Regulations, supervision and banks' cost and profit efficiency around the world: a stochastic frontier approach

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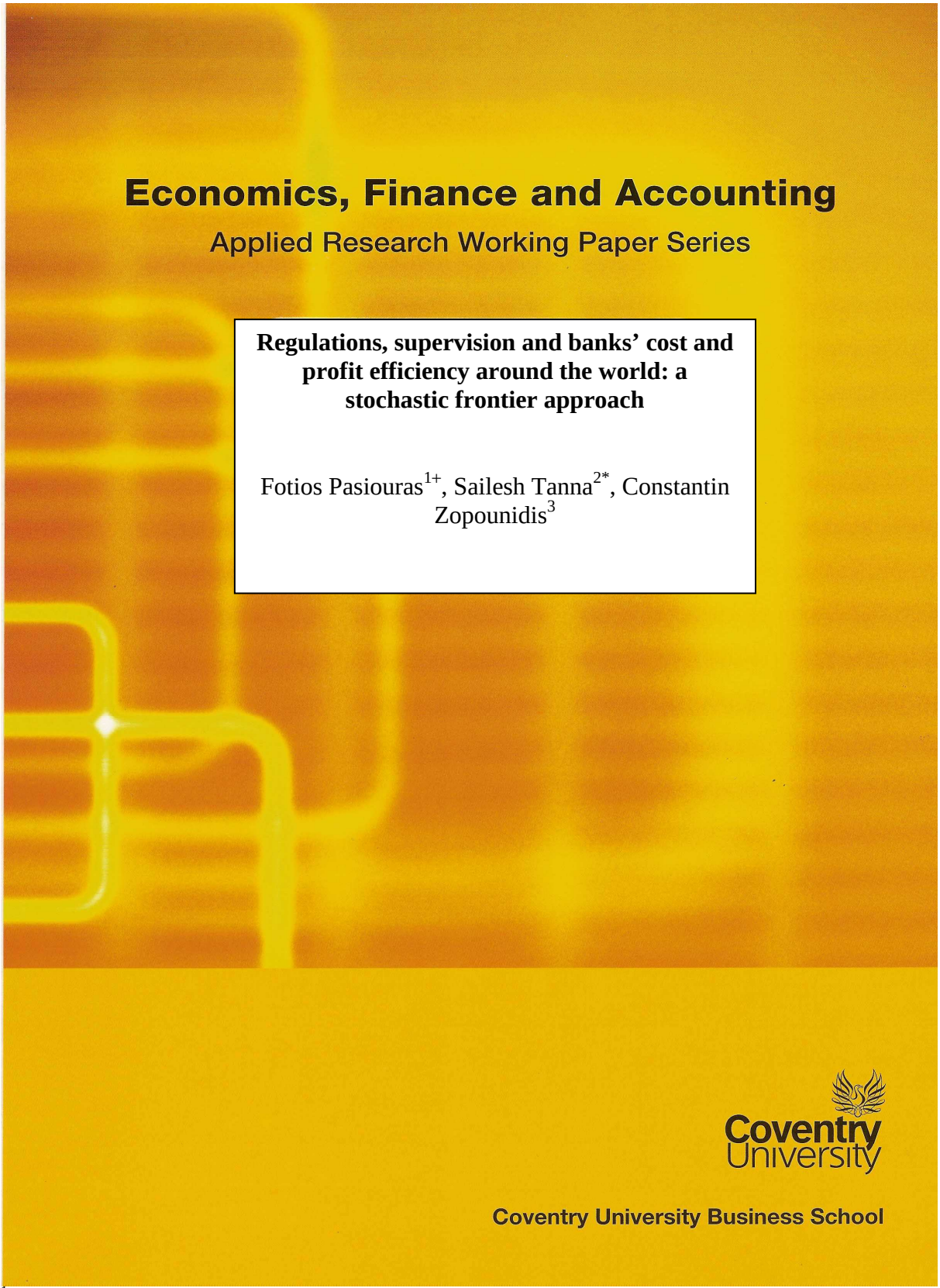

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Abstract

This paper uses stochastic frontier analysis and Tobit regressions to provide international evidence on the impact of regulatory, supervision and environmental factors on bank efficiency. Our contribution is twofold. First, we use a newly constructed database of 3,086 observations from 677 publicly quoted commercial banks operating in 88 countries to provide cross-country evidence on the determinants of banks' cost and profit efficiency during the period 2000-2004. Second, we utilise a relatively new database of the World Bank (WB), to investigate the impact of a broad range of regulatory and supervision measures, including capital requirements, restrictions on bank activities, private monitoring, official supervisory power of the authorities, and deposit insurance. Our results suggest a robust association of some of these measures with bank efficiency, and we also reveal some similarities and differences in the determinants of cost and profit efficiency, with plausible effects of the impact of the conditioning environmental factors on bank efficiency.

Keywords: Banking, Efficiency, Regulations, Stochastic frontier analysis, Supervision, Tobit

JEL: G21**,** G28, D2**,** C24

1. Introduction

A number of studies have recently made use of available cross-country World Bank (WB) database[1] constructed by Barth et al (2001a, 2004a) to provide international evidence on the impact of regulations and supervision on banks' performance as measured by financial ratios (e.g. Barth et al., 2002; 2003a, Demirguc-Kunt et al., 2004; Levine, 2004), risk-taking behaviour (Gonzalez, 2005; Laeven and Levine, 2006), overall soundless as measured by credit ratings (Demirguc-Kunt et al., 2006; Pasiouras et al., 2006), stability and banking sector crisis (Demirguc-Kunt and Detragiache, 2002; Barth et al., 2004b; Beck et al., 2006a). This paper builds on this strand of the literature by studying the impact of the regulatory environment on banks' cost and profit efficiency, using efficient frontiers rather than financial ratios[2].

The importance of specifying environmental variables while studying efficiency in the banking industry has been recognized in the literature (e.g. Dietsch and Lozano-Vivas, 2000), and most of the recent studies that use cross-country data account for some measures of the environment in which banks operate, such as market capitalization, GDP growth, etc. However, with regard to the regulatory aspects of the environment the empirical literature on bank efficiency so far has been constrained, owing to data limitations, to investigation of the use of simple measures such as the degree of market concentration, industry average capital, industry average profitability and intermediation ratios (e.g. Dietsch and Lozano-Vivas, 2000; Lozano-Vivas et al., 2002).

[1] The WB database on bank regulations was originally constructed by Barth et al. (2001a) and the data were available from 1999. It was updated in early 2004 with data from 2003 (henceforth referred to as Barth et al. (2004a).

[2] Berger and Humphrey (1997) and Bauer et al. (1998) emphasise that efficient frontier approaches seem to be superior compared to the use of traditional financial ratios from accounting statements - such as return on assets (ROA) or the cost/revenue ratio – in terms of measuring performance. Berger and Humphrey (1997) also point out that the frontier approaches offer an overall objective numerical score and ranking, an efficiency proxy to comply with the economic optimization mechanism.

Pasiouras (2007) takes the first step, to our knowledge, in extending the above literature by investigating the impact of a broad range of regulatory and supervision measures on banks' technical efficiency, using data envelopment analysis (DEA) on a sample of 715 banks operating in 95 countries during 2003. In this paper, by contrast, we concentrate in estimating cost and profit efficiency[3] of banks using stochastic frontier analysis (SFA). The main advantage of SFA over DEA is that it allows us to distinguish between inefficiency and other stochastic shocks (Yildirim and Philippatos, 2006) in the estimation of efficiency scores. Furthermore, we use panel data over the period 2000-2004 rather than cross-section data at one point in time (i.e. 2003) since it has been argued that efficiency is better studied and modelled with panels (Carbo et al., 2002). Maudos et al. (2002) point out that estimation of profit efficiency and its comparison to cost efficiency, and international efficiency comparisons are two areas where the available evidence on bank efficiency is very limited. Our study contributes in filling this gap, while at the same time provides statistical evidence of the association of these two efficiency measures with the regulation and supervision approaches around the world, using a cross-country dataset of 677 publicly quoted commercial banks representing 88 countries.

We employ a two-stage estimation procedure as in Carbo et al. (2002), Maudos et al. (2002), Bos and Kool (2006), Yildirim and Philippatos (2006) among several others. In the first stage, SFA is used on the banks' financial information to obtain cost and profit efficiency scores. In the second stage, we use Tobit regressions in order to assess the impact of regulatory and environmental measures on efficiency. We examine a broad range of regulatory and supervision variables that are related to capital adequacy requirements, private monitoring, official disciplinary power of the

[3]Cost efficiency is a wider concept than technical efficiency, since it refers to both technical and allocative efficiency. Profit efficiency is an even wider concept as it combines both costs and revenues in the measurement of efficiency.

authorities, restrictions on banking activities, and deposit insurance schemes. In assessing the impact of these measures, we control for bank size and bank capital, and check for robustness by adding country level environmental variables, replacing them as appropriate to account separately for cross-country differences in macroeconomic conditions, financial development, market structure, overall institutional development and access to banking services. The results generally indicate that there are similarities and differences in the impact of regulatory, supervision and environmental measures on cost and profit efficiency. Overall, apart from deposit insurance, the impact of the regulatory related variables is robust to changes in the environmental conditions, some of which also have plausible effects on bank efficiency.

The rest of the paper is structured as follows. Section 2 provides a brief background discussion on the impact of regulations in banking. Section 3 covers the methodological issues and data for our empirical work. Section 4 discusses the empirical results, and Section 5 concludes.

2. Background discussion

The banking crises around the world over the last thirty years along with evidence that economic growth is related to the development of the financial sector have attracted the attention of policy makers on the construction of an appropriate regulatory and supervision framework (Levine, 2005; Barth et al. 2003a, 2004b).

While many countries are in the process of upgrading their bank regulation and supervision approaches, this is a complex and difficult process because there is no clear answer on what exactly is good regulation and supervision (Demirguc-Kunt et al., 2006) or on how specific regulations affect the performance and stability of the banking sector. More precisely, Barth et al. (2004b) point out that economic theory provides conflicting predictions about the effect of regulations and supervisory

practices on banks, while it also makes subtle predictions about the precise conditions under which regulations and supervisory practices will achieve the desired outcomes. Furthermore, cross-country empirical evidence is rather limited on which of the many different regulations and supervisory practices adopted around the world promote bank development and stability (Barth et al., 2004b), and we attempt to provide such evidence associating their effect on banking sector efficiency.

The traditional view of the impact of bank regulation is that higher capital requirements will have a positive effect on the banking sector. However, some studies indicate that capital requirements increase risk-taking behaviour (e.g. Blum, 1999; Calem and Rob, 1999), while others argue that this happens only under specific circumstances (Kendall, 1992). Barth et al. (2004b) find that while stringent capital requirements are associated with fewer non-performing loans, capital stringency is not robustly linked with banking sector stability, development or bank performance (measured with overhead and margin ratios) when controlling for other supervisory-regulatory policies.

In theory, there tends to be support for both the *official supervision approach* and the *private monitoring approach*[4] to bank supervision. The *official supervision approach* argues that official supervisors have the capabilities to avoid market failure by directly overseeing, regulating, and disciplining banks. By contrast, the *private monitoring approach* argues that powerful supervision might be related to corruption or other factors that impede bank operations, and regulations that promote private monitoring will result in better outcomes for the banking sector. While these two approaches of supervision might reflect different attitudes towards the role of the authorities in monitoring banks, they are not necessarily mutually exclusive (Levine,

[4] Barth et al. (2004b) and Levine (2004) provide discussions of these two approaches.

2004). Consequently, in practice countries could adopt regulations that enhance both the disclosure of accurate information and the creation of powerful supervisors (Levine, 2004). Under this combined approach, a greater quality of information provided by a system that enhances private monitoring through accounting and auditing requirements might boost supervisors' abilities to intervene in managerial decisions in the right way and at the right time (Fernandez and Gonzalez, 2005).

In addition to these regulatory approaches, which are related to the three pillars of Basel II, we also comment briefly on two other measures deemed to have an impact on banks' cost and profit efficiency, namely restrictions on bank activities and deposit insurance schemes.

Barth et al. (2004b) outline several theoretical reasons for restricting bank activities as well as alternative reasons for allowing banks to participate in a broad range of activities. For example, emphasising the argument by Boyd et al. (1998), they suggest that as moral hazard encourages riskier behaviour, banks will have opportunities to increase risk if allowed to engage in a broader range of activities. On the other hand, fewer regulatory restrictions permit the utilization of economies of scale and scope (Claessens and Klingebiel, 2000), whilst also increase the franchise value of banks and result in a more sensible behaviour.

Finally, as pointed out by Demirguc-Kunt and Detragiache (2002), several countries have established a system of national deposit insurance over the last 25 years, this being viewed as a way of avoiding bank runs and thereby contributing to bank stability. However, it can also create moral hazard problems and encourage excessive risk-taking behaviour, as supported by evidence from several studies (e.g. Hendrickson and Nichols, 2001); or adversely affect the stability of the banking systems as a whole (Demirguc-Kunt and Detragiache, 2002).

3. Methodology, Variables and Data

3.1. Methodology

The stochastic frontier approach has been applied to several recent studies in banking and as already mentioned we use it in our first stage to estimate cost and profit efficiency of banks. As in Casu and Girardone (2004) and Beccalli et al. (2006) among others, we adopt the Battese and Coelli (1992) model for panel data, with individual firm effects assumed to be distributed as truncated normal variables, and permitted to vary systematically with time.

Starting with the specification of the cost frontier, we follow the value added approach (Berger and Humphrey, 1992) and as in Dietsch and Lozano-Vivas (2000), Maudos et al. (2002), Cavallo and Rossi (2002) and others, we choose the following three outputs: loans (Q_1), other earning assets (Q_2), and total deposits (i.e. customer and interbank) (Q_3). Furthermore, consistent with most previous studies on banking efficiency we select the following three input prices: cost of loanable funds (P_1), calculated as the ratio of interest expenses to total deposits; cost of physical capital (P_2), calculated by dividing the expenditures on plant and equipment (i.e. overhead expenses net of personnel expenses) by the book value of fixed assets; and cost of labour (P_3), calculated by dividing the personnel expenses by total assets[5]. Using the multi-product translog specification gives our empirical cost frontier model as follows:

$$\ln TC_{kt} = a_0 + \sum_{i=1}^{3} \alpha_i \ln Q_{ikt} + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3} a_{ij} \ln Q_{ikt} \ln Q_{jkt} + \sum_{j=1}^{3} \beta_i \ln P_{ikt} + \frac{1}{2}\sum_{i-1}^{3}\sum_{j=1}^{3} \beta_{ij} \ln P_{ikt} \ln P_{jkt} + \sum_{i=1}^{3}\sum_{j=1}^{3} \gamma_{ij} \ln Q_{ikt} \ln P_{jkt} + v_{kt} + u_{kt} \quad (1)$$

[5] We use total assets rather than the number of employers due to several missing values for the later. Our approach is consistent with several previous studies such as Carbo et al. (2002), Maudos et al. (2002), Carvallo and Kasman (2005), Beccalli et al. (2006).

where TC_{kt} is total cost (i.e. interest expenses plus non-interest expenses) of bank *k* in period *t* (*t=1, 2, …, T*); Q_{ikt} corresponds to the output *i* ($Q_{i,}$ *i=1, …., 3*) of bank *k* in period *t*; P_{ikt} represents the input price (P_i) for input factor *i* (*i=1, …., 3*) of bank *k* in period *t*; v_{kt} are random errors assumed to be iid and $N(0,\sigma_v^2)$; u_{kt} being non-negative random variables accounting for cost inefficiency and assumed to be iid with truncations at zero on the $N(\mu,\sigma_u^2)$ distribution, and $u_{kt} = (u_k \exp(-\eta(t-T)))$, where η is an unknown scalar parameter; and α_i,α_{ij}, β_i, β_{ij} γ_{ij} are the parameters to be estimated.

In the case of the profit frontier model, the variable to be explained is the profit before taxes (*PBT*). As in most previous studies we estimate an alternative profit frontier, which ignores output price data by assuming imperfect competition. Consequently, the specification of the profit frontier model is the same as that of the cost frontier (equation (1)) with PBT_{kt} replacing TC_{kt} as the dependent variable. However, the sign of the inefficiency term now becomes negative ($-u_{kt}$).

We also impose linear homogeneity restrictions by normalizing the dependent variable and all input prices by the third input price P_3. Additionally, since a number of banks in the sample exhibit negative profits (i.e. losses), the dependent variable in the profit model is transformed to $\ln\left(PBT / P_3 + \left|(PBT / P_3)^{\min}\right| + 1\right)$, where $\left|(PBT / P_3)^{\min}\right|$ is the minimum absolute value of (PBT / P_3) over all banks in the sample[6].

All bank-specific data for the estimation of the efficient frontiers were directly converted to US dollars, in Bankscope, prior to downloading. Furthermore, as in Altunbas et al. (2001) and Hauner (2005) among others, we expressed the data in real

[6] So that the dependent variable is $\ln(1) = 0$ for the bank with lowest *PBT*, and positive for all other banks. Apart from that, the range of variability in *PBT* is smaller than in *TC*, which accounts for most of the differences in the results for cost and profit efficiency.

1995 terms using individual country GDP deflators. Table 1 presents the mean of the variables discussed above by year (Panel A) and geographical region (Panel B)[7].

[Insert Table 1 Around Here]

The parameters of the stochastic frontier models are estimated using maximum likelihood[8]. The individual bank (in)efficiency scores are calculated from the estimated frontiers as $CE_{kt} = exp(u_i)$ and $PEF_{kt} = exp(-u_i)$, the former taking a value between one and infinity and the latter between zero and one. To make our results comparable, however, we calculate the index of cost efficiency as follows: $CEF_{kt} = 1/CE_{kt}$. Hence, in both cases our efficiency scores will be between 0 and 1 with values closer to 1 indicating a higher level of efficiency.

3.2. Explanatory variables in Tobit Regressions

This section briefly outlines the set of regulatory and appropriate control variables used in Tobit regressions, while Appendix A provides further details on their calculations and sources of information.

3.2.1 Regulations and supervision related variables

CAPRQ is an index of capital requirements, accounting for both initial and overall capital stringency. PRMONIT is an index of private monitoring, indicating the degree of information that is released to officials and the public, auditing related requirements and whether credit ratings are required. OFPR indicates the ability of supervisors to exercise their power and get involved in banking decisions related to prompt corrective action, declaring insolvency, and restructuring. ACTRS is a proxy for the restrictions on the activities (i.e. securities, insurance, real estate) that banks

[7] In assigning countries in regions we follow the classification of Global Market Information Database (GMID) of Euromonitor International.
[8] See Battese and Coelli (1992) and Coelli (1996), for further details.

can undertake as well as whether banks can own non-financial firms. Finally, DEPINS is a dummy variable indicating whether the country has an explicit deposit insurance scheme or not.

3.2.2 Control variables

We use the logarithm of total assets (SIZE) and the equity to assets ratio (EQAS) to control for bank size and capitalization[9]. In addition, we draw upon the relevant literature to select appropriate control variables in accounting for differences in various country level characteristics. Annual GDP growth (GRDGR) and annual inflation (INF) are commonly used measures to control for the country-specific macroeconomic environment (e.g. Maudos et al., 2002; Kasman and Yildirim, 2006).

To control for financial sector development across countries, we incorporate measures that proxy for the size of the banking system (ASSGDP), activity in the banking sector (CLAIMS) and size of the stock market (MACGDP). Same or similar measures have been used in other studies (e.g. Kasman and Yildirim, 2006, Pasiouras, 2007).

Also, following previous studies that focus on banks' performance (Barth et al., 2002, 2004b; Demirguc-Kunt et al., 2004; Fries and Taci, 2005), we control for cross-country differences in the national structure and competitive conditions of the banking sector, using the percentage of foreign-owned (FOREIGN) and government-owned (GOVERN) banks operating in the market, as well as the degree of concentration (CONC). Furthermore, we follow La Porta et al. (1998), Levine (1998) and others (e.g. Barth et al., 2004b; Demirguc-Kunt et al., 2004) who have studied the

[9] We do not control for other bank-specific characteristics such as loans to assets or deposits to assets ratios, as these elements (i.e. deposits, loans) were considered during the estimation of the efficiency frontiers. Their inclusion in the second stage of the analysis could therefore lead to potential endogeneity bias that is difficult to be deal with in Tobit regressions.

effects of different legal environments on the financial system, and control for differences in the institutional environment using indicators of the protection of property rights (PRIGHT) and government intervention in the economy (GOVINT). Finally, following Dietsch and Lozano-Vivas (2000), Maudos et al. (2002), and Pasiouras (2007), we control for access to banking services using the number of branches (BRAKM) and ATMs (ATMKM) per 1,000 sq km.

3.3. Data and summary statistics

Our final sample consists of 677 publicly quoted commercial banks[10], operating in 88 countries, for which data for at least one year are available between 2000 and 2004. This sample was determined as follows. We started by considering all the publicly quoted commercial banks in the Bankscope database, giving a total of 1,008 banks from 113 countries. We then excluded 72 banks from 15 countries not included in the Barth et al. (2004a) database. We further excluded 28 bank-year observations that corresponded to 15 banks operating in 3 countries for which GDP deflators where not available in GMID. Finally, we excluded any bank-year observation for which at least one of the dependent or explanatory bank-specific variables was zero or missing. This resulted in an unbalanced dataset of 3,086 bank-year observations. As shown in Appendix A, data for country-specific variables were collected from the WB databases, GMID and the Heritage Foundation. Table 2 presents the sample means of the independent variables by geographical region.

[Insert Table 2 Around Here]

[10] We focus on publicly quoted banks because, as mentioned in Laeven and Levine (2006), it enhances comparability across countries. Furthermore, it allows us to examine a more homogenous sample in terms of services, and consequently inputs and outputs. Finally, it is more appropriate to use the sample for this type of banks since, as mentioned in Demirguc-Kunt et al. (2004), the regulatory data of Barth et al. (2004a) are for commercial banks.

4. Results

4.1 Stage 1- SFA results

Table 3 presents the estimates of the efficiency score for the cost and profit frontier models[11]. The full sample overall mean profit efficiency score (PEF) equals 0.9402, while that of cost efficiency (CEF) is 0.8499, and the table also provides information about the level of banking efficiency by year (Panel A) and region (Panel B). The results indicate that over the period of estimation, banks have become more profit efficient albeit less cost efficient. This seemingly anomalous result implies in fact that banks operate at higher cost in order to achieve a higher level of profitability.

[Insert Table 3 Around Here]

More specifically, PEF increases each successive year from 0.9235 in 2000 to 0.9548 in 2004, while CEF declines over the corresponding period from 0.8568 to 0.8448. Of the seven regions, Australia has the most profit efficient banking system (0.9495), followed by Eastern Europe (0.9481), while North America (0.9378) and Western Europe (0.9373) show the lowest scores. However, the latter two are the most cost efficient banking systems with CEF scores of 0.9329 and 0.8910 respectively. By contrast, the less cost efficient banking sectors are those of Latin America and Caribbean (0.7855) and Eastern Europe (0.8068). Hence, as in previous studies, we observe that the most cost efficient banks are not necessarily the most profit efficient banks and visa versa,[12] and our findings confirm this anomalous trend for the time period 2000-2004. Consequently, we support the argument of Guevara

[11]These were obtained using the Frontier 4.1 computer program discussed in Coelli (1996).

[12]Casu and Girardone (2004) report that over the period 1996-1999 the most cost efficient banking groups in Italy seem to be also the least profitable. Guevara and Maudos (2002) examine cost and profit efficiency in EU-15, and indicate that the "other bank institutions" group is the most efficient in terms of costs but the most inefficient in terms of profits. Berger and Mester (1997) also show that profit efficiency is not positively correlated with cost efficiency.

and Maudos (2002) that the analysis of cost efficiency offers only a partial view of banks' efficiency and it is therefore important to analyze profit efficiency as well.

4.2. Stage 2- Tobit regression results

In the second stage, as already mentioned, we investigate the determinants of bank efficiency by estimating Tobit regressions using the efficiency scores CEF and PEF as the dependent variables. Since these scores range between 0 and 1, Tobit regressions are more appropriate than OLS. Since use of estimated scores as dependent variables in a two-stage process can render heteroskedasticity (Saxonhouse, 1976), we follow Hauner (2005) and Pasiouras (2007) in reporting QML (Huber/White) standard errors and covariates.

We estimate several specifications of the Tobit model, while controlling for two bank-specific attributes and various country characteristics discussed in Section 3. In each specification, we include all the regulatory variables, since Barth et al. (2004b) and Fernandez and Gonzalez (2005) among others indicate that many regulations can be substitutes or complements and countries will probably not select these policies in isolation.[13] However, we do not simultaneously include all the control variables for two reasons. First, this would considerably reduce the degrees of freedom and presumably affect the significance of the estimates[14]. Second, including many regressors increases the potential for multicollinearity.

The regression results obtained with different sets of control variables are presented in Columns 1 to 6 of Tables 4 and 5 for cost (CEF) and profit efficiency

[13] We also estimated specifications with regulatory variables entering individually, and the results obtained are similar. To conserve space we do not report the full set of results, which are available from the authors upon request.

[14] Simultaneously considering all variables would significantly decrease the number of available observations due to different missing observations for different countries.

(PEF) respectively. Depending on data availability, the estimation sample ranges between 2,366 and 2,974 observations[15].

[Insert Tables 4 and 5 Around Here]

Comparing the results in Tables 4 and 5 we observe one similarity but otherwise significant differences in the effects of the regulatory variables between cost and profit efficiency. More precisely, only ACTRS has a statistically significant impact on both CEF and PEF in all cases. The negative sign of its coefficient indicates that higher (lower) restrictions on the activities that banks undertake reduce (increase) bank efficiency. This is consistent with the view that less regulatory control allows banks to engage in various activities which result in exploitation of economies of scale and scope and generate income from several sources, thus increasing both cost and profit efficiency.

In most cases, the other regulatory variables have a statistically significant impact only on CEF. The effect of CAPRQ is positive, and statistically significant in four specifications (Table 4), indicating that more stringent regulations related to capitalization result in higher cost efficiency. We also find that the existence of a deposit insurance scheme (DEPINS) has an influence on cost efficiency; however its statistical significance and sign depends on the control variables that enter the equation. To some extent this result is consistent with previous studies examining the performance, stability, and risk-taking in the banking industry, which indicate that the impact of deposit insurance depends on other regulations and the overall environment

[15]At this stage, we also excluded from the sample the bank with the lowest PBT/P_3. This bank had an efficiency score (i.e. dependent variable) considerably lower than all the other scores in the sample, and this outlier could potentially bias the regression estimates. In the specifications with regulatory variables entering individually, the sample ranges between 2,366 and 3,082 observations.

in which banks operate (Demirguc-Kunt and Detragiache, 2002; Barth et al., 2004b; Pasiouras et al., 2006).

As with ACTRS, the effect of PRMONIT is negative, as expected, suggesting that higher requirements related to private monitoring reduce cost efficiency. This effect might be associated to higher costs required to meet increased disclosure requirements, such as consolidated accounts, disclosure of off-balance sheet items and risk management procedures to supervisors and to the public, auditing by certified auditors, as well as further expenses to obtain credit ratings from external agencies. Alternatively, it could be associated to possible differences between reported figures and actual costs. Assuming that banks in less developed accounting and auditing environments have more incentives to hide part of their expenditures for tax reasons, it is plausible that lower requirements of private monitoring could present higher cost efficiency.

Similarly, the impact of OFPR is negative and statistically significant on CEF (except in one specification). Hence, as in Levine (2004), we find that official supervisory power of the authorities exerts a negative influence on the functioning of banks. Barth et al. (2003b) also indicate that official government power is particularly harmful to bank development in countries with closed political systems. That higher supervisory power increases cost inefficiency, as in our case, is also consistent with the view that powerful supervisors may use their power to induce banks to lend politically-connected firms on advantageous terms[16].

Turning to the effects of control variables, we find that when we control only for bank-specific characteristics (Column 1), higher size results in higher cost

[16]As Barth et al. (2004b) summarize powerful supervisors may use their power to benefit favored constituents, attract camain donations and extract bribes. Both Barth et al. (2004b) and Levine (2004) report positive and statistically significant relationships between corruption and official supervisory power using international datasets.

efficiency, but not in higher profit efficiency. In contrast, EQAS has a negative and statistically significant impact on both CEF and PEF, its effect more dominant on the former. While one may expect the effect of EQAS and CAPRQ to be of the same sign, this is not necessarily so for two reasons. First, the construction of CAPRQ is mostly related to the way the capital ratios are calculated rather than to their absolute values (Appendix A). Second, while capital adequacy requirements refer to risk-weighted ratios, we have used the equity to assets ratio as a measure of capitalization (EQAS) as in most previous studies, owing to data availability[17]. The coefficient values on this term indicate that, on average, EQAS affects CEF by roughly 30% and PEF by 1.5%. Although this result contradicts some previous studies, it is consistent with Allen and Rai (1996) who report that higher stockholders' equity (relative to total assets) increases inefficiency for small universal banks and large banks in countries that prohibit functional integration of commercial and investment banking. Similarly, Cavallo and Rossi (2002) report a positive and significant relationship between capitalization and cost inefficiency for Germany and Italy.

One potential explanation of the above finding is that more skilful managers can generate profits and achieve efficient use of inputs while operating with higher leverage. Another explanation, potentially related to *moral hazard theory,* is that banks with lower capital levels may increase their risk-taking. Hence, by investing in more risky but potentially more profitable activities, these banks may turn out to be more efficient in the short term, although they will probably pay the consequences of

[17]Data unavailability or many missing values in Bankscope precluded the use of risk-weighted ratios such as Tier 1 ratio or total capital ratio. According to Valkanov and Kleimeir (2007), the use of risk-weighted ratios might imply different results, in contrast to the ones we obtained with the equity to assets ratio. They mention that the denominator of regulatory ratios consists of risk-weighted assets, rather than average total assets. Consequently, more risk-averse banks having their portfolios invested in less risky assets, will have lower risk-adjusted assets and, consequently, higher regulatory capital ratios than an otherwise similar but less risk-averse banks. In addition, the more risk-averse a bank is, the higher its risk-based capital ratios will be relative to its equity-to-assets ratio. While examining acquisitions they argue that this can explain why target banks have, on average, higher regulatory capital ratios but at the same time lower equity capitalization rates than other institutions.

their risky behaviour in the long term. Furthermore, Berger and Bonaccorsi di Patti (2006) mention that under the *efficiency-risk hypothesis*, more efficient firms tend to choose relatively low equity ratios, as higher expected returns from greater profit efficiency substitutes to some degree for equity capital in protecting the firm against financial distress[18]. While interpreting our results, it should be also kept in mind that our sample consists of only publicly quoted banks, which are typically the larger ones in a given country and as mentioned by McAllister and McManus (1993) and Demsetz and Strahan (1997) tend to operate with lower capital ratios.

The results in column 2 show that controlling for the macroeconomic environment (using GDPR and INF) does not significantly change the impact of the regulatory variables or EQAS on CEF and PEF. However, with respect to the impact of SIZE the results are now mixed, this effect being displaced partly by the impact of inflation (INF). In other words, higher inflation has a more significant influence on increasing costs and reducing profits, implying lower cost and profit efficiency, as found by Kasman and Yildirim (2006). In addition, GDPGR has a positive and statistically significant effect on PEF. Hence, as in Maudos et al. (2002) we find that banks operating in expanding markets present higher levels of profit efficiency. Furthermore, Maudos et al. (2002) report that under expansive demand conditions, banks feel less pressured to control their expenses and become less cost efficient. Although we find a negative impact of GDPGR on CEF, this is insignificant.

Of the three variables chosen to control for financial sector development (Column 3), only stock market capitalisation (MACGDP) has a statistically significant impact on both CEF and PEF. Kasman and Yildirim (2006) also find that both cost and profit efficiency increases as market capitalization increases, while

[18] In their extended US banks' study investigating the relationship between profit efficiency and capital structure, they find that lower equity capital ratio is associated with higher profit efficiency, an effect that is economically and statistically significant.

Pasiouras (2007) confirms the same for technical efficiency. Demirguc-Kunt and Huizinga (1999) also find a positive relationship between stock market capitalization and net interest margin, attributing it to a complementarity effect between debt and equity financing. Furthermore, Barth et al. (2003a) report a positive and significant relationship between stock market capitalization and return on assets in half of their specifications. These findings support the view that, as stock markets develop, improved information availability increases the potential pool of borrowers, making it easier for banks to identify and monitor them, which can obviously have a positive impact on both cost and profit efficiency. Appropriately we also find a significantly positive impact of the level of activity in the banking sector (CLAIMS) on CEF, although its effect on PEF is negative (but insignificant). We also find a marginally negative impact of the size of the banking sector (ASSGDP) on CEF.

Column 4 reports the results after including the three market structure indicators (GOVERN, FOREIGN and CONC). In this case, with regard to the bank-specific and regulatory variables, the results are mostly consistent with those of Column 1, with the impact of CAPRQ now statistically significant on both cost and profit efficiency. However, the three control variables have opposite effects on CEF and PEF, and their effects differ in terms of magnitude and significance. The significance of GOVERN on both implies that a higher share of government owned banks contributes to higher CEF, but results in lower PEF (and its effect here is very marginal). In a sense, the positive effect on CEF is consistent with the view that government-owned banks contribute to economic development and improvement of welfare (Stiglitz, 1994), whereas the opposite effect on PEF can be associated with the claim that government ownership can have negative consequences for the financial and banking sectors (Barth et al., 2001b). The negative and statistically

significant impact on cost efficiency of the presence of foreign banks in the market (FOREIGN) is consistent with Ataullah and Le (2006).[19] We also find some evidence (although very limited and marginal) to support the opposite view that a higher proportion of foreign banks has a positive impact on the banking sector, consistent with prior studies that report a positive association with profitability (Demirguc-Kunt and Huizinga, 1999; Barth et al., 2002, 2003a) and credit ratings (Pasiouras et al., 2006). Also, higher concentration (CONC) results in higher cost efficiency, as in Ataullah and Le (2006) and others. This effect is quite significant relative to the effects of GOVERN and FOREIGN and suggests that larger banks operating in more competitive markets (with foreign and state banks) are under increased pressure to control their costs. However, the effect of CONC on PEF is insignificant, indicating further differences in the results for cost and profit efficiency.

Controlling for institutional development within each country (using PRIGHT and GOVINT - Column 5) we find that the results for CEF are robust and, as in Column 4, CAPRQ has a positive and marginally significant impact on PEF. However, the significance of OFPR is now displaced. The most significant change in the results for PEF is the positive and statistically significant impact of bank SIZE, associated mainly with the impact of the property rights variable (PRIGHT). In turn, this contributes to the insignificance of OFPR, but at the same time we uncover a positive and statistically significant effect of DEPINS on PEF. In Column 3, we controlled for financial sector development and observed a statistically significant (and negative) effect of DEPINS on CEF. Here, the impact of DEPINS on CEF is insignificant (although remains negative), this being displaced by the inclusion of the environmental variables, both of which are significant on CEF. Together, these results

[19]Our sample includes banks from several less developed countries, where the recent and rapid entry of foreign banks has led to an increase in costs of domestic banks in the short-run in order to set up advanced information systems and risk management practices introduced by foreign banks.

indicate that deposit insurance has a discernible effect on bank cost or profit efficiency, but the effect seems to depend on financial sector and institutional development. As regards the impact of PRIGHT, this is positive on CEF but negative on PEF. This seemingly anomalous result may be due to factors such as country laws that protect private property, and court systems that enforce contracts, which contribute to cost efficiency, but otherwise the reduction in profit efficiency may be due to high levels of corruption and expropriation in developing countries. However, the positive effect of PRIGHT on CEF is consistent with that found by Pasiouras (2007) on technical efficiency, and the negative impact on profit efficiency is consistent with the findings of Demirguc-Kunt et al. (2004). Another way of explaining the opposite effects may be the due to the degree to which banks can increase the gap between what they pay savers (i.e. minimizing cost inefficiency) and what they receive from borrowers (maximizing profit efficiency), which is dependent upon the state of the economy or the institutional environment. Furthermore, banks' risk taking capabilities can potentially vary with the institutional environment[20].

Column 6 shows the results of our regressions while conditioning for access to the banking system through branch services and ATMs. It should be noted that the sample in this case has been reduced by approximately 700 banks observations owing to the absence of data on ATMKM and BRAKM for several countries, and therefore comparisons with previous results need to be treated with caution. However, we observe only minor differences in the results for CEF (such as the insignificant impact of SIZE in most specifications that we estimated), but otherwise the results are robust with both ATMKM and BRAKM being statistically significant. The sign of these coefficients indicates that, contrary to expectations, cost efficiency rises as the

[20]Fernandez and Gonzalez (2005) report that banks carry a higher risk in a poor legal system with improper enforcement of rules.

number of branches per 1,000 square km increases and falls with the increase in ATMs. However, the magnitude of these effects is very small and the effects are not robust to alternative specifications[21]. None of these two effects are significant on PEF[22], and so the results in this case resemble those of Column 1 indicating that profit efficiency is driven mainly by EQAS and ACTRS in the absence of other significant environmental factors.

5. Conclusions

This paper extends the literature on bank efficiency by providing empirical evidence on the association between cost and profit efficiency and regulation and supervisory approaches around the world. Our sample consisted of a panel dataset of 3,086 financial observations covering the period 2000-2004, comprising 677 publicly listed commercial banks operating in 88 countries. We first employed stochastic frontier analysis on bank financial information to estimate cost and profit efficiency, and then performed Tobit regressions to investigate the impact on these measures of regulations related to capital adequacy, private monitoring, disciplinary power of the authorities, restrictions on banks' activities, and deposit insurance, subject to changes in the environmental conditions to account for macroeconomic factors, financial development, market structure, overall institutional development, and access to banking services.

[21] We estimated alternative specifications, with ATMKM and BRAKM entered individually, and found that BRAKM remained statistically significant and positively related to CEF, but the effect of ATMKM became positive and significant on CEF in some specifications. In any case, the magnitude and hence the economic significance of these coefficients remains very marginal. We also replaced ATMKM and BRAKM by the ratio of BRAKM/ATMKM, and obtained some inconsistent results. For example, BRAKM/ATKM was positive and statistically significant in some specifications but negative and statistically significant in other specifications. Hence, we conclude that the effects of these variables are not robust.

[22] In this case, both variables were insignificant in alternative specifications too, and no statistically significant association was found between BRAKM/ATMKM and PEF.

The empirical results show a robust association of some of the regulatory and environmental measures with cost efficiency and to a limited extent with profit efficiency, after accounting for bank size and capitalization as bank-specific control factors. In this context, our results reveal some similarities and differences in the determinants of cost and profit efficiency. In most specifications, cost efficiency is influenced by regulations related to capital requirements, private monitoring (i.e. information disclosure), official power of the authorities, and restrictions on banking activities. However, profit efficiency is affected only by restrictions on the activities that banks can undertake. The impact of these measures is marginal compared to the influence of bank level capitalization, but is invariant to robustness checks conducted by changing the conditioning environmental variables.

Our results also indicate that the significance of some regulatory measures is governed by the conditioning variables. For example, capital adequacy requirements improve profit efficiency in market environments where the effect of government ownership of banks is also significant. Similarly, the impact of deposit insurance on banks efficiency depends on the financial and institutional development of the countries. Similarly, the impact of bank size on cost efficiency is either positive or negative, depending on the state of the economy. The impact of bank size on profit efficiency is found to be positive and statistically significant only with better protection of property rights. We also find that some of the conditioning variables have plausible effects on the two measures of efficiency, in some cases similar and in others opposite.

Whilst providing comprehensive cross-country evidence on the impact of regulatory and environmental factors on bank efficiency, it seems appropriate to conclude by addressing some of the data-related issues that have constrained the

scope of this study. First, since the WB database on bank regulations is available for only two points in time, we have assumed that regulatory policies within each country remained constant over the time period of our analysis. This, however, does not seem unreasonable, since Barth et al. (2004b) point out that such regulations change very little over time and control of these influences in their study did not alter their findings.[23] Second, in obtaining efficiency scores we used general proxies for input prices, as missing values for the number of employees and detailed information on expenditures relating to depreciation precluded calculation of more accurate measures. Furthermore, owing to data availability we had to rely on endogenous prices (i.e. calculated from banks own accounts) rather than exogenous ones as recently suggested by Berger and Mester (2003) and Bos and Kool (2006). Nevertheless, our approach to estimating efficiency is consistent with a majority of previous studies and we believe that, despite these data based limitations, our study represents an advance on the existing literature in uncovering international evidence suggesting an association between the regulatory environment and bank efficiency.

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[23] Consequently, other studies using this database (e.g. Demirguc-Kunt and Detragiache 2002; Demirguc-Kunt et al., 2004; Fernandez and Gonzalez, 2005; Beck et al., 2006a), have implicitly made the same assumption.

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Table 1: Mean of variables used in Stochastic Frontier Analysis (SFA)

	TC	PBT	Q1	Q2	Q3	P1	P2	P3
Panel A: Sample means by year								
2000 (N = 575)	873.074	118.615	8,381.672	6,613.135	13,152.846	0.054	0.998	0.018
2001 (N = 602)	809.363	83.396	8,176.305	6,606.077	13,077.034	0.050	1.021	0.017
2002 (N = 621)	734.972	95.210	8,783.130	6,975.897	13,799.882	0.047	1.133	0.017
2003 (N = 641)	748.285	139.979	10,322.076	8,662.502	16,532.132	0.038	1.214	0.016
2004 (N = 647)	761.867	173.618	11,495.451	9,835.891	18,294.350	0.035	1.308	0.015
Panel B: Sample means by geographical region								
Africa & Middle East (N = 517)	163.619	49.453	1,592.864	1,382.395	2,744.158	0.049	0.861	0.015
Asia Pacific (N = 1,002)	392.060	77.288	9,885.413	5,365.697	14,315.382	0.032	0.637	0.010
Australia (N = 45)	2,569.739	773.507	37,049.115	8,974.930	37,235.083	0.046	3.817	0.008
Eastern Europe (N = 303)	79.724	19.264	516.102	461.126	871.469	0.049	0.743	0.022
Latin America & Caribbean (N = 432)	282.308	44.403	1,577.219	1,515.927	2,714.908	0.077	1.246	0.031
North America (N = 96)	2,775.936	512.131	26,212.362	18930.098	41,758.425	0.027	1.910	0.016
Western Europe (N = 691)	2,044.246	242.530	19,536.757	21,593.398	34,087.559	0.040	1.903	0.015
Total sample average	783.620	123.004	9,478.266	7,786.108	15,048.130	0.045	1.140	0.016

Notes: TC: Total Cost, PBT: Profits before taxes; Q1: Loans, Q2: Other earning assets, Q3: Deposits; P1: Interest expenses/Deposits, P2: Other overhead expenses/Fixed assets, P3: Personnel expenses/total assets; TC, PBT, Q1, Q2, Q3 are in $ millions expressed in real 1995 terms; In assigning countries in regions we follow the classification of Global Market Information Database (GMID) of Euromonitor International.

Table 2: Sample means of independent variables*

	Africa & Middle East	Asia Pacific	Australia	Eastern Europe	Latin America & Caribbean	North America	Western Europe	Total
Number of bank observations	517	1,002	45	303	432	96	691	3,086
Number of countries	23	14	1	14	15	2	19	88
CAPRQ	6.4197	5.5212	7.0000	5.2541	5.4375	4.0625	5.9667	5.7103
PRMONIT	7.4004	7.5544	8.0000	7.1155	7.1644	7.4688	7.4443	7.4096
OFPR	8.6230	8.9912	8.0000	7.8977	7.8109	7.1250	5.9334	7.8643
ACTRS	2.5048	2.7740	2.7500	2.2170	2.7471	2.2813	2.1378	2.5123
DEPINS**	249	842	45	176	242	96	528	2178
SIZE	3.0032	3.6495	4.3517	2.3088	2.6336	3.8168	3.5990	3.2715
EQAS	0.1083	0.0704	0.0688	0.1453	0.1269	0.0808	0.0954	0.0979
INF	4.2018	2.1226	3.3940	6.5025	10.5950	2.4685	3.5280	4.4310
GDPGR	5.0716	3.9521	3.2400	4.7099	2.9657	2.7563	2.2454	3.6462
MACGDP	0.7794	0.6030	1.0464	0.1678	0.2798	1.1854	0.7046	0.5946
ASSGDP	0.2212	0.2454	0.0797	0.1225	0.0472	0.1302	0.5797	0.2737
CLAIMS	0.4681	0.7391	0.9327	0.3056	0.2420	0.5577	1.1238	0.6642
GOVERN	16.1829	22.9417	0.0000	12.0947	13.3284	0.0000	9.6867	15.4736
FOREIGN	28.9724	15.0973	17.0000	64.9881	28.1187	12.3438	8.2068	22.9962
CONC	0.6497	0.4398	0.6399	0.5964	0.5466	0.3979	0.6666	0.5575
GOVINT	3.7327	2.4104	2.0000	2.7295	2.9028	2.1875	2.8466	2.8141
PRIGHT	3.3228	3.6056	5.0000	2.6199	2.7847	5.0000	4.5137	3.6183
BRAKM	28.2294	30.8635	0.7731	12.5345	4.2154	5.9428	71.0701	33.2955
ATMKM	55.2819	262.1683	1.6616	23.6609	8.3641	22.5915	98.4612	116.6114

Notes: *Sample means for country-specific variables have been calculated on the basis of bank observations (e.g. N = 3,086) and not country observations (e.g. N =88). In some cases, the sample number is lower than the one mentioned in the second line due to missing values; **In the case of DEPINS the figure corresponds to the number of observations (i.e. banks) operating under an explicit deposit insurance scheme. Variables are defined in Appendix A.

Table 3: Cost and Profit efficiency estimates

	Cost Efficiency (CEF)	Profit Efficiency (PEF)
Panel A: Mean by year		
2000	0.8568	0.9235
2001	0.8540	0.9320
2002	0.8493	0.9405
2003	0.8457	0.9481
2004	0.8448	0.9548
Panel B: Mean by region		
Africa & Middle East	0.8706	0.9406
Asia Pacific	0.8421	0.9410
Australia	0.8894	0.9495
Eastern Europe	0.8068	0.9417
Latin America & Caribbean	0.7855	0.9411
North America	0.9329	0.9378
Western Europe	0.8910	0.9373
Overall mean (N = 3,086)	0.8499	0.9402

Note: The means by year and region are calculated from the total sample, and do not correspond to cross-section or region specific estimates.

Table 4: Supervision, regulations and cost efficiency (controlling for bank specific and environmental factors) – Tobit regression results

CAPRQ	0.0066***	0.0087***	0.0017	0.0030**	-0.0007	0.0033***
	(0.0000)	(0.0000)	(0.1829)	(0.0249)	(0.5208)	(0.0073)
PRMONIT	-0.0207***	-0.0200***	-0.0147***	-0.0175***	-0.0255***	-0.0239***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
OFPR	-0.0072***	-0.0074***	-0.0049***	-0.0017	-0.0039***	-0.0071***
	(0.0000)	(0.0000)	(0.0000)	(0.1012)	(0.0000)	(0.0000)
ACTRS	-0.0301***	-0.0279***	-0.0336***	-0.0319***	-0.0184***	-0.0323***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
DEPINS	0.0072*	0.0071*	-0.0092**	-0.0024	-0.0044	0.0226***
	(0.0983)	(0.0925)	(0.0297)	(0.5934)	(0.2198)	(0.0000)
SIZE	0.0089***	0.0023	-0.0109***	0.0077***	-0.0036*	0.0010
	(0.0000)	(0.2893)	(0.0000)	(0.0007)	(0.0789)	(0.6856)
EQAS	-0.2977***	-0.2697***	-0.2365***	-0.3335***	-0.3508***	-0.3330***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDPGR	---	-0.0009	---	---	---	---
		(0.1606)				
INF	---	-0.0030***	---	---	---	---
		(0.0000)				
MACGDP	---	---	0.0094***	---	---	---
			(0.0000)			
ASSGDP	---	---	-0.0073**	---	---	---
			(0.0360)			
CLAIMS	---	---	0.0804***	---	---	---
			(0.0000)			
GOVERN	---	---	---	0.0006***	---	---
				(0.0000)		
FOREIGN	---	---	---	-0.0006***	---	---
				(0.0000)		
CONC	---	---	---	0.1261***	---	---
				(0.0000)		
PRIGHT	---	---	---	---	0.0377***	---
					(0.0000)	
GOVINT	---	---	---	---	0.0286***	---
					(0.0000)	
ATMKM	---	---	---	---	---	-2.05E-06
						(0.9113)
BRAKM	---	---	---	---	---	0.0003***
						(0.0000)
Constant	1.0992***	1.1131***	1.0807***	1.0060***	0.9580***	1.1505***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
No. of obs.	2,974	2,974	2,676	2,859	2,948	2,366

***Statistically significant at the 1% level, **Statistically significant at the 5% level, *Statistically significant at the 10% level; p-values in parentheses; Independent variables are defined in Appendix A; QML (Huber/White) standard errors and covariates have been calculated to control for heteroscedacity.

Table 5: Supervision, regulations and profit efficiency (controlling for bank specific and environmental factors) – Tobit regression results

CAPRQ	4.05E-05	2.28E-05	0.0002	0.0004*	0.0004*	7.41E-05
	(0.8418)	(0.9100)	(0.4786)	(0.0842)	(0.0790)	(0.7430)
PRMONIT	0.0001	0.0002	0.0006	-0.0001	0.0011***	0.0002
	(0.7243)	(0.5202)	(0.2280)	(0.7620)	(0.0086)	(0.7799)
OFPR	-8.08E-06	-0.0001	-9.88E-05	0.0002	-0.0002	-0.0001
	(0.9612)	(0.5389)	(0.5690)	(0.2711)	(0.3162)	(0.5123)
ACTRS	-0.0022***	-0.0020***	-0.0019***	-0.0013**	-0.0029***	-0.0023***
	(0.0001)	(0.0003)	(0.0028)	(0.0367)	(0.0000)	(0.0010)
DEPINS	0.0001	0.0003	0.0002	-9.04E-05	0.0017**	0.0003
	(0.8295)	(0.6966)	(0.7584)	(0.8951)	(0.0132)	(0.7548)
SIZE	-7.79E-05	-0.0001	-0.0005	-0.0001	0.0011***	-0.0004
	(0.8365)	(0.7253)	(0.2849)	(0.7906)	(0.0057)	(0.3425)
EQAS	-0.0150**	-0.0141**	-0.0144**	-0.0165***	-0.0117*	-0.0140*
	(0.0191)	(0.0256)	(0.0421)	(0.0093)	(0.0682)	(0.0667)
GDPGR	---	0.0005***	---	---	---	---
		(0.0000)				
INF	---	-0.0001***	---	---	---	---
		(0.0001)				
MACGDP	---	---	0.0015***	---	---	---
			(0.0000)			
ASSGDP	---	---	0.0002	---	---	---
			(0.7344)			
CLAIMS	---	---	-0.0006	---	---	---
			(0.4783)			
GOVERN	---	---	---	-4.02E-05**	---	---
				(0.0157)		
FOREIGN	---	---	---	1.75E-05	---	---
				(0.1178)		
CONC	---	---	---	-0.0009	---	---
				(0.6360)		
PRIGHT	---	---	---	---	-0.0029***	---
					(0.0000)	
GOVINT	---	---	---	---	3.04E-05	---
					(0.9236)	
ATMKM	---	---	---	---	---	3.79E-06
						(0.2041)
BRAKM	---	---	---	---	---	-7.02E-06
						(0.4694)
Constant	0.9480***	0.9464***	0.9445***	0.9449***	0.9474***	0.9492***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
No. of obs.	2,974	2,974	2,676	2,859	2,948	2,366

***Statistically significant at the 1% level, **Statistically significant at the 5% level, *Statistically significant at the 10% level; p-values in parentheses; Independent variables are defined in Appendix A; QML (Huber/White) standard errors and covariates have been calculated to control for heteroscedacity.

Appendix A- Information on independent variables

Variable	Category	Description	Source/Datab
Regulatory variables			
CAPRQ	Capital requirements	This variable is determined by adding 1 if the answer is yes to questions 1-7 and 0 otherwise, while the opposite occurs in the case of questions 8 and 9 (i.e. yes=0, no =1). (1) Is the minimum required capital asset ratio risk-weighted in line with Basle guidelines? (2) Does the ratio vary with individual bank's credit risk? (3) Does the ratio vary with market risk? (4-6) 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? (7) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (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?	WB (Barth et a 2004a)
PRMONIT	Private monitoring	This variable is determined by adding 1 if the answer is yes and 0 otherwise, for each one of the following ten questions: (1) Does accrued, though unpaid interest/principal enter the income statement while loan is non-performing? (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 supervisors? (4) Are off-balance sheet items disclosed to public? (5) Must banks disclose their risk management procedures to public? (6) Are directors legally liable for erroneous/misleading information? (7) Is an external audit compulsory? (8) Are there specific requirements for the extent of audit? (9) Are auditors licensed or certified? (10) Do regulations require credit ratings for commercial banks?	WB (Barth et al 2004a)
OFPR	Official disciplinary power	This variable is determined by adding 1 if the answer is yes and 0 otherwise, for each one of the following ten questions: (1) Can the supervisory authorities force a bank to change its internal organizational structure? (2) Are there any mechanisms of cease-desist type orders whose infraction leads to automatic imposition of civil & penal sanctions on banks directors & managers? (3) Can the supervisory agency order directors/management to constitute provisions to cover actual/potential losses? (4) Can the supervisory agency suspend director's decision to distribute dividends? (5) Can the supervisory agency suspend director's decision to distribute bonuses? (6) Can the supervisory agency suspend director's decision to distribute management fees? (7) Can the supervisory agency supersede bank shareholder rights and declare bank insolvent? (8) Does banking law allow supervisory agency to suspend some or all ownership rights of a problem bank? (9) Regarding bank restructuring & reorganization, can supervisory agency remove and replace management? (10) Regarding bank restructuring & reorganization, can supervisory agency remove and replace directors?	
ACTRS	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 (4) bank ownership of non-financial firms. 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 calculating the average value over the four categories.	WB (Barth et al 2004a)
DEPINS	Deposit insurance scheme	Dummy variable that takes the value of one if there is an explicit deposit insurance scheme and zero otherwise.	WB (Barth et a 2004a)

Control variables			
SIZE	Bank size	Logarithm of total assets	
EQAS	Bank capitalization	Equity / total assets	
GDPGR	Overall economic conditions	Real GDP growth	GMID
INF	Inflation	Annual rate of Inflation	GMID
ASSGDP	Size of the banking system	Assets of deposit money banks/ GDP	GMID
CLAIMS	Activity in the banking sector	Bank claims to the private sector / GDP	GMID
MACGDP	Size of the stock market	Stock market capitalization / GDP	GMID
FOREIGN	Presence of foreign banks	Fraction of the banking system's assets in banks that are 50% or more foreign-owned	WB (Barth et a 2004a)
GOVERN	Presence of government-owned banks	Fraction of the banking system's assets in banks that are 50% or more foreign-owned	WB (Barth et a 2004a)
CONC	Concentration	Percentage of assets held by the three largest commercial banks in the country	WB (Beck et a 2006b)
PRIGHT	Property rights	This is an index of property rights that indicates the degree to which a country's laws protect property rights and the degree to which its government enforces those laws. It also assesses the likelihood that private property will be expropriated and analyzes the independence of the judiciary, and the ability of individuals and business to enforce contracts. The index takes values between 1 and 5, with higher values indicating higher property rights protection. (See note below).	Heritage Foundation
GOVINT	Government intervention in the economy	This is an index of government intervention in the economy. It measures government's direct use of scarce resources for its own purposes and government's control over resources through ownership. The index takes values between 1 and 5, with higher values indicating higher levels of government consumption in the economy and higher share of revenues received from state-owned enterprises and property.	Heritage Foundation
BRAKM	Extent of branch network	Number of branches per 1,000 sq k	WB (Beck et a 2005).
ATMKM	Extent of ATMs	Number of ATMs per 1,000 sq km	WB (Beck et a 2005).

Notes: WB: World Bank; GMID: Global Market Information Database of Euromonitor International; In its original form, as published by the Heritage Foundation, higher values for the property rights index ind lower protection of private property. Hence, a score of 5 would imply very low protection whereas a score of 1 would indicate very high protection. For the purposes of the present study, for easiness of interpreta we have reversed this scale. Thus, we replaced original values of 5 with 1 and visa versa, as well as original values of 4 with 2 and visa versa. Consequently, in our case higher values indicate more protection.