calculated as the ratio of interest expenses to total deposits; cost of physical capital (W2a), calculated by dividing overhead expenses other than personnel expenses by the book value of fixed assets; and cost of labor (W3), calculated by dividing the personnel expenses by total assets. A time trend (T=1 for 2002, T=2 for 2003… T=7 for 2008) is included in models to allow for technological change, using both linear and quadratic (i.e. T and T^2) terms. Finally, we specify equity (E) to control for differences in risk preferences. And the last $u_{i,t}$ are the cost inefficiency components. The three efficiencies are estimated using the same translog functional model, by using total cost (TC_{it}), profits before taxes (PBT_{it}) and total revenue (TR_{it}) as the dependent variable in the function respectively. As in several recent studies (e.g., Pasiouras et al., 2009; Lozano-Vivas and Pasiouras, 2010), we use the multi-product translog specification, the cost function is given as:

$$\ln\frac{TC}{W3} = \beta_0 + \beta_1\ln(Q1) + \beta_2\ln(Q2) + \beta_3\ln(Q3) + \beta_4\ln\left(\frac{W1}{W3}\right) + \beta_5\ln\left(\frac{W2_a}{W3}\right)$$
$$+ \beta_6\frac{1}{2}(\ln(Q1))^2 + \beta_7\ln(Q1)\ln(Q2) + \beta_8\ln(Q1)\ln(Q3)$$
$$+ \beta_9\frac{1}{2}(\ln(Q2))^2 + \beta_{10}\ln(Q2)\ln(Q3) + \beta_{11}\frac{1}{2}(\ln(Q3))^2$$
$$+ \beta_{12}\frac{1}{2}\left(\ln\left(\frac{W1}{W3}\right)\right)^2 + \beta_{13}\ln\left(\frac{W1}{W3}\right)\ln\left(\frac{W2_a}{W3}\right) + \beta_{14}\frac{1}{2}\left(\ln\left(\frac{W2_a}{W3}\right)\right)^2$$
$$+ \beta_{15}\ln(Q1)\ln\left(\frac{W1}{W3}\right) + \beta_{16}\ln(Q1)\ln\left(\frac{W2_a}{W3}\right) + \beta_{17}\ln(Q2)\ln\left(\frac{W1}{W3}\right)$$
$$+ \beta_{18}\ln(Q2)\ln\left(\frac{W2_a}{W3}\right) + \beta_{19}\ln(Q3)\ln\left(\frac{W1}{W3}\right) + \beta_{20}\ln(Q3)\ln\left(\frac{W2_a}{W3}\right)$$
$$+ \beta_{21}T + \beta_{22}\frac{1}{2}T^2 + \beta_{23}\ln(Q1)\times T + \beta_{24}\ln(Q2)\times T + \beta_{25}\ln(Q3)\times T$$
$$+ \beta_{26}\ln\left(\frac{W1}{W3}\right)\times T + \beta_{27}\ln\left(\frac{W2_a}{W3}\right)\times \mathrm{T} + \beta_{28}\ln(EQUITY) + u_{i,t} + v_{i,t}. \quad (2)$$

3.2. Market power

For examining the impact of market structure in banking on efficiency, we use Lerner index as a proxy for market power (e.g., Berger et al., 2009; Turk-Ariss, 2010; Anzoategui, Peria and Melecky, 2012; Beck et al., 2013). The Lerner index represents the pricing power because it is a level indicator of the proportion by which price exceeds marginal cost, which lower values suggest increased competition and higher values increased market power, and is calculated as:

$$L = (P_{TA} - MC_{TA})/P_{TA} \quad (3)$$

where P_{TA} is the price of total assets is calculated as the ratio of total revenues to total assets, and MC_{TA} is the marginal cost of total assets, which is obtained by computing the first derivative from the following translog cost function:

$$\ln TC = \beta_0 + \beta_1 \ln Q + \frac{\beta_2}{2} \ln Q^2 + \sum_{k=1}^{3} \gamma_k \ln W_k + \sum_{k=1}^{3} \emptyset_k \ln Q \ln W_k + \sum_{k=1}^{3} \sum_{j=1}^{3} \ln W_k \ln W_j + \varepsilon \quad (4)$$

where bank cost (TC) are a function of output (Q for total assets), and W_k are three input prices. Respectively, W_1 is the price of funds, calculated as the ratio of interest expenses to total deposits; W_{2b} is the price of fixed capital, calculated as the ratio of other operating and administrative expenses to total assets; and W_3 is the price of labor, calculated as the ratio of personnel expenses to total assets, which the W_1 and W_3 are the same with the input prices of efficiency. Finally, the marginal cost (MC_{TA}) is computed as following function and the Lerner index can be constructed:

$$MC_{TA} = \frac{TC}{Q} [\beta_1 + \beta_2 \ln Q + \sum_{k=1}^{3} \emptyset_k \ln W_k] \quad (5)$$

3.3. Regulatory and control variables

We use the regulatory and supervisory S variables of Barth et al. (2006, 2008) with Versions II and III; the bank-specific B variables are drawn from Bankscope, and the country-specific C control variables are from the World Bank. These variables with the corresponding vectors defined as follows:

S = (*CAPRQ, SPOWER, RESTR, PRMON*) (6)

B = (*LNTA, LIQ, EQAS*) (7)

C = (*ZSCORE, FINDEV, VOICE, CORR, GDPGR, HHI, GOVERN, FOREIGN*) (8)

CAPRQ is an index of capital requirements that accounts for both initial and overall capital stringency. Initial capital stringency indicates whether the source of funds that count as regulatory capital can include assets other than cash or government securities and borrowed funds, as well as whether the regulatory or supervisory authorities verify these sources of capital. Overall capital stringency indicates whether risk elements and value losses are

considered while calculating the regulatory capital. The index can take values between 0 and 9, with higher values indicating more stringent capital requirements.

SPOWER is a measure of the power of the supervisory agencies indicating the extent to which they can take specific actions against bank management and directors, shareholders, and bank auditors. In this study, it ranges between 4 and 14 with higher value indicating greater power of supervisors for involvement in banking decisions.

RESTR is an indicator of restrictions on banks' activity. It is determined by considering whether securities, insurance, real estate activities, and ownership of non-financial firms are unrestricted, permitted, restricted, or prohibited. This index can range from 1 to 4, with higher values indicating greater restrictiveness.

PRMON is an indicator of private monitoring, and shows the degree to which banks are forced to disclose off-balance sheet items and risk management procedures to the public, and whether there are more incentives to increase private monitoring, with higher values indicating more private supervision.

The vector B includes three bank-specific variables: size, measured as the natural logarithm of banks' total assets (*LNTA*); liquidity, that is calculated by a ratio between total loans and total deposits (*LIQ*); and capitalization is proxied by the equity to assets ratio (*EQAS*). The vector of control variables C contains measures of risk, market structure and economic conditions, and institutional environment.

We include the *GDPGR*, is the real GDP growth rate, which is used to control for the macroeconomic environment as in Pasiouras et al. (2009) and Chortareas et al. (2012). The probability of risk of insolvency is proxied by the Z-score (*ZSCORE*), which measures how many standard deviations' profits must fall below its mean to bankruptcy, with higher values of the Z-score indicating lower probabilities of failure.

To control for institutional environment, we use the following variables: financial development (*FINDEV*); voice and accountability (*VOICE*) and control of corruption (*CORR*).

Financial development is measured by the claims on domestic real non-financial sector by deposit money banks as a share of GDP and attempts to capture the importance of the services provided by financial institutions relative to the size of the economy (Beck, Demirguc-Kunt and Levine, 2009). Voice and accountability is an indicator of the degree to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association and a free media (Kaufmann, Kraay and Mastruzzi, 2010). Control of corruption measures the extent to which public power is exercised for private gains, with larger values indicating better control of corruption by government officials (Kaufmann et al., 2010).

Following previous studies (Pasiouras et al., 2009; Chortareas et al., 2012), we account for national market structure of the banking sector, using the following measures: (i) the Herfindahl index (*HHI*), which is measured as the sum of squared market shares (in terms of total assets) of each bank in the sample; (ii) The government-owned banks (*GOVERN*) variable is used as proxy for the degree of state-owned banks. It is calculated as the percentage of banking system's assets in banks that are 50% or more government owned; and (iii) the foreign-owned banks (*FOREIGN*) are used to account for the percentage of banking system's assets in banks that are 50% or more foreign owned.

3.4. Data

All individual bank data used in constructing efficiency scores, Lerner index and bank-specification variables are taken from BankScope database. Data for regulatory indices (*CAPRQ, SPOWER, RESTR, PRMON*) and two market structure variables (*GOVERN, FOREIGN*) are obtained from the World Bank database on "Bank Regulation and Supervision" Versions II and III developed by Barth et al. (2006, 2008). In addition, data for the indicators of institutional environment (*ZSCORE, FINDEV*) are from the World Bank financial structure

database (Beck et al., 2009), and (*VOICE, CORR*) from the Worldwide Governance Indicators (Kaufmann et al., 2010), and the macroeconomic environment (*GDPGR*) is from World Bank database. We exclude: (i) banks with missing values for inputs or outputs, and (ii) banks from countries not included in the regulatory and other country-specific variables. Our final sample consists of 4,755 bank observations in the 31 European countries over the period 2002-2008[1]. Table 1 presents the descriptive statistics of the bank inputs and outputs used in the cost, revenue and profit functions of efficiency scores and Lerner index.

【Table 1 Insert Here】

Table 2 presents the descriptive statistics for the dependent and explanatory variables used in the regression analysis, and with no extreme vales in our variables. The full sample overall mean cost efficiency score equals 0.70, while that of profit efficiency is 0.54. Thus, the average bank could reduce its costs by 30%, and improve its profits by 46% to match its performance with the most efficient bank. Thus the results show that, on average, banks experienced much higher profit inefficiency than cost inefficiency, confirming the findings of previous studies (e.g. Pasiouras et al. 2009; Yildirim and Philippatos, 2007). We also checked the correlations among the bank regulation, supervision and other control variables and found that multicollinearity is not a series problem. Most of the correlation coefficients are below 0.3, which makes us comfortable with simultaneously including these variables in the estimated models.[2]

【Table 2 Insert Here】

[1] The dataset comprised of the following 31 countries within each country for which all of the necessary data were available to carry out our analysis: Austria (120), Belgium (46), Bulgaria (82), Croatia (140), Cyprus (61), the Czech Republic (57), Denmark (97), Estonia (64), Finland (49), France (403), Germany (158), Hungary (63), Iceland (64), Italy (1,228), Latvia (162), Lithuania (78), Luxembourg (41), Macedonia (9), Malta (53), , Moldova (20), Netherlands (104), Norway (70), Poland (86), Portugal (132), Romania (12), Slovakia (65), Slovenia (66), Spain (830), Sweden (35), Switzerland (52), and the United Kingdom (297).

[2] The correlation matrix for the variables is available from the authors upon request.

4. Empirical results

4.1 Main results

In this section, we investigate what impact of regulations and market power on bank efficiency separately and what effect of regulations channeled through market power. Table 3 and 4 presents the results of the different estimations of Eq. (1) using bank cost and profit efficiency as dependent variables, and in Table 5 we re-estimate same models focusing on revenue efficiency as a robustness check.

In the Tables 3–5, we first show the general results of regulatory variables in model (1). *CAPRQ* has a positive but not significant impact on bank efficiencies, and *SPOWER* has a positive and statistically significant impact on all efficiencies. *RESTR* and *PRMON* are both found a negative and statistically significant relationship with all efficiencies. Our results are consistent with most of literatures (e.g., Barth et al., 2013; Chortareas et al., 2012; Pasiouras, 2008; Pasiouras et al., 2009).

【Table 3–5 Insert Here】

Different with past studies, we include the interaction terms between bank market power and regulations in model (2) of Tables 3–5. We find that *CAPRQ* has a positive coefficient individually, but its interaction term *L*CAPRQ* enters with a negative and significant coefficient, which implies that capital requirements decrease the efficiency of banks with more market power, since that banks with market power may undertake more costs for applying the capital restrictions. This result contradicts to prior studies for the usefulness of capital requirements in reducing risk-taking of banks, but in line with the view of Agoraki et al. (2011) that capital requirements may increase insolvency risk when a bank has high market power. Our result also may be due to the fact that banks substitute loans with alternative forms of assets to meet stricter capital standards (VanHoose, 2007; Pasiouras et al., 2009;

Lozano-Vivas and Pasiouras, 2010). The coefficients of *L*SPOWER* are positive and statistically significant, and it could be explained that this regulation can ameliorate banks' operations without producing additional costs, so it will increase profit and efficiency regardless market power of banks. This result is also in line with the official supervisory direct effect, suggesting that powerful supervision can improve the corporate governance of banks, reduces corruption in bank lending, and then improves the efficiency of banks (Beck et al., 2006; Pasiouras et al., 2009; Chortareas et al., 2012).

*L*RESTR* has a statistically significant and positive impact on profit and revenue efficiency, which is different with the direct effect, implies that activity restrictions will increase the efficiency of banks with more market power. Probably because their business is widely diversified and abundant, and the proportion of the restricted asset income is small, thus there is less negative impact on efficiency. This is also consistent with the view that banks may trade-off inefficiencies associated with higher restrictions by acquiring greater expertise and specialization, and then become more profit efficient (Pasiouras et al., 2009). *L*PRMON* has a positive and statistically significant relationship with profit and revenue efficiency, which probably since that banks with large market power could exploit economies of scale to cut cost (e.g., Casu and Girardone, 2006), and this benefit may offset the increased costs of making disclosure. The results also support the *private monitoring approach*, that disclosure of accurate information to the public will allow private agents to overcome information and transactions costs, and monitor banks more effectively (Pasiouras et al., 2009; Lozano-Vivas and Pasiouras, 2010).

Tables 3–5 also show a significant negative relationship between Lerner index and cost efficiency, and a significant positive relationship between Lerner index and profit efficiency, which are in line with the results of Turk-Ariss (2010), said that the higher costs that are associated with more market power are eventually channeled to bank clients, which in turn feed into higher prices and possibly boost bank profit efficiency. Our findings also provide

evidence against the “quiet life” hypothesis. Following Berger et al. (2009) and Turk-Ariss (2010), we include a quadratic term for the Lerner index in model (3) to allow for a non-linear relationship between market power and bank efficiency. The results show negative coefficient with cost efficiency, indicating that the estimated function is a downward oriented or reverse parabola. Conversely, there is a positive coefficient with profit efficiency, indicating that it is an upward oriented parabola. Although the sign of coefficients with revenue efficiency is mixed, we also learn that there are linear and non-linear relationship between banks’ market power and its level of efficiencies.

Turning to the control variables in Tables 3–5, we find that log of total assets (*LNTA*) has a significant and negative relationship with profit and revenue efficiency, indicating that the more assets in banks will lead to lower efficiency. Liquidity (*LIQ*) and bank capitalization (*EQAS*) also have a negative and statistically significant relationship with all efficiencies, which suggest that if banks have lower deposits and higher equity will reduce all the efficiencies of banks. As expected, the probability of insolvency (*ZSCORE*) has a positive and significant relationship with efficiencies, which indicates that lower insolvency risk will make banks more efficient (Chortareas et al., 2012).

Concerning the institutional environment variables, the coefficients of financial development (*FINDEV*) are positive and significant for all efficiencies, implying that the improved information availability will make banks to monitor themselves easier, and thus boost banks’ efficiency (Pasiouras et al., 2009). The voice and accountability (*VOICE*) has a significantly positive relationship with profit efficiency, indicating that the more freedom of expressions and media will improve the profit of banks (Chortareas et al., 2012). Surprisingly, the control of corruption (*CORR*) has a negative and significant impact on all efficiencies, which imply that better control for officials’ corruption will achieve lower bank efficiency. The real GDP growth (*GDPGR*) has a positive and statistically significant impact on profit and revenue efficiency, which imply that banks in expanding markets will be more efficient

(Pasiouras et al., 2009).

Considering the effect of other environment variables, the coefficients of Herfindahl index (*HHI*) has a negative and significant relationship with cost and revenue efficiency, indicating that banks may reduce efficiency in more concentrated markets, which is in line with results of Chortareas et al. (2012). The government-owned banks (*GOVERN*) has a significantly negative impact on profit efficiency, which is consistent with the view of Pasiouras et al. (2009) that government ownership may result in financial repression with negative consequences for the economy. Finally, the foreign-owned banks (*FOREIGN*) has negative but not statistically significant impact on all efficiencies, implying that the more presence of foreign banks may limit domestic banks to operate efficiently. The results are in line with Lensink, Meesters and Naaborg (2008), which report that foreign ownership negatively impacts bank efficiency.

4.2 Robust checks: Instrumental Variables

In this section, we address a possible endogeneity problem that may be associated with our previous regressions. A potential endogeneity problem could exist insofar as the main results in Table 3-5 may be due to reverse causality. The regulatory framework may be endogenous to the structure of the banking system in each country. To address this concern, we use an Instrument Variable (IV) approach. Following previous studies (Barth et al., 2009; 2013; Beck et al., 2006), we select the instrumental variables based on the existing literature on law and finance literature (e.g., La Portal et al., 1999 and Beck et al., 2003). It is less likely that legal origin itself would have a direct impact on banking performance today. Instead, it may exert an indirect impact through the channels of various regulations. Based on the above discussion, we use legal origin (English, French), latitude as instrumental variables for the bank regulatory variables in that country.

【Table 6 Insert Here】

In Table 6, the coefficients of main regulatory variables, the capital requirement, supervisory power and supervisory independence, and market monitoring, are all statistically significant and their signs are the same as in the regressions in Table 3-5. Similar results also obtain for the control variables. Taken altogether, the results for our IV estimations imply that our findings are robust to potential endogeneity concerns.

4.3 Robust checks: developed and developing countries

In line with the view of Turk-Ariss (2010) and Agoraki et al. (2011),that capital markets in developing countries are relatively underdeveloped, and banks represent the main providers of credit to the economy. Under such different institutional settings of countries banks will behave differently. Therefore, we suggest that regulations will have different effect on bank efficiency in different countries.

【Table 7 Insert Here】

Table 7 presents the results of two subsamples from developed and developing countries. We find that the effects of regulations on all efficiencies in developed countries are statistically significant and consistent with our previous results. However, there are some different results in developing countries. *SPOWER* decrease all efficiencies significantly in developing countries, which may because that powerful supervision in developing countries may reflect excessive government involvement, which result in a decrease in the integrity of bank lending with adverse implications on the efficiency of credit allocation (Chortareas et al., 2012), or be more positively related to corruption and will not improve bank development, performance and stability (e.g., Barth et al., 2004). Different from previous results, in developing countries *RESTR* and *PRMON* increase all efficiencies, but *L*RESTR* decrease profit efficiency and *L*PRMON* decrease revenue efficiency. Although we don't know what cause the efficiencies in the developing countries, we also find evidence that regulations should have different effect on bank efficiency in different countries.

5. Conclusions

In this paper we analyze the relationship among regulations, market power, and bank efficiency. Using data from 4,755 bank observations in 31 European countries over the period 2002–2008, we compute proxies for the degree of market power and bank efficiency, and imply the indicators of regulatory and supervisory policies, namely capital requirements, official supervisory power, restrictions on bank activities, and private monitoring. Our results show that supervisory power has a direct and positive impact on bank efficiency, but activity restrictions and private monitoring have a direct and negative impact on bank efficiency (e.g., Chortareas et al., 2012). However, the impacts of above three regulations are all positive when the banks have sufficient market power. An important finding is that capital requirement has an indirectly negative impact on bank efficiency through market power. These results suggest that regulations may not only have direct effect on bank efficiency, but a consideration of the market power of banks is also required. Another important result is found that the effects of regulations on bank efficiency are different depending on whether in developed or developing countries, which implies that the regulations are not appropriate for all countries. In addition, an evidence of linear and non-linear relationship between market power and bank efficiency is also provided to against the “quiet life” hypothesis, which is consistent with Turk-Ariss (2010).

Overall, our paper provides a more disaggregate and detailed analysis of the impact of bank regulations on efficiency. Regulations may interfere with the efficient operation of banks, such as that leverage constraint will influence the decision of banks regarding their sources of funds and may reduce a bank’s expected returns. Our results suggest that policy makers must also consider the market power of banks and the conditions of countries into the formulation of bank regulations. Finally, the possible research in the future could be to provide international evidence of the same issue for other world regions.

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Table 1

Descriptive statistics on variables entering the cost, revenue and profit functions of efficiency and Lerner index. (Variables are in logarithmic format.)

Variable	TC	TR	PBT	Q	Q1	Q2	Q3	W1	W2a	W2b	W3	E
Mean	5.51	5.75	3.93	8.56	7.79	1.52	3.86	-3.30	0.08	-4.72	-4.66	6.00
Std. Dev.	2.32	2.29	2.33	2.36	2.59	2.80	2.49	0.76	1.14	0.90	0.89	2.12
Minimum	-1.61	-0.69	-2.30	2.03	-2.30	-2.30	-2.30	-5.75	-2.35	-9.38	-10.25	-0.22
Maximum	12.96	13.14	11.52	15.58	15.18	11.96	11.92	0.99	4.66	-0.86	-0.41	12.97
Median	5.49	5.75	3.92	8.49	7.89	0.00	3.91	-3.36	-0.12	-4.67	-4.53	5.95

Notes: TC = total cost, TR = total revenue, PBT = profit before taxes, Q = total assets, Q1 = loans, Q2 = other earning assets, Q3 = non-interest income, W1 = interest expenses/deposits and short term funding, W2a = non-personnel administrative expenses/fixed assets, W2b = non-personnel administrative expenses/total assets, W3 = personnel expenses/total assets, E = equity. All variables measured in € million.

Table 2

Summary statistics.

Variable	Obs	Mean	Std. Dev.	Minimum	Maximum	Median
Dependent variables						
TC_EFF	4,755	0.70	0.09	0.15	0.95	0.71
TR_EFF	4,755	0.73	0.08	0.20	0.95	0.74
PBT_EFF	4,560	0.54	0.17	0.00	0.92	0.56
Explanatory variables						
L	4,755	0.21	0.15	-2.28	0.81	0.22
CAPRQ	4,755	6.06	1.98	3.00	9.00	6.00
SPOWER	4,755	9.34	2.26	4.00	14.00	8.00
RESTR	4,755	6.85	1.89	3.00	11.00	7.00
PRMON	4,755	6.88	0.86	4.00	8.00	7.00
LNTA	4,755	8.49	2.36	2.48	15.58	8.42
LIQ	4,755	1.04	1.09	0.00	24.46	0.91
EQAS	4,755	9.55	6.60	0.88	61.49	8.20
ZSCORE	4,755	10.02	5.37	2.02	44.74	8.65
FINDEV	4,755	1.21	0.46	0.12	2.70	1.16
VOICE	4,755	1.15	0.28	-0.58	1.83	1.12
CORR	4,755	0.97	0.74	-0.99	2.56	0.99
GDPGR	4,755	2.98	2.29	-4.24	12.23	2.47
HHI	4,755	0.08	0.08	0.02	0.53	0.05
GOVERN	4,755	0.06	0.09	0.00	0.42	0.02
FOREIGN	4,755	0.28	0.28	0.00	0.99	0.11

Notes: TC_EFF , cost efficiency; TR_EFF, revenue efficiency; PBT_EFF, profit efficiency; L, Lerner index; CAPRQ, capital regulatory index; SPOWER, official supervisory power; RESTR, activity restrictions; PRMON, private monitoring;; LNTA, LN of total assets; LIQ, total loans/total deposits; EQAS, equity/total assets; ZSCORE, (ROA+EQAS)/St. Dev(ROA); FINDEV, deposit money bank assets/GDP; VOICE, voice and accountability; CORR, control of corruption; GDPGR, real GDP growth; HHI, Herfindahl index; GOVERN, government-owned banks; FOREIGN, foreign-owned banks. All financial variables measured in € million. Annual GDP growth is measured at 2000 market prices.

Table 3

Regulations, market power, and bank efficiency (using cost efficiency).

	Dependent variable: TC_EFF		
	(1)	(2)	(3)
Constant	0.887 (0.000) ***	0.911 (0.000) ***	0.919 (0.000) ***
L	-0.096 (0.000) ***	-0.213 (0.002) ***	-0.267 (0.000) ***
L^2			-0.018 (0.009) ***
CAPRQ	0.000 (0.712)	0.001 (0.292)	0.001 (0.396)
SPOWER	0.004 (0.000) ***	0.002 (0.056) *	0.002 (0.053) *
RESTR	-0.010 (0.000) ***	-0.010 (0.000) ***	-0.011 (0.000) ***
PRMON	-0.008 (0.000) ***	-0.009 (0.000) ***	-0.009 (0.000) ***
LNTA	0.000 (0.922)	0.000 (0.794)	0.000 (0.573)
LIQ	-0.032 (0.000) ***	-0.031 (0.000) ***	-0.031 (0.000) ***
EQAS	-0.006 (0.000) ***	-0.006 (0.000) ***	-0.006 (0.000) ***
ZSCORE	0.000 (0.035) **	0.000 (0.018) **	0.000 (0.018) **
FINDEV	0.014 (0.000) ***	0.014 (0.000) ***	0.014 (0.000) ***
VOICE	-0.003 (0.703)	-0.001 (0.904)	-0.001 (0.903)
CORR	-0.023 (0.000) ***	-0.024 (0.000) ***	-0.024 (0.000) ***
GDPGR	0.001 (0.277)	0.001 (0.154)	0.001 (0.120)
HHI	-0.053 (0.001) ***	-0.051 (0.001) ***	-0.050 (0.001) ***
GOVERN	0.005 (0.635)	0.001 (0.942)	-0.001 (0.944)
FOREIGN	-0.005 (0.407)	-0.007 (0.213)	-0.007 (0.190)
L*CAPRQ		-0.007 (0.079) *	-0.006 (0.136)
L*SPOWER		0.013 (0.000) ***	0.013 (0.000) ***
L*RESTR		0.003 (0.419)	0.005 (0.103)
L*PRMON		0.003 (0.766)	0.006 (0.488)
Observations	4,755	4,755	4,755
Adjusted R^2 (%)	49.93	50.16	50.22

Notes: L, Lerner index; L^2, (Lerner index)^2 ; CAPRQ, capital regulatory index; SPOWER, official supervisory power; RESTR, activity restrictions; PRMON, private monitoring;; LNTA, LN of total assets; LIQ, total loans/total deposits; EQAS, equity/total assets; ZSCORE, (ROA+EQAS)/St. Dev(ROA); FINDEV, deposit money bank assets/GDP; VOICE, voice and accountability; CORR, control of corruption; GDPGR, real GDP growth; HHI, Herfindahl index; GOVERN, government-owned banks; FOREIGN, foreign-owned banks; Constant, constant term. The table reports coefficients and p-values in parentheses, with *, **, *** representing significance at the 10%, 5%, and 1% levels respectively. All models include year dummy variables.

Table 4

Regulations, market power, and bank efficiency (using profit efficiency).

	Dependent variable: PBT_EFF		
	(1)	(2)	(3)
Constant	0.526 (0.000) ***	0.616 (0.000) ***	0.626 (0.000) ***
L	0.962 (0.000) ***	0.497 (0.006) ***	0.399 (0.028) **
L^2			0.191 (0.000) ***
CAPRQ	0.000 (0.866)	0.001 (0.652)	0.001 (0.758)
SPOWER	0.006 (0.000) ***	0.005 (0.035) **	0.005 (0.029) **
RESTR	-0.011 (0.000) ***	-0.018 (0.000) ***	-0.017 (0.000) ***
PRMON	-0.008 (0.013) **	-0.014 (0.007) ***	-0.015 (0.004) ***
LNTA	-0.006 (0.000) ***	-0.005 (0.000) ***	-0.006 (0.000) ***
LIQ	-0.022 (0.000) ***	-0.022 (0.000) ***	-0.022 (0.000) ***
EQAS	-0.010 (0.000) ***	-0.010 (0.000) ***	-0.010 (0.000) ***
ZSCORE	0.001 (0.098) *	0.001 (0.081) *	0.001 (0.085) *
FINDEV	0.016 (0.041) **	0.014 (0.073) *	0.014 (0.086) *
VOICE	0.051 (0.002) ***	0.052 (0.002) ***	0.053 (0.001) ***
CORR	-0.042 (0.000) ***	-0.042 (0.000) ***	-0.043 (0.000) ***
GDPGR	0.006 (0.000) ***	0.007 (0.000) ***	0.006 (0.000) ***
HHI	-0.023 (0.454)	-0.027 (0.384)	-0.028 (0.356)
GOVERN	-0.074 (0.001) ***	-0.079 (0.001) ***	-0.078 (0.001) ***
FOREIGN	-0.014 (0.216)	-0.016 (0.139)	-0.016 (0.154)
L*CAPRQ		-0.006 (0.520)	-0.005 (0.611)
L*SPOWER		0.009 (0.242)	0.008 (0.276)
L*RESTR		0.031 (0.001) ***	0.027 (0.005) ***
L*PRMON		0.031 (0.117)	0.037 (0.061) *
Observations	4,560	4,560	4,560
Adjusted R^2 (%)	49.20	49.31	49.46

Notes: L, Lerner index; L^2, (Lerner index)^2 ; CAPRQ, capital regulatory index; SPOWER, official supervisory power; RESTR, activity restrictions; PRMON, private monitoring;; LNTA, LN of total assets; LIQ, total loans/total deposits; EQAS, equity/total assets; ZSCORE, (ROA+EQAS)/St. Dev(ROA); FINDEV, deposit money bank assets/GDP; VOICE, voice and accountability; CORR, control of corruption; GDPGR, real GDP growth; HHI, Herfindahl index; GOVERN, government-owned banks; FOREIGN, foreign-owned banks; Constant, constant term. The table reports coefficients and p-values in parentheses, with *, **, *** representing significance at the 10%, 5%, and 1% levels respectively. All models include year dummy variable.

Table 5

Robustness check: Regulations, market power, and bank efficiency (using revenue efficiency).

	Dependent variable: TR_EFF		
	(1)	(2)	(3)
Constant	0.878 (0.000) ***	0.946 (0.000) ***	0.927 (0.000) ***
L	0.101 (0.000) ***	-0.254 (0.000) ***	-0.126 (0.069) *
L^2			0.043 (0.000) ***
CAPRQ	0.000 (0.908)	0.001 (0.292)	0.002 (0.118)
SPOWER	0.004 (0.000) ***	0.002 (0.051) *	0.002 (0.057) *
RESTR	-0.010 (0.000) ***	-0.014 (0.000) ***	-0.013 (0.000) ***
PRMON	-0.008 (0.000) ***	-0.011 (0.000) ***	-0.010 (0.000) ***
LNTA	-0.002 (0.000) ***	-0.002 (0.000) ***	-0.002 (0.000) ***
LIQ	-0.028 (0.000) ***	-0.028 (0.000) ***	-0.028 (0.000) ***
EQAS	-0.006 (0.000) ***	-0.006 (0.000) ***	-0.006 (0.000) ***
ZSCORE	0.000 (0.142)	0.000 (0.077) *	0.000 (0.079) *
FINDEV	0.013 (0.001) ***	0.012 (0.001) ***	0.012 (0.001) ***
VOICE	0.002 (0.829)	0.004 (0.625)	0.004 (0.622)
CORR	-0.022 (0.000) ***	-0.022 (0.000) ***	-0.022 (0.000) ***
GDPGR	0.001 (0.101)	0.001 (0.034) **	0.001 (0.070) *
HHI	-0.033 (0.024) **	-0.034 (0.021) **	-0.036 (0.013) **
GOVERN	0.016 (0.133)	0.012 (0.283)	0.015 (0.152)
FOREIGN	-0.003 (0.510)	-0.006 (0.228)	-0.006 (0.292)
L*CAPRQ		-0.005 (0.169)	-0.008 (0.044) **
L*SPOWER		0.013 (0.000) ***	0.012 (0.000) ***
L*RESTR		0.021 (0.000) ***	0.014 (0.000) ***
L*PRMON		0.019 (0.016) **	0.011 (0.162)
Observations	4,755	4,755	4,755
Adjusted R^2 (%)	45.27	46.10	46.57

Notes: L, Lerner index; L^2, (Lerner index)^2 ; CAPRQ, capital regulatory index; SPOWER, official supervisory power; RESTR, activity restrictions; PRMON, private monitoring;; LNTA, LN of total assets; LIQ, total loans/total deposits; EQAS, equity/total assets; ZSCORE, (ROA+EQAS)/St. Dev(ROA); FINDEV, deposit money bank assets/GDP; VOICE, voice and accountability; CORR, control of corruption; GDPGR, real GDP growth; HHI, Herfindahl index; GOVERN, government-owned banks; FOREIGN, foreign-owned banks; Constant, constant term. The table reports coefficients and p-values in parentheses, with *, **, *** representing significance at the 10%, 5%, and 1% levels respectively. All models include year dummy variable.

Table 6

Regulations, market power, and bank efficiency: Instrument variables regression results

Dependent Variables	(1) TC_EFF		(2) PBT_EFF		(3) TR_EFF	
Constant	0.882	(0.044) ***	0.437	(0.094) ***	0.894	(0.042) ***
L	-0.206	(0.075) ***	0.572	(0.193) ***	-0.070	(0.071)
L^2	-0.015	(0.007) **	0.175	(0.049) ***	0.044	(0.007) ***
CAPRQ	0.005	(0.003) **	0.012	(0.006) **	0.006	(0.002) **
SPOWER	0.001	(0.003)	0.007	(0.006)	0.002	(0.003)
RESTR	0.003	(0.004)	-0.020	(0.008) **	-0.003	(0.004)
PRMON	-0.013	(0.006) **	-0.005	(0.014)	-0.013	(0.006) **
LNTA	0.000	(0.001)	-0.005	(0.001) ***	-0.002	(0.000) ***
LIQ	-0.031	(0.001) ***	-0.021	(0.002) ***	-0.027	(0.001) ***
EQAS	-0.006	(0.000) ***	-0.009	(0.000) ***	-0.006	(0.000) ***
ZSCORE	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
FINDEV	-0.014	(0.007) **	0.052	(0.014) ***	-0.002	(0.006)
VOICE	-0.005	(0.014)	0.013	(0.029)	-0.006	(0.014)
CORR	-0.004	(0.011)	-0.016	(0.023)	-0.011	(0.011)
GDPGR	0.000	(0.001)	0.009	(0.001) ***	-0.001	(0.001)
HHI	-0.049	(0.027) *	0.095	(0.053) *	-0.031	(0.025)
GOVERN	-0.123	(0.073) *	0.063	(0.147)	-0.076	(0.070)
FOREIGN	-0.050	(0.055)	-0.097	(0.113)	-0.046	(0.053)
L*CAPRQ	-0.014	(0.004) ***	-0.016	(0.011)	-0.015	(0.004) ***
L*SPOWER	0.013	(0.003) ***	0.007	(0.008)	0.012	(0.003) ***
L*RESTR	0.001	(0.003)	0.014	(0.010)	0.010	(0.003) ***
L*PRMON	0.007	(0.009)	0.036	(0.021) *	0.013	(0.008)
Observations	4,755		4,755		4,755	
Adjusted R^2 (%)	51.45		50.14		48.12	

Notes: L, Lerner index; L^2, (Lerner index)^2 ; CAPRQ, capital regulatory index; SPOWER, official supervisory power; RESTR, activity restrictions; PRMON, private monitoring;; LNTA, LN of total assets; LIQ, total loans/total deposits; EQAS, equity/total assets; ZSCORE, (ROA+EQAS)/St. Dev(ROA); FINDEV, deposit money bank assets/GDP; VOICE, voice and accountability; CORR, control of corruption; GDPGR, real GDP growth; HHI, Herfindahl index; GOVERN, government-owned banks; FOREIGN, foreign-owned banks; Constant, constant term. The table reports coefficients and p-values in parentheses, with *, **, *** representing significance at the 10%, 5%, and 1% levels respectively. All models include year dummy variables.

Table 7

Robustness check: Regulations, market power, and bank efficiency in developed and developing countries.

	Developed countries			Developing countries		
	(4) TC_EFF	(5) PBT_EFF	(6) TR_EFF	(1) TC_EFF	(2) PBT_EFF	(3) TR_EFF
Constant	1.010 (0.000) ***	0.609 (0.000) ***	1.009 (0.000) ***	0.845 (0.000) ***	0.610 (0.021) **	0.823 (0.000) ***
L	-0.400 (0.000) ***	0.400 (0.055) *	-0.239 (0.004) ***	-0.110 (0.553)	0.966 (0.037) **	0.300 (0.063) *
L^2	-0.024 (0.002) ***	0.218 (0.000) ***	0.035 (0.000) ***	-0.001 (0.956)	0.255 (0.011) **	0.098 (0.000) ***
CAPRQ	0.001 (0.278)	-0.004 (0.148)	0.002 (0.095) *	-0.003 (0.492)	0.009 (0.447)	-0.002 (0.653)
SPOWER	0.001 (0.338)	0.007 (0.007) ***	0.001 (0.568)	-0.029 (0.002) ***	-0.042 (0.047) **	-0.026 (0.001) ***
RESTR	-0.012 (0.000) ***	-0.019 (0.000) ***	-0.014 (0.000) ***	0.030 (0.000) ***	0.050 (0.007) ***	0.028 (0.000) ***
PRMON	-0.013 (0.000) ***	-0.010 (0.087) *	-0.014 (0.000) ***	0.023 (0.050) *	0.021 (0.455)	0.024 (0.017) **
LNTA	-0.001 (0.261)	-0.006 (0.000) ***	-0.002 (0.000) ***	0.012 (0.000) ***	0.011 (0.004) ***	0.006 (0.000) ***
LIQ	-0.032 (0.000) ***	-0.021 (0.000) ***	-0.029 (0.000) ***	-0.030 (0.000) ***	-0.030 (0.000) ***	-0.027 (0.000) ***
EQAS	-0.006 (0.000) ***	-0.010 (0.000) ***	-0.006 (0.000) ***	-0.003 (0.000) ***	-0.007 (0.000) ***	-0.003 (0.000) ***
ZSCORE	0.000 (0.238)	0.001 (0.013) **	0.000 (0.333)	0.001 (0.450)	-0.006 (0.016) **	0.001 (0.488)
FINDEV	0.010 (0.020) **	0.010 (0.258)	0.009 (0.020) **	-0.013 (0.636)	-0.025 (0.706)	-0.001 (0.974)
VOICE	-0.028 (0.037) **	0.052 (0.055) *	-0.024 (0.056) *	-0.015 (0.578)	-0.074 (0.240)	-0.005 (0.827)
CORR	-0.018 (0.000) ***	-0.042 (0.000) ***	-0.016 (0.001) ***	-0.015 (0.522)	-0.027 (0.608)	-0.028 (0.175)
GDPGR	0.002 (0.030) **	0.004 (0.038) **	0.002 (0.049) **	0.001 (0.410)	0.012 (0.000) ***	0.001 (0.458)
HHI	-0.063 (0.002) ***	-0.011 (0.790)	-0.038 (0.051) *	0.001 (0.971)	0.029 (0.744)	-0.004 (0.908)
GOVERN	0.020 (0.100) *	-0.086 (0.001) ***	0.037 (0.002) ***	-0.590 (0.000) ***	-0.832 (0.023) **	-0.537 (0.000) ***
FOREIGN	-0.006 (0.340)	0.005 (0.660)	-0.002 (0.721)	-0.087 (0.008) ***	-0.131 (0.077) *	-0.074 (0.009) ***
L*CAPRQ	-0.010 (0.032) **	0.016 (0.155)	-0.012 (0.010) **	0.010 (0.274)	-0.066 (0.005) ***	0.001 (0.900)
L*SPOWER	0.015 (0.000) ***	-0.002 (0.781)	0.014 (0.000) ***	0.008 (0.384)	0.021 (0.361)	0.008 (0.319)
L*RESTR	0.007 (0.041) **	0.034 (0.001) ***	0.016 (0.000) ***	0.005 (0.695)	-0.052 (0.088) *	-0.001 (0.932)
L*PRMON	0.025 (0.020) **	0.024 (0.304)	0.026 (0.009) ***	-0.024 (0.272)	0.055 (0.337)	-0.043 (0.025) **
Observations	4,166	3,993	4,166	589	567	589
Adjusted R^2 (%)	50.71	46.16	45.78	58.28	67.97	64.58

Notes: L, Lerner index; L^2, (Lerner index)^2 ; CAPRQ, capital regulatory index; SPOWER, official supervisory power; RESTR, activity restrictions; PRMON, private monitoring;; LNTA, LN of total assets; LIQ, total loans/total deposits; EQAS, equity/total assets; ZSCORE, (ROA+EQAS)/St. Dev(ROA); FINDEV, deposit money bank assets/GDP; VOICE, voice and accountability; CORR, control of corruption; GDPGR, real GDP growth; HHI, Herfindahl index; GOVERN, government-owned banks; FOREIGN, foreign-owned banks; Constant, constant term. The table reports coefficients and p-values in parentheses, with *, **, *** representing significance at the 10%, 5%, and 1% levels respectively. All models include year dummy variable.

Table A.1

Variables description.

Variables	Symbol	Description
Dependent variables		
Cost efficiency	TC_EFF	Estimated using stochastic frontier approach[a]
Revenue efficiency	TR_EFF	Estimated using stochastic frontier approach[a]
Profit efficiency	PBT_EFF	Estimated using stochastic frontier approach[a]
Explanatory variables		
Lerner index	L	Indicator of bank market power, calculated as the proportion by bank price exceeds marginal costs
Capital regulatory index	CAPRQ	See Table A.2[b]
Official supervisory power	SPOWER	See Table A.2[b]
Restrictions on bank activity	RESTR	See Table A.2[b]
Private monitoring	PRMON	See Table A.2[b]
Size	LNTA	Natural logarithm of total assets[c]
Liquidity	LIQ	Total loans divided by total deposits[c]
Capitalization	EQAS	Shareholder's equity divided by total assets[c]
Z-score	ZSCORE	Risk of insolvency, measured by how many standard deviations' profits must fall below its mean to bankruptcy[d]
Financial development	FINDEV	Deposit money bank assets divided by GDP[d]
Voice and accountability	VOICE	Indicator of the degree to which a country's citizens are able to participate in selecting their government[e]
Control of corruption	CORR	Extent to which public power is exercised for private gains[e]
Real GDP growth rate	GDPGR	Annual growth rate of per capita GDP[f]
Herfindahl index	HHI	Local market concentration, measured by sum of squared market shares in terms of total assets
Government-owned banks	GOVERN	Percentage of banking system's assets in banks that are 50% or more government owned[b]
Foreign-owned banks	FOREIGN	Percentage of banking system's assets in banks that are 50% or more foreign owned[b]

[a] More detail for the estimation procedures are provided in Section 3.1.

[b] Source of data: World Bank (Barth et al., 2006, 2008).

[c] Source of data: Bankscope.

[d] Source of data: World Bank financial structure database (Beck et al., 2009).

[e] Source of data: Worldwide Governance Indicators (Kaufmann et al., 2010).

[f] Source of data: World Bank database.

Table A.2

Information on regulatory variables.

Variable	Category	Description
CAPRQ	Capital requirements	This variable takes values between 0 and 9, with higher values indicating greater stringency. It is determined by adding 1 if the answer is yes to questions 1–6 and 0 otherwise, while the opposite occurs in the case of questions 8 and 9 (i.e. yes=0, no =1), and 1 if question 7 < 0.75. (1) Is the minimum required capital asset ratio risk-weighted in line with Basle guidelines? (2) Does the ratio vary with market risk? (3–5) Before minimum capital adequacy is determined, which of the following are deducted from the book value of capital: (a) market value of loan losses not realized in accounting books? (b) unrealized losses in securities portfolios? (c) unrealized foreign exchange losses? (6) Are the sources of funds to be used as capital verified by the regulatory / supervisory authorities? (7) What fraction of revaluation gains is allowed as part of capital? (8) Can the initial or subsequent injections of capital be done with assets other than cash or government securities? (9) Can initial disbursement of capital be done with borrowed funds?
SPOWER	Official supervisory power	This variable takes values between 0 and 14, with higher values indicating higher power of the supervisory authorities. It is determined by adding 1 if the answer is yes and 0 otherwise, for each one of the following fourteen questions: (1) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (2) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (3) Can supervisors take legal action against external auditors for negligence? (4) Can the supervisory authorities force a bank to change its internal organizational structure? (5) Are off-balance sheet items disclosed to supervisors? (6) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (7) Can the supervisory agency suspend director's decision to distribute dividends? (8) Can the supervisory agency suspend director's decision to distribute bonuses? (9) Can the supervisory agency suspend director's decision to distribute management fees? (10) Can the supervisory agency supersede bank shareholder rights and declare bank insolvent? (11) Does banking law allow supervisory agency or any other government agency (other than court) to suspend some or all ownership rights of a problem bank? (12) Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency (other than court) supersede shareholder rights? (13) Regarding bank

		restructuring and reorganization, can supervisory agency or any other government agency (other than court) remove and replace management? (14) Regarding bank restructuring and reorganization, can supervisory agency or any other government agency (other than court) remove and replace directors?
RESTR	Restrictions on banks activities	The score for this variable is determined on the basis of the level of regulatory restrictiveness for bank participation in: (1) securities activities (2) insurance activities (3) real estate activities. These activities can be unrestricted, permitted, restricted or prohibited that are assigned the values of 1, 2, 3 or 4, respectively. We use an overall index by summing up the value over the three categories. Obviously, a higher value indicates greater restrictiveness.
PRMON	Private monitoring	This variable takes values between 0 and 9, with higher values indicating policies that promote private monitoring. It is determined by adding 1 if the answer is yes to questions 1-6 and 0 otherwise, while the opposite occurs in the case of questions 7 and 8 (i.e. yes=0, no=1), and 1 if question 9 equals 100%. (1) Is subordinated debt allowable (required) as part of capital? (2) Are financial institutions required to produce consolidated accounts covering all bank and any non-bank financial subsidiaries? (3) Are off-balance sheet items disclosed to public? (4) Are bank directors legally liable for erroneous / misleading information? (5) Must banks disclose their risk management procedures to public? (6) Is an external audit by licensed/certified auditor a compulsory obligation for banks? (7) Does accrued, though unpaid interest/principal enter the income statement while the loan is still non-performing? (8) Is there an explicit deposit insurance protection system? (9) What percent of the top ten banks are rated by international credit rating agencies?