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Bank productivity change and off-balance-sheet activities across different levels of economic development

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Abstract

This study analyses the impact of OBS on banking productivity growth using a sample of 752 banks from 87 countries to calculate their productivity growth between 1999 and 2006. Our international setting allows us to analyse differences on the performance on banking institutions among various groups of countries with different economic and financial innovations development. We estimate cost and profit productivity growth using a parametric approach that decomposes the change in costs and profit performance into a component due to changes in business conditions and a component due to changes in productivity. The latter one is decomposed further into the change in best practice and change in (in)efficiency.

Keywords: Banks, Efficiency, Productivity, Regulations
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1. Introduction

In recent years, there has been a widespread use of off-balance-sheet (OBS) activities in the banking system around the world. The reasons for the rapid growth in bank's OBS exposures have been much debated. Deregulation and technological progress have increased competitive pressures, from banks and non-banking institutions. In turn, this increase in competition have led banks' margins for many types of conventional on-balance-sheet business to diminish, whilst at the same time supervisors have acted to restore and strengthen banks' capital adequacy. This urges bank to seek out non-traditional ways to exploit extraordinary profit opportunities, leading to financial innovation, with OBS being one of the most common types. Off-balance-sheet activities have the potential to generate positive or negative cash flows, and influence the production mix of banks. That is, some OBS are often effective substitutes for directly issued loans requiring similar information-gathering costs of origination (Berger and Mester, 1997) while others are used by banks to hedge risk and to generate income. Furthermore, the proliferation of OBS activities has allowed banks to avoid certain regulatory costs such as minimum reserve, deposit insurance, and capital adequacy requirement. Thus, OBS can influence both bank costs and profits.

It remains an open question, however, whether reorganisation of the production structure of banks will lead to improved performance (Rime and Stiroh, 2003). Evidence from the bank efficiency literature that provides comparisons of efficiency estimations with and without OBS, suggests that omitting OBS items may result in a misspecification of bank output and lead to incorrect conclusions (Rogers, 1998; Stiroh, 2000; Clark and Siems, 2002; Lozano-Vivas and Pasiouras, 2010). However, less is known on the effect that the increase in non-traditional activities has on banks' productivity growth (Casu and Girardone, 2005). For instance, one could easily argue that the mix of on- and off-balance sheet activities will have a substantial impact on productivity, if banks are not equally efficient in engaging in those activities. At the end, if banks are becoming more productive then one might expect better performance, lower prices, improved service quality for consumers, as well as greater safety and soundness (Casu et al. 2004). Therefore, the relationship between OBS and productivity growth could be of great interest to management, shareholders, as well as for supervisory authorities.

This paper contributes to the literature by providing international evidence on the relevance of OBS activities on the estimation of bank productivity change. To the best of our knowledge, up to date only Casu and Girardone (2005) provide similar evidence while focusing on the five largest EU banking sectors. We differentiate our paper from Casu and Girardone (2005) in two very important respects.

First, we proceed to an international comparison using banks from 87 countries that makes our study far more comprehensive in terms of geographical coverage, than all previous cross-country studies on bank productivity (e.g. Pastor et al., 1997; Chaffai et al., 2001; Casu et al., 2004; Casu and Girardone, 2005). While the developments of financial innovations have spread in the banking system around the world, the pace has being quicker in some countries than others, and it should therefore be interesting to investigate the effect of OBS on banks productivity from a wide international perspective. Furthermore, it is of particular interest that this international setting allows us to perform our analysis in terms of group of countries across different levels of economic development (i.e. major-advanced, advanced, transition and developing). Thus, we can examine whether banks from advanced countries with a longer history and higher volume of involvement in OBS activities are more productive than the ones operating in less developed markets. Additionally, our setting may be helpful in identifying the success or failure of policy-making, since the use of OBS activities may differ due to differences in capital requirements, governmental regulations and so on, increasing the adverse selection and moral hazard problems among countries. For instance, one policy implication, highlighted by Rogers (1998) is that the increase (decrease) in efficiency indicates that banks tend to be producing and selling non-traditional output better (worse) than traditional output, on average. Therefore, policy makers may want to consider such changes in banks' performance when developing regulations related to restrictions on bank activities.

Second, while Casu and Girardone (2005) focus on technical and technological change we provide estimates of economic productivity in cost and profit and measure the important role for these operations in a bank's economic activity. The main reason is that OBS activities incorporate cost but they can also increase revenue, so cost productivity alone should not be able to capture some of the benefits of the changes in the product mix of banks due to the development of OBS activities. Therefore, it is essential to derive measures of productivity change in banks' costs and

profits. In other words, while the cost productivity controls for the level of outputs and input prices across banks, revealing the managerial attention to cost, the profit productivity gives information about the managerial attention paid to raising marginal revenues as well as to reducing marginal cost.

To calculate the aforementioned productivity measures we follow the parametric approach suggested by Berger and Mester (2003) that was also adopted in Casu et al. (2004), and Molyneux and Williams (2005). This approach decomposes total cost and profit changes into a component due to changes in business conditions and a component due to changes in productivity. The latter one is decomposed further into a change in best practice and a change in (in)efficiency. Since our paper addresses an international comparison, we assume that banks from different countries operate in different environments. To control for such differences we use the approach of Battese and Coelli (1995) which allows environmental factors to influence directly the inefficiency term. Besides accounting for differences in the macroeconomic conditions and banking structure as many international banking comparisons suggest (e.g. Dietsch and Lozano-Vivas, 2002; Lozano-Vivas et al. 2001, among others) we also include differences in terms of regulation and supervision among countries. More specifically, we proxy for capital requirements, private monitoring, official disciplinary power and restrictions on banks activities, under the assumption that the impact of the financial innovation instruments (i.e. OBS activities) on the bank production process differs across different regulatory and supervisory systems.

The rest of the paper is as follows. Section 2 presents the methodology, data and variables. Section 3 discusses the empirical results. Section 4 concludes the study.

2. Methodology

2.1. Productivity measurement from a decomposition of cost (profit) changes

We adopt the methodology of Berger and Mester (2003) to measure cost and profit productivity. The productivity growth is obtained from a decomposition of cost and profit changes. By using cost and profit function estimates, the cost and profit changes over time are decomposed in a proportion due to business conditions changes and another due to productivity changes. Productivity changes are further decomposed into changes in best practice and changes in inefficiency.

To estimate the cost and profit function we resort to the cost minimization and profit maximization problems. For brevity, we present only the cost minimization problem and the decomposition of cost changes. Therefore, we assume that banks minimize costs subject to exogenously given prices of inputs, quantities of outputs, their own managerial inefficiency, and a random error. Consequently, we define and estimate a standard cost function that relates cost with those conditions. The use of the cost estimations in the calculation of the cost changes requires the definition and estimation of one cost function for each year as follows:

$$\ln C_{i,t} = f_{C_t}(X_{C_{i,t}};\beta) + \ln u_{i,t} + \ln v_{i,t} \qquad i = 1,2,...,N;\ t = 1,2,...,T \quad (1)$$

where: $C_{i,t}$ is the total cost of bank *i* at year *t*; $f_{C_t}(\bullet)$ is the best practice cost function; $X_{C_{i,t}} \equiv (\ln q_{i,t}, \ln w_{i,t})$ is a set of exogenous business conditions that affect cost, particularly quantity of outputs (given in logged terms by the vector q) and price of inputs (given in logged terms by the vector w); β is a vector of unknown scalar parameters to be estimated; $\ln u_{i,t}$s u denotes the inefficiency factors that are zero for best-practice banks and raises costs for other banks and $\ln v_{i,t}$s are random errors assumed to have zero mean each period.

The cost of the banking industry at year t is represented by the predicted cost of a bank, $\exp\left[f_{Ct}\left(\bar{X}_{C_{i,t}}\right)\right] \times \exp\left[\ln \bar{u}_{C_{i,t}}\right]$, with average business conditions, average inefficiency for the period and a zero random error. Where $\bar{X}_{C_{i,t}}$ corresponds to the average values of the business condition at time t and $\ln \bar{u}_{C_{i,t}}$ corresponds to the average value of the inefficiency factor. Following Berger and Mester (2003) the total gross change in cost between period t and $t+k$ is obtained by the ratio of the predicted costs in the two periods as follows:

$$\Delta TOTAL_{Ct,t+k} \equiv \frac{\exp\left[f_{Ct+k}\left(\bar{X}_{Ct+k}\right) \times \exp\left[\ln \bar{u}_{Ct+k}\right]\right]}{\exp\left[f_{Ct}\left(\bar{X}_{Ct}\right)\right] \times \exp\left[\ln \bar{u}_{Ct}\right]} \qquad (2)$$

Where, the total gross change in cost ($\Delta TOTALc$)can be decomposed further into the gross changes productivity (gross changes in best practice, and in inefficiency), and business conditions as follows:

$$
\begin{aligned}
&\Delta TOTAL_{Ct,t+k} \\
&= \left\{\exp\left[f_{Ct+k}\left(\overline{X}_{Ct}\right)\right] / \exp\left[f_{Ct}\left(\overline{X}c_{t}\right)\right] \times \exp\left[\ln \overline{u}_{Ct+k}\right] / \exp\left[\ln \overline{u}_{cT}\right]\right\} (\textit{changes in productivity}) \\
&\times \left\{\exp\left[f_{Ct+k}\left(\overline{X}_{Ct+k}\right)\right] / \exp\left[f_{Ct+k}\left(\overline{X}_{Ct}\right)\right]\right\} \qquad (\textit{changes in business conditions}) \\
&\equiv \Delta PROD_{Ct,t+k} \times \Delta BUSCOND_{Ct,t+k} \qquad (3)
\end{aligned}
$$

Furthermore, the cost productivity change, $\Delta PROD_C$, is obtained by the product of the change in best practice and the change in inefficiency (i.e. $\Delta PROD_{Ct,t+k} \equiv \Delta BESTPR_{Ct,t+k} \times \Delta INEFF_{Ct,t+k}$). Thus, the changes in productivity can be decomposed into changes in best-practice and changes in inefficiency as follow

$$
\begin{aligned}
&\Delta TOTAL_{Ct,t+k} \\
&= \left\{\exp\left[f_{Ct+k}\left(\overline{X}_{Ct}\right)\right] / \exp\left[f_{Ct}\left(\overline{X}c_{t}\right)\right]\right\} \qquad (\textit{changes in best-practice}) \\
&\times \left\{\exp\left[\ln \overline{u}_{Ct+k}\right] / \exp\left[\ln \overline{u}_{cT}\right]\right\} \qquad (\textit{changes in inefficiency}) \\
&\times \left\{\exp\left[f_{Ct+k}\left(\overline{X}_{Ct+k}\right)\right] / \exp\left[f_{Ct+k}\left(\overline{X}_{Ct}\right)\right]\right\} \qquad (\textit{changes in business conditions}) \\
&\equiv \Delta BESTPR_{Ct,t+k} \times \Delta INEFF_{Ct,t+k} \times \Delta BUSCOND_{Ct,t+k}
\end{aligned} \qquad (4)
$$

Consequently, the change in costs is disaggregated into three multiplicative components. The change in best practice, $\Delta BESTPR_C$, gives the change in costs due to changes in the best practice cost function $f_c(\bullet)$, since it holds business conditions and inefficiency constant. $\Delta INEFF_C$ and $\Delta BUSCOND_C$ give the contributions from changes in inefficiencies (revealing changes in cross-section inefficiency or dispersion from the best-practice technology) and business conditions, respectively. All these terms are measured as gross changes.

For the measurement of profit productivity, consistent with studies on bank efficiency, we use the alternative profit function.[1] Thus, although the alternative profit

[1] Berger and Mester (1997) argue that alternative profit efficiency may provide useful information and be preferred when one or more of the following conditions are applicable: (a) there are substantial unmeasured differences in the quality of banking services; (b) outputs are not completely variable; (c) output markets are not perfectly competitive; (d) output prices are not accurately measured. Based on these arguments, Kasman and Yildirim (2006) point out that in international comparisons with a

function has the same objective as the standard profit maximization concept (i.e. it assumes that firms maximize profits subjects to exogenous business conditions), it is specified under the same set of business conditions with the cost minimization problem. Consequently, the decomposition of profit changes will be equal to that of cost changes, the only difference being in equation (1) where the variable cost ($\mathbf{ln}\boldsymbol{C}_{\boldsymbol{i,t}}$) is replaced by the variable profits $\mathbf{ln}\boldsymbol{P}_{\boldsymbol{i,t}}$.

2.2. Methodology implementation

In view of the fact that our goal is to analyse the effect of the involvement in non-traditional activities on banks' productivity growth we estimate the cost and profit functions with and without non-traditional activities. For the selection of inputs and outputs, we follow the intermediation approach which assumes that banks act as intermediates that collect purchased funds and use labour and physical capital to transform these funds into loans and other assets. Thus, we estimate two versions of our model. Model 1 assumes that banks have two outputs, namely loans (Q1) and other earning assets (Q2). Model 2 is identical to Model 1 but OBS activities (Q3) are used as an additional output that captures non-traditional activities. In each case, we obtain estimates for both costs and profits so we have four models in total. Model C1 and Model C2 correspond to costs functions whereas Model P1 and Model P2 correspond to profits functions.

In all the cases, we use three input prices. Consistent with most previous studies these are: cost of borrowed funds (W1), calculated as the ratio of interest expenses to customer deposits and short term funding; cost of physical capital (W2), calculated by dividing overhead expenses other than personnel expenses by the book value of fixed assets; and cost of labour (W3), calculated by dividing the personnel expenses by total assets[2]. To impose linear homogeneity restrictions we normalize the dependent variable and all input prices by W3.

Following Berger and Mester (1997) among others, we use equity to control for differences in risk preferences. One of the reasons is that while some of the OBS

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diverse group of countries and competition levels it seems more appropriate to estimate an alternative rather than a standard profit function. Furthermore, DeYoung and Hasan (1998) point out that output quantities tend to vary across banks to a greater extent than input prices, thus explaining a larger portion of the variation in profits in regression analysis.

[2] In calculating W3, we use total assets rather than the number of employees due to data unavailability. Our approach is consistent with several other studies (e.g. Altubas et al., 2001).

instruments lead to risk reduction, others increase the risk exposure of the commercial banks. So, the OBS activities not only enable higher profits, but they also expose banks to additional risks. As in Berger and Mester (2003), our specification is estimated separately for each year. Thus, using the multi-product translog specification[3], Equation (3) in the case of Model 2C becomes[4]:

$$\begin{aligned}
\ln\frac{TC}{W3} &= \beta_0 + \beta_1 \ln(Q1) + \beta_2 \ln(Q2) + \beta_3 \ln(Q3) + \beta_4 \ln\left(\frac{W1}{W3}\right) + \beta_5 \ln\left(\frac{W2}{W3}\right) \\
&+ \beta_6 \frac{1}{2}(\ln(Q1))^2 + \beta_7 \ln(Q1)\ln(Q2) + \beta_8 \ln(Q1)\ln(Q3) + \beta_9 \frac{1}{2}(\ln(Q2))^2 \\
&+ \beta_{10} \ln(Q2)\ln(Q3) + \beta_{11} \frac{1}{2}(\ln(Q3))^2 + \beta_{12} \frac{1}{2}\left(\ln\left(\frac{W1}{W3}\right)\right)^2 + \beta_{13} \ln\left(\frac{W1}{W3}\right)\ln\left(\frac{W2}{W3}\right) \\
&+ \beta_{14} \frac{1}{2}\left(\ln\left(\frac{W2}{W3}\right)\right)^2 + \beta_{15} \ln(Q1)\ln\left(\frac{W1}{W3}\right) + \beta_{16} \ln(Q1)\ln\left(\frac{W2}{W3}\right) + \beta_{17} \ln(Q2)\ln\left(\frac{W1}{W3}\right) \\
&+ \beta_{18} \ln(Q2)\ln\left(\frac{W2}{W3}\right) + \beta_{19} \ln(Q3)\ln\left(\frac{W1}{W3}\right) + \beta_{20} \ln(Q3)\ln\left(\frac{W2}{W3}\right) + \beta_{21} \ln(EQ) \\
&+ \beta_{22} \frac{1}{2}(\ln EQ)^2 + \beta_{23}(\ln EQ)\ln(Q_1) + \beta_{24}(\ln EQ)\ln(Q_2) + \beta_{25}(\ln EQ)\ln(Q3) \\
&+ \beta_{26}(\ln EQ)\ln\left(\frac{W1}{W3}\right) + \beta_{27}(\ln EQ)\ln\left(\frac{W2}{W3}\right) + \ln u_{i,t} + \ln v_{i,t} \qquad (5)
\end{aligned}$$

We estimate the cost and profit functions using stochastic frontier analysis. More precisely, as mentioned in the introduction, we use the Battese and Coelli (1995) specification that allow us to control for country-specific attributes in a single stage during the estimation of efficiency. Thus, following Battese and Coelli (1995), $v_{i,t}s$ in the above specification are random errors, assumed to be i.i.d. and have $N(0,\sigma_v^2)$; $u_{i,t}s$ are the non-negative inefficiency effects in the model which are assumed to be independently (but not identically) distributed, such that $u_{i,t}$ is obtained by truncation (at zero) of the $N(m_{i,t},\sigma_u^2)$ distribution where the mean is defined by:

[3]Some other studies rely on the Fourier Flexible (FF) specification to estimate efficiency (e.g. DeYoung and Hasan, 1998). Berger and Mester (1997) found that both the translog and the FF function form yielded essentially the same average level and dispersion of measure efficiency, and both ranked the individual banks in almost the same order. However, Altunbas and Chakravarty (2001) compare the FF and translog specifications and urge caution about the growing use of the former to investigate bank efficiency. We therefore use the translog specification as in several other recent studies (e.g. Dietsch and Lozano-Vivas, 2000; Fries and Taci , 2005).

[4] For brevity of space, we present only one of the models. In the case of Model 2P one has to replace TC with PBT and change the sign of the inefficiency term. In the case of Models C1 and P1, one has to drop Q3 from the specification.

$$m_{i,t} = z_{i,t}\delta \tag{6}$$

where $z_{i,t}$ is a $(1xM)$ vector of observable explanatory variables that influence the inefficiency of bank i at time t; and δ is an $(Mx1)$ vector of coefficients to be estimated (which would generally be expected to included an intercept parameter). In the case of profit efficiency, equations (5) and (6) are estimated taking profit before taxes (*PBT*) as the variable to be explained. As mentioned before, since we estimate an alternative profit function, the specification of the profit frontier model is the same as that of the cost frontier (equation (5)) with *PBT* replacing *TC* as the dependent variable.[5] However, the sign of the inefficiency term now becomes negative ($-u_{it}$). The parameters of equations (5) and (6) are estimated in one step using maximum likelihood.[6] The individual bank cost and profit (in)efficiency scores are calculated from the estimated frontiers as $CE_{kt} = exp(u_i)$ and $PEF_{kt} = exp(-u_i)$ respectively. The former takes a value between one and infinity and the latter, between zero and one, whereas in both cases, values closer to one indicate higher efficiency.

To control for country-specific environmental factors such as macroeconomic conditions, activity, and concentration in the banking sector, regulatory conditions, and overall development, m_{it} in Equation (6) is defined by:

$$m_{it} = \delta_0 + \delta_1 INF + \delta_2\ GDPGR + \delta_3 CLAIMS + \delta_4 CONC3 + \delta_5 CAPRQ + \delta_6 SPOWER + \delta_7 PRMON + \delta_8 RESTR + \delta_9 MADV + \delta_{10} ADV + \delta_{11} TRANS$$

where *INF* is the annual rate of inflation and *GDPGR* is the real GDP growth, both capturing macroeconomic conditions. We control for inflation because Kasman and Yildirim (2006) argue that high inflation may affect behaviour and induce banks to compete through excessive branch networks and Demirguc-Kunt et al. (2004) find a robust positive impact of inflation on bank margins and overhead costs. Turning to GDPGR, Maudos et al. (2002) find that banks that operate in expanding markets - proxied by the real growth rate of GDP - present higher levels of profit efficiency.

[5] Additionally, as in previous studies, since a number of banks in the sample exhibit negative profits (i.e. losses), the dependent variable in the profit model is transformed to $\ln\left(PBT + \left|(PBT)^{\min}\right| + 1\right)$, where $\left|(PBT)^{\min}\right|$ is the minimum absolute value of PBT over all banks in the sample.

[6] See Battese and Coelli (1995) and Coelli et al. (2005), for further details.

CLAIMS measures the activity in the banking sector and it is calculated by dividing the bank claims to the private sector with GDP. Higher values of *CLAIMS* imply higher banking activity due to the increase of loans, and can result in higher efficiency. *CONC* is the concentration in the banking sector, as measured by the proportion of total assets held by the three largest banks in the country. Under Hicks (1935) *quite life hypothesis*, higher concentration could result in less efficient banks. However, under the efficient structure hypothesis, higher concentration could be the result of greater efficiency in the production process (Demsetz, 1973).

CAPRQ, SPOWER, PRMON and *RESTR* are variables that control for the main regulatory conditions in each country's banking industry. *CAPRQ* is a measure of capital requirements that accounts for both initial and overall capital stringency.[7] As discussed in Delis et al. (2008) capital requirements can influence bank productivity due to several reasons: (i) changes in the volume of aggregate lending and loan quality, (ii) changes in the portfolio of assets which result in different returns, and (iii) changes in the mix of deposits and equity, which bear different costs.

SPOWER is a measure of the power of the supervisory agencies indicating the information that is communicated to the supervisors (including OBS disclosures) and the extent to which they can take specific actions against bank management and directors, shareholders, and bank auditors. SPOWER could had either a positive or a negative impact on productivity depending on whether powerful supervisors improve the corporate governance of banks, reduce corruption in bank lending, and improve the functioning of banks as financial intermediaries or whether they are related to corruption or other factors that impede bank operations (Delis et al., 2008; Beck et al., 2006).

PRMON is an indicator of private monitoring and shows the degree to which banks are forced to disclose accurate information to the public (including OBS) and whether there are incentives to increase private monitoring. Under a market discipline perspective, we would expect that enhanced private monitoring would boost the functioning of banks (Barth et al., 2007) and their productivity.

The last regulatory variable, *RESTR*, is a proxy for the level of restrictions on banks' activities. It is determined by considering whether securities, insurance, real

[7] For the construction of the capital requirements (*CAPRQ*), power of supervisory agencies (*SPOWER*) and private monitoring (*PRMON*) indices, we use the summation of the 0/1 quantified answers as in Fernández and Gonzalez (2005), Barth et al. (2001, 2008), Pasiouras et al. (2006), Pasiouras (2008), Fonseca and Gonzalez (2008) among others.

estate activities, and ownership of non-financial firms are unrestricted, permitted, restricted, or prohibited. Pasiouras et al. (2009) find that higher restrictions have a negative influence on cost efficiency but positive influence on profit efficiency. The latter is consistent with Delis et al. (2008) who find that restrictions on bank activities have a positive impact on the total factor productivity growth of banks in Central Eastern European countries, suggesting that these banks fail to manage a diverse set of financial activities which translates in a decrease in productivity.

Finally, we classify the set of countries in four groups, on the basis of their level of economic development, and we introduce dummy variables for each group. MADV indicates whether a country belongs in the group of major-advanced economies (MADV=1) or not (MADV =0). ADV indicates whether a country belongs in the group of advanced economies (ADV=1) or not (ADV= 0). TRANS indicates whether a country belongs in the group of transition economies (TRANS =1) or not (TRANS= 0). Developing countries form the reference category and are represented by zero values in all three dummy variables.

3.3. Data

We initially considered the population of publicly quoted commercial banks that appeared to have financial records in Bankscope. After excluding banks that: (i) had missing, negative or zero values for inputs/outputs, and (ii) had missing values in the case of the country-specific control variables, we obtained a sample of 4,960 observations from 752 banks operating in 87 countries during 1999-2006[8].

We collected information from various sources. All bank-specific data were obtained from Bankscope database of Bureau van Dijk and were converted to US dollars and in real terms using GDP deflators. Information on bank regulations and supervision (i.e. *CAPRQ, PRMON, SPOWER, RESTR*) is obtained by the World Bank (WB) database developed by Barth et al. (2001) and updated by Barth et al. (2006,

[8] We focus on publicly quoted banks because as mentioned in Laeven and Levine (2006) it enhances comparability across countries. Furthermore, we focus on commercial banks for two reasons. First, because it allows us to examine a more homogenous sample in terms of services, and consequently inputs and outputs, enhancing further the comparability among countries. Second, as mentioned in Demirguc-Kunt et al. (2004), since the regulatory data of the Barth et al. (2001, 2006, 2008) database are for commercial banks, it is more appropriate to use bank-level data only for this type of banks.

2008)[9]. Data for concentration (i.e. CONC) are collected from the updated version of the WB database on financial development and structure (Beck et al., 2006b). Data for the macroeconomic conditions and financial development indicators (i.e. *GDPGR*, *INF*, *CLAIMS*) are obtained from the Global Market Information Database (GMID). To assign countries in the four groups of development we combine information from the International Monetary Fund (IMF) and the European Bank for Reconstruction and Development (EBRD).

Tables 1 and 2 present descriptive statistics for our sample by year and level of development. Although the bank-level variables in the cost functions are used in natural logarithms, we present the mean and standard deviations of the levels to be more informative.

[Insert Tables 1 and 2 Around Here]

4. Results

In this section we present the results on cost and profit productivity growth. First, we discuss the overall effect of OBS on those two types of productivity. Then, we examine whether and how this effect differs across different levels of economic development.

4.1. Overall cost and profit productivity growth with and without OBS

Table 3 presents the results for the cost (Panels A and B) and profit (Panels C and D) models. We report the total changes in costs (profits) over time (*ΔTOTAL*) and the decomposition of these total changes into their cost (profit) productivity change

[9] This WB database is available in only three points in time. Version I was released in 2001 (Barth et al., 2001). For most of the countries, information corresponds to 1999, while for others information is either from 1998 or 2000. Version II describes the regulatory environment at the end of 2002 (Barth et al., 2006). Version III describes the situation in 2005/06 (Barth et al., 2008). Consequently, we had to work under the assumption that the scores of our regulatory variables (*CAPRQ*, *PRMON*, *SPOWER*, *RESTR*) remain constant within short windows of time. More precisely, we used information from Version I for bank observations from the period 1999-2000, from Version II for bank observations from the period 2001-2003, and from Version III for bank observations from 2004-2006. In the case of a few countries for which information was not available in all versions, we used information from the most appropriate one. While acknowledging this shortcoming, we do not believe that it has an impact on our results. Other studies that have used this database across a number of years have obviously worked under a similar assumption (e.g. Demirguc-Kunt and Detragiache, 2002; Demirguck-Kunt et al., 2004; Fernandez and Gonzalez, 2005; Beck et al., 2006a; Pasiouras et al., 2009).

(*ΔPROD*), business condition change (*ΔBUSCOND*), best-practice frontier change (Δ*BESTPR*)**,** and (in)efficiency change (Δ*(IN)EFF*). For each model, we present the annualised figures in the first seven rows while the last row presents the geometric mean for the whole period.

[Insert Table 3 Around Here]

Looking at Panel A, the $\Delta TOTAL_C$ figure shows that over the entire period 1999-2006 the cost of the average bank rose by 9%. Using the average-practice cost function to decompose the costs changes we observe that the increase in costs is due to changes in business conditions rather than cost productivity. More precisely, the results show that cost productivity improved by 0.21% over 1999-2006 however changes in business conditions increased costs by 9.23%. Decomposing $\Delta PROD_C$ further, we observe a favourable shift in the best practise (0.34%) and a slight increase in inefficiency (0.12%). The inclusion of OBS as an additional output in the cost function returns an overall similar picture. $\Delta TOTAL_C$ now equals 9.19% showing that OBS activities increase the costs of banks further. While the negative impact of change in business conditions is slightly lower than in Model C1, productivity change also contributes now to the increase of costs in Model C2. However, differently than the case where OBS activities are not included, we observe a negative shift in the best practise (0.31%) and a slight decrease in inefficiency (0.21%). Overall, the comparison of the cost models shows that the impact of OBS on productivity is negative, which is explained by the adverse shift in the best practice cost that outperforms the positive contribution of inefficiency changes on cost productivity.

Turning to Model P1, we observe that when we do not account for OBS, the profits of the average bank seem to decrease by 0.49%. In this case, changes in business conditions have a positive impact on profits (0.37%) which is however counterbalance by the negative impact of profit productivity change (0.86%). The latter is due to an adverse shift in best practice which offsets the increase in efficiency. When we include OBS in the profit function (Model P2), we observe that there are important differences from Model P1. More detailed, the results now indicate an improvement in all the measures. The $\Delta TOTAL_\Pi$ figure shows that the profits of the average bank increase by 3.94%. As before, profit productivity change exercises a higher influence (3.42%) than business conditions' change (0.37%) on

profits, however both figures have now a favourable impact. The change in efficiency is now only 0.43% compared to 4.04% in the case of Model P1; however, the change in best practice becomes now favourable (2.98%), resulting in an improvement in profit productivity that is equal to 3.42%.

Therefore, it seems that as banks offer a wider range of services, and more specifically as they engage in OBS, they experience an increase in costs. However, this increase in costs can be perceived as a perquisite in offering additional and higher quality services to bank customers, eventually resulting in higher profits. Overall, our results are consistent with this hypothesis and provide support to the arguments of Berger and Mester (2003). Moreover, it seems that OBS activities have a large and positive effect on profit productivity and a small negative effect on cost productivity. Interesting enough is that the decomposition of productivity illustrates that OBS activities improve (worsen) cost (profit) efficiency and worsen (improve) best practice cost (profit). Those results suggest that while OBS activities exercise a favourable (unfavourable) shift in profit (cost) frontier, they increase (decrease) the divergences of banks with respect the best practice profit (cost) frontier. In order words, it seems that OBS activities increase profit technological change but the diffusion of this progress among banks is small. The opposite is true for the case of cost.

[Insert Table 4 Around Here]

4.2. Cost and profit productivity growth with and without OBS by country with different levels of economic development

We turn now our attention to the main goal of our paper that is the investigation of the effect of OBS on banks productivity across various groups of countries on the basis on their level of economic development. Table 4 presents the disaggregating of our measures by level of development.[10] The results from both cost models indicate that *ΔTOTALc* worsens in all cases. However, there are important differences between the four groups, while the influence of the OBS also differs across the groups. For

[10] For brevity of space we present only geometric averages for the entire period (1999-2006). Results by year are available from the authors upon request.

instance, the results from Model C1 indicate that the change in the cost of the average bank varies between 1.98% in advanced countries to 14.11% in transition countries. However, when we consider OBS (Model C2) we observe a boost in the change of costs in advanced countries reaching 11.60%. Model C2 provides more favourable results for all the groups of countries except for advanced countries. More detailed, the change in total costs is now equal to 4.49% for major-advanced countries (compared to 9.62% in Model C1), 12.32% for transition countries (14.11% in Model C1) and 5.86% for developing countries (7.22% in Model C1).

As before the decomposition into cost productivity growth and changes in business conditions shows that it is the latter that drives our results.[11]According to Model C1, changes in business conditions increased cost by 2.90% for the average bank in advanced countries and by 13.03% in transition countries. These figures worsen further, especially in the case of advanced countries (12.50%), when we include OBS (Model C2). The change in business conditions increases the cost of the average bank in major-advanced countries by 8.94%, however, the inclusion of OBS in the model counterbalances this adverse effect making the increase in costs equal to 4.41% in Model 2. Developing countries are also influenced favourably by the inclusion of OBS (compared to Model C1), with the increase in costs due to changes in business conditions falling from 7.83% to 5.44%.

The impact of business conditions in increasing costs supports Stiroh (2000), although it contradicts Berger and Mester (2003) who report that business conditions put downward pressures on the costs of U.S. banks. The difference between our study and the one of Berger and Mester can be most likely attributed to our cross-country setting and the business conditions that we consider. However, we believe that the increase in costs due to changes in business conditions is not surprising over the period that we examine. Barth et al. (2008) show that between 1999 and 2006 most countries have empowered the banking environment conditions. The fact that transition countries are the ones that were the most heavily influence by the changes in business conditions is also not surprising. These countries experienced fundamental changes in recent years such as restructuring and privatisation of state banks, policies

[11] This also means that the changes in costs due to a shift in best practise and inefficiency changes are also small and there are only marginal differences across the two models and the various groups. Probably the most notable difference between the two models is observed in the case of inefficiency change for transition countries which equals 1.130 in the case of Model C1 and 0.9872 in the case of Model C2. In contrast, banks in developing-emerging countries experience an adverse shift in best practice from 0.9952 in Model C1 to 1.0032 in Model C2.

to promote the transformation of socialist banking systems to market oriented ones, introduction of and changes in prudential regulation and supervision, transfer of technology and know-how (Fries and Taci, 2005; Bonin et al., 2005a,b). Obviously, these changes have altered the environment that banks operate and posed many challenges to managers.

Overall, the introduction of OBS improves cost productivity in two out of the four cases. More detailed, banks in advanced and developing countries experience a decrease in productivity in contrast to the improvement that it is recorded in the case of major-advanced and transition countries. Further decomposition, illustrates that the advance in productivity is basically due to an improvement in inefficiency changes, i.e. OBS activities enhance efficiency in all the group of countries, with the exception of developing countries where efficiency slightly worsens. The most favoured countries are the transition ones, which record a major improvement in cost efficiency, making them the ones with the highest improvement in cost productivity. On the other hand, we observe a deterioration of best practice in all the groups of countries, with the exception of major-advanced ones which improve best practice as well as cost efficiency.

Turning to Model P1 (Panel C), the results are mixed as we observe that total profits ($\Delta TOTAL_{\pi}$) for the average bank in major-advanced (2.30%) and advanced countries (1.35%) increase; however, the average bank in transition and developing countries experiences a decrease by 0.58% and 2.63%, respectively. In contrast to the cost models we now observe that profit productivity change rather than the change in business conditions, is the main driver of the total profits change. The only exception is the group of advanced countries where business conditions increase profits by 3.64% despite the adverse effect of productivity by 2.21%. The decomposition of $\Delta PROD_{\pi}$ shows a positive change in efficiency and a negative change in best practice in all cases. Furthermore, while the changes in efficiency do not vary much between the four groups, the variation is much higher in the case of the change in best practice. It ranges from -0.23% in major-advanced countries to -7.62% in transition countries. The inclusion of OBS in the model alters significantly the picture. $\Delta TOTAL_{\pi}$ increases in all cases and it now ranges between 2.09% (developing) and 10.71% (transition). Productivity change is now positive and it influences profits more than business conditions in two (major-advanced, developing) out of the four cases.

Overall, it seems that OBS activities improve profit productivity for all the groups of countries, with the highest improvement being recorded in the case of developing countries followed by transitory, advanced and major-advanced countries. However, the major-advanced countries are in both cases (i.e. with and without OBS) the ones with the highest level of profit productivity. Inversely to the case of cost, the improvement in profit productivity, once OBS is taking into account, is due to an advance in best practice (for all the groups of countries), and not to improvements in inefficiency. The highest improvement in best practice is recorded in advanced countries; however, the major-advanced countries experience again the highest level of changes in best practice. On the other hand, there exists a deterioration of profit efficiency in all the groups of countries when OBS is introduced as an additional output, with the highest deterioration being recorded in the case of advanced and transition countries.

Taking together our results on cost and profit productivity it seems that major-advanced and transition countries are the only two groups of countries that are influenced positively by OBS in terms of both cost as well as profit productivity. Moreover, while OBS activities improve cost efficiency for all groups of countries (except for developing ones), they worsen profit efficiency for all the groups of countries. Overall, the results suggest that OBS incorporate a better diffusion of technology among banks for cost than for profit. On the other hand, while OBS worsen best practice cost for all categories of countries (except for major-advanced ones), it improve best practice profit. That means that OBS shift upwards the profit frontier and downwards the cost frontier, i.e. OBS exercise technological profit progress and cost regress.

5. Conclusions

Over the last years, commercial banks have engaged in non-lending activities and as a result OBS items such as credit lines, contingent liabilities and other commitments represent now a large proportion of the balance sheets in most banking sectors. However, it is still unclear whether this reorganisation of the production structure improves or worsens the productivity of banks. This study used a sample of 4,960 observations from 752 banks operating in 87 countries to calculate productivity changes with and without OBS during 1999-2006. The productivity changes were

obtained through the parametric decomposition approach suggested by Berger and Mester (2003), while to control for cross-country specific characteristics the cost and profit frontiers were estimated using the Battese and Coelli (1995) model.

We found that the cost of the average bank rose by 9% over the period of our study, while the inclusion of OBS in the model increased this figure to 9.19%. Using the average-practice cost function to decompose the costs changes we observed that not matter which model was considered, the increase in costs was due to changes in business conditions rather than cost productivity. As it concerns profit, when we did not account for OBS, the profits of the average bank appeared to decrease by 0.49%. However, the inclusion of OBS in the model altered the picture and we observed an improvement in almost all the components, resulting in a positive change of total profits by 3.94%. In contrast to the cost model, it was profit productivity rather than the change in business conditions that drove the results. Overall, one could argue that as banks engaged in OBS activities they experienced an increase in their costs which was however counterbalanced by the generation of additional revenues, resulting in higher profits.

When we disaggregated our measures by level of development, we observed that, as before, total cost increased in all cases. However, there were important differences between the four groups, while the influence of the OBS also differed across the groups. The transition countries were the most heavily influenced ones by the changes in business condition, an observation that could be related to the fundamental changes that they experienced in recent years. In the case of the profit models, the results were mixed. Without accounting for OBS, we observed an increase in the total profits in the groups of major-advanced and advanced countries, and a decrease in the case of transition and developing countries. As before profit productivity change rather than the change in business conditions, was the main driver of the total profits change. However, once we included OBS in the model, the total profit change became positive in all cases. Furthermore, we observed changes as for the impact of productivity change and the shift in the influence of the change in the best practice. Finally, profit productivity change was more important than the change in business conditions in major-advanced and developing countries, while in the remaining two groups we observed the opposite. Overall, the results suggest that while the developments of financial innovations have spread in the banking systems around the world, the impact on productivity differs among groups of countries.

Banks in major-advanced countries and countries in transition were the ones that favoured the most by their involvement in OBS activities, since they experienced an improvement in cost as well as profit productivity. As it concerns the advanced and developing countries, their involvement in OBS activities increased costs, resulting in a worsening of the cost productivity measures; however, at the same time they experienced a higher increase in revenues leading to an improvement in the profit productivity measures.

To conclude, our paper makes an important contribution in the appraisal of bank productivity by offering international evidence on the possible effects of the use of OBS activities on productivity. We are therefore able to provide insights with regards to the benefits that changes in the product mix of banks have on productivity as well as to make comparisons between cost and profit productivity. Furthermore, extending this analysis to a wide sample of country banking industries around the world, allowed us to examine the effect of the financial innovation (as captured by OBS activities) on productivity depending of the level of economic development across various countries. Our exercise should be interesting to various stakeholders due to the importance that OBS activities had in the last decade in the operation of the banks around the world. Furthermore, since regulatory and supervisory measures are taking into account our findings may have policy implications as policy makers may consider the impact of OBS activities on the productivity of banks while developing regulations related to restrictions on bank activities.

References

Altunbas, Y., Chakravarty, S.P., 2001. Frontier cost functions and bank efficiency. Economic Letters 2001;72; 233-240.

Altunbas, Y., Gardener, E.P.M., Molyneux, P., Moore, B.. Efficiency in European banking. European Economic Review. 2001; 45, 1931-1955.

Barth, J.R, Caprio, G., Levine, R. 2001. The regulation and supervision of bank around the world: a new database. In: Litan, R.E., Herring, R. (Eds.), Integrating Emerging Market Countries into the Global Financial System, Brookings-Wharton Papers in Financial Services, Brooking Institution Press: Washington; 2001.

Barth, J.R., Caprio, G., Levine, R. Bank Regulations Are Changing: For Better or Worse? World Bank Policy Research Working Paper 4646; 2008.

Battese, G.E., Coelli, T.J. A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. Empirical Economics. 1995; 20, 325-332.

Beck, T., Demirguc-Kunt, A., Levine, R. Bank concentration, competition, and crises: first results. Journal of Banking and Finance. 2006a;30, 1581-1603.

Beck, T., Demirguç-Kunt, A., Levine, R.. A New Database on Financial Development and Structure (1960-2006). September 2006b update, World Bank.

Berger, A.N., Mester, L.J.Explaining the dramatic changes in performance of US banks: technological change, deregulation, and dynamic changes in competition. Journal of Financial Intermediation. 2003; 12, 57-95.

Berger, A.N., Mester, L.J.Inside the black box: What explains differences in the efficiencies of financial institutions? Journal of Banking and Finance. 1997; 21, 895-947.

Bonin, J.P., Hasan, I., Wachtel, P. Bank performance, efficiency and ownership in transition countries. Journal of Banking and Finance, 2005a; 29, 31-53.

Bonin, J.P., Hasan, I., Wachtel, P.Privatization matters: Bank efficiency in transition countries. Journal of Banking and Finance. 2005b; 29, 2155-2178.

Casu, B., Girardone, C. An analysis of the relevance of off-balance sheet items in explaining productivity change in European banking. Applied Financial Economics. 2005; 15, 1053-1061.

Casu, B., Girardone, C., Molyneux, P. Productivity change in European banking: A comparison of parametric and non-parametric approaches. Journal of Banking and Finance. 2004; 28, 2521-2540.

Clark, A.J., Siems, T. F. X-efficiency in Banking: looking beyond the balance sheet. Journal of Money, Credit and Banking. 2002; 34, 987-1013.

Coelli, T.J., Prasada Rao, D.S., O'Donnell, C.J., Battese, G.E. An Introduction to Efficiency and Productivity Analysis. 2nd Ed., Springer: USA.2005.

Demirguc-Kunt, A., Detragiache, E.. Does deposit insurance increase banking system stability? An empirical investigation. Journal of Monetary Economics. 2002; 49, 1373-1406.

Demirguc-Kunt, A., Laeven, L., Levine, R. Regulations, Market Structure, Institutions, and the Cost of Financial Intermediation. Journal of Money, Credit and Banking. 2004; 36, 593-622.

DeYoung, R., Hasan, I.. The performance of de novo commercial banks: a profit efficiency approach. Journal of Banking and Finance. 1998; 22, 565-587.

Dietsch, M., Lozano-Vivas, A. How the Environment Determines Banking Efficiency: a comparison between French and Spanish industries. Journal of Banking and Finance. 2000; 24, 985-1004.

Duarte, J., Han, X., Harford, J., Young, L.. Information asymmetry, information dissemination and the effect of regulation FD on the cost of capital. Journal of Financial Economics. 2008; 87, 24-44.

Fernandez, A., Gonzalez, F.How accounting and auditing systems can counteract risk-shifting of safety nets in banking: some international evidence. Journal of Financial Stability. 2005; 1, 466-500.

Fonseca, A.R., Gonzalez, F.. Cross-country determinants of bank income smoothing by managing loan-loss provisions. Journal of Banking and Finance. 2008; 32, 217-228.

Fries, S., Taci, A.. Cost efficiency of banks in transition: evidence from 289 banks in 15 post-communist countries. Journal of Banking and Finance. 2005; 29, 55-81.

Kazandjieva, I., 2007. Management Practices Generated by Foreign Banks Entry, In: Altzinger, W., Petkova, I. (Eds), Impacts of foreign direct investments on banking sectors in South East European countries, Economic Policy Institute, Sofia. 2007.

Laeven, L., Levine, R.. Corporate Governance, Regulation, and Bank Risk Taking. Working Paper, June 11, IMF and Brown University, available at SSRN. 2006.

Lozano-Vivas A., Pasiouras F. The impact of non-traditional activities on the estimation of bank efficiency: international evidence, Journal of Banking and Finance, Forthcoming (2010).

Molyneux P., Williams J. The Productivity of European Co-operative Banks. Managerial Finance. 2005; 31, 26-35.

Pasiouras, F.. International evidence on the impact of regulations and supervision on banks' technical efficiency: an application of two-stage data envelopment analysis. Review of Quantitative Finance and Accounting. 2008; 30, 187-223.

Pasiouras, F., Gaganis, C., Zopounidis, C.. The impact of bank regulations, supervision, market structure, and bank characteristics on individual bank ratings: a cross-country analysis. Review of Quantitative Finance and Accounting. 2006; 27, 403-438.

Pasiouras, F., Tanna, S., Zopounidis, C.. The impact of banking regulations on banks' cost and profit efficiency: Cross-country evidence. International Review of Financial Analysis. 2009; 18, 294-302.

Pastor J.M., Perez F., Quesada J.. Efficiency analysis in banking firms: An international comparison. European Journal of Operational Research. 1997; 98, 395-407.

Rime, B., Stiroh, K.J.. The performance of universal banks: evidence from Switzerland. Journal of Banking and Finance. 2003; 27, 2121-2150.

Rogers K.E.. Non-traditional activities and the efficiency of US commercial banks. Journal of Banking and Finance. 1998; 22, 467-482.

Rogers, K.E.. Nontraditional activities and the efficiency of US commercial banks. Journal of Banking and Finance. 1998; 22, 467-482

Tortosa-Ausina, E. Nontraditional activities and bank efficiency revisited: a distributional analysis for Spanish financial institutions. Journal of Economics and Business. 2003; 55, 371-395.

Table 1 - Descriptive statistics for bank-specific variables

		TC	PBT	Q1	Q2	Q3	W1	W2	W3	EQ
Panel A: Descriptive statistics by level of development										
Major-advanced	Average	1,816,260	237839	24,681,579	21,848,368	10,104,866	0.0265	1.3535	0.0105	2,272,063
	St. dev	4,979,060	748988,1	47,110,486	63,517,367	41,141,880	0.1553	2.3081	0.0131	4,119,776
Advanced	Average	1,430,751	289914	15,888,511	12,355,628	7,560,819	0.0330	2.1772	0.0147	1,592,808
	St. dev	4,604,383	791045,5	42,630,632	54,188,609	23,638,858	0.0198	6.0346	0.0074	3,768,431
Transition	Average	64,588	14116,85	425,528	353,308	671,093	0.0558	1.4168	0.0219	84,004
	St. dev	135,708	43607,64	857,982	895,576	3,302,087	0.0324	8.6732	0.0116	189,880
Developing	Average	287,117	66308,78	2,731,018	21,16,128	1,485,664	0.0632	1.1000	0.0171	384,514
	St. dev	868,134	325988,8	13,153,689	10,915,045	5,010,027	0.1106	1.6598	0.0144	1,547,961
Panel B: Descriptive statistics by year										
1999	Average	721,992	85019,73	6,265,223	4,942,541	3,141,522	0.0702	1.5399	0.0186	712,475
	St. dev	2,508,829	360929	20,436,772	20,996,322	13,894,513	0.0644	9.1543	0.0162	2,147,408
2000	Average	759,728	96724,61	7,220,964	5,495,848	3,308,657	0.0590	1.1511	0.0173	759,313
	St. dev	2,930,058	338469,1	21,928,837	21,599,724	16,138,461	0.0693	2.1695	0.0139	2,050,802
2001	Average	703,976	61789,4	7,028,891	5,350,830	3,180,576	0.0617	1.2248	0.0167	700,922
	St. dev	2,682,408	323148,3	21,666,226	21,986,892	15,140,708	0.1712	2.5245	0.0134	1,935,478
2002	Average	648,278	73522,1	7,837,170	5,841,893	3,294,899	0.0481	1.2422	0.0165	757,436
	St. dev	2,461,830	275175,2	24,807,517	23,726,840	16,141,726	0.0506	2.5881	0.0139	2,195,266
2003	Average	726,859	130956,1	9,738,338	8,131,171	4,466,567	0.0409	1.2681	0.0158	1,011,440
	St. dev	2,783,340	510562,5	30,335,327	36,539,683	22,073,124	0.0721	2.6047	0.0126	2,945,380
2004	Average	710,415	154389,8	10,397,459	9,253,153	4,329,671	0.0401	1.3753	0.0152	1,029,993
	St. dev	2,846,962	552759,5	34,176,725	45,395,349	21,927,545	0.1281	3.0376	0.0124	2,986,849
2005	Average	770,889	209009	11,007,706	9,875,603	5,017,428	0.0409	1.5857	0.0144	1,121,859
	St. dev	3,172,371	811603,3	36,515,652	48,670,875	25,880,545	0.1455	4.3742	0.0122	328,6250
2006	Average	1,024,451	233596,3	12,713,366	11,636,407	6,222,711	0.0426	1.5240	0.0135	1,323,454
	St. dev	4,577,949	740728,4	43,798,553	60,239,615	33,820,434	0.0876	3.4869	0.0114	3,899,663
Panel C: All sample										
1999-2006	Average	755,923	130652,8	9,053,666	758,6812	4,122,011	0.0500	1.3593	0.0160	928,149
	St. dev	3,050,567	528453,2	3,0328,321	3,770,6095	21,567,636	0.1084	4.1599	0.0134	2,766,422

Notes: TC = Total Cost, Q1 = Loans, Q2 = Other-earning assets, Q3 = Off-balance sheet items, W1 = Interest expenses/Deposits & short term funding, W2 = Non-personnel administrative expenses / Fixed assets, W3 = Personnel expenses / Total assets, EQ = Equity. Nominal values are in thousands in 1995 US dollars terms.

Table 2 – Descriptive statistics for country-specific variables

		CAPRQ	SPOWER	PRMONIT	ACTRS	CONC	INF	GDPGR	CLAIMS
Panel A: Descriptive statistics by level of development									
Major-advanced	Average	4.9599	10.6178	5.4213	2.5540	43.4077	0.6534	1.7716	1.0603
	St. dev	0.9212	2.2703	0.7319	0.4991	12.0713	1.3236	1.2163	0.3355
Advanced	Average	5.5538	9.9551	5.5641	2.2369	79.0715	2.3314	2.8390	1.2064
	St. dev	1.4335	1.9299	0.8262	0.4465	11.1976	1.2680	1.8644	0.4307
Transition	Average	5.1681	10.8862	4.7233	2.2683	56.4174	9.4431	5.6048	0.2898
	St. dev	1.4512	1.8011	0.8630	0.4993	17.8623	11.4222	3.2134	0.1451
Developing	Average	5.4747	12.0280	5.5557	2.7923	56.1137	7.2461	4.8099	0.3969
	St. dev	1.6295	1.8547	1.1947	0.5586	17.7629	9.7064	3.5824	0.2668
Panel B: Descriptive statistics by year									
1999	Average	5.1745	10.7017	5.1182	2.4282	59.9361	7.7653	2.4859	0.5413
	St. dev	1.4898	2.4130	1.1822	0.5868	18.6870	15.0089	3.1555	0.4496
2000	Average	5.1971	10.8433	5.0953	2.5093	57.0195	6.2483	4.5683	0.7032
	St. dev	1.4889	2.2946	1.1114	0.6079	18.0419	12.7210	2.3461	0.5934
2001	Average	5.4246	11.2893	5.3950	2.5595	58.0292	5.4978	2.3078	0.6303
	St. dev	1.4004	1.9424	1.0152	0.5485	19.2833	8.8276	2.9088	0.4397
2002	Average	5.3907	11.2078	5.3612	2.5516	57.7212	4.8746	2.5586	0.6265
	St. dev	1.3682	1.9354	1.0068	0.5479	19.4494	7.4191	3.0006	0.4320
2003	Average	5.5162	11.4022	5.4700	2.5836	56.9935	4.8356	4.0501	0.6350
	St. dev	1.3077	2.0000	1.0013	0.5752	20.2204	6.3789	3.7348	0.4304
2004	Average	5.3480	11.5669	5.6268	2.6988	54.0999	4.5017	5.5093	0.6364
	St. dev	1.5464	2.0925	0.9909	0.5370	18.7997	4.4058	3.2985	0.4284
2005	Average	5.3247	11.5084	5.6539	2.6949	54.6642	4.8086	4.9028	0.6795
	St. dev	1.5788	2.0992	0.9906	0.5609	18.3418	4.4514	2.7927	0.4638
2006	Average	5.3448	11.6003	5.6792	2.7011	59.3305	4.8616	5.2561	0.7246
	St. dev	1.5793	2.0179	0.9957	0.5565	19.4430	3.8736	2.6584	0.5088
Panel C: All sample									
1999-2006	Average	5.3446	11.2756	5.4304	2.5935	57.1394	5.3744	3.9677	0.6483
	St. dev	1.4737	2.1183	1.0560	0.5719	19.1324	8.6422	3.2557	0.4730

Notes: CAPRQ = Proxy for capital requirements, SPOWER = Measure of power of supervisory agencies, PRMONIT = Indicator of private monitoring, ACTRS= Restrictions on bank activities, CONC3 = concentration ratio of 3 largest banks in the country (%), INF = inflation rate (%), GDPGR = Real GDP growth (%), CLAIMS = Claims to the private sector /GDP. Figures calculated using the number of bank observations and not country-observations (e.g. 4,960 observations in all sample).

Table 3 – Measured gross changes in cost and profit

Panel A: Model C1	$\Delta TOTAL_c$	ΔBUSCOND	ΔPROD	ΔINEFF	ΔBESTPR
1999-2000	1.1007	1.1061	0.9951	1.0030	0.9921
2000-2001	0.9854	0.9889	0.9965	0.9999	0.9966
2001-2002	0.9365	0.9551	0.9805	1.0007	0.9798
2002-2003	1.0795	1.0891	0.9912	1.0137	0.9778
2003-2004	1.0469	1.0255	1.0208	0.9579	1.0656
2004-2005	1.1434	1.1539	0.9909	1.0197	0.9718
2005-2006	1.3924	1.3776	1.0108	1.0151	0.9958
1999-2006 (Geometric Mean)	1.0900	1.0923	0.9979	1.0012	0.9966
Panel B: Model C2	$\Delta TOTAL_c$	ΔBUSCOND	ΔPROD	ΔINEFF	ΔBESTPR
1999-2000	1.1117	1.1043	1.0067	0.9816	1.0256
2000-2001	0.9861	0.9879	0.9982	1.0013	0.9968
2001-2002	0.9399	0.9395	1.0004	0.9934	1.0070
2002-2003	1.0798	1.0868	0.9935	1.0145	0.9794
2003-2004	1.0432	1.0291	1.0136	0.9626	1.0530
2004-2005	1.1349	1.1520	0.9852	1.0344	0.9524
2005-2006	1.4053	1.3920	1.0096	0.9987	1.0109
1999-2006 (Geometric Mean)	1.0919	1.0909	1.0010	0.9979	1.0031
Panel C: Model P1	$\Delta TOTAL_\Pi$	ΔBUSCOND	ΔPROD	ΔEFF	ΔBESTPR
1999-2000	1.0085	0.9486	1.0631	1.0495	1.0129
2000-2001	0.7008	1.0102	0.6937	1.5097	0.4595
2001-2002	1.1118	0.9579	1.1606	0.8212	1.4132
2002-2003	0.9930	0.9955	0.9975	1.1204	0.8903
2003-2004	1.3232	1.0024	1.3200	0.7643	1.7272
2004-2005	0.9158	1.0520	0.8705	1.1287	0.7712
2005-2006	1.0219	1.0650	0.9595	1.0493	0.9145
1999-2006 (Geometric Mean)	0.9951	1.0037	0.9914	1.0404	0.9529
Panel D: Model P2	$\Delta TOTAL_\Pi$	ΔBUSCOND	ΔPROD	ΔEFF	ΔBESTPR
1999-2000	1.4350	0.9468	1.5157	0.7728	1.9614
2000-2001	0.6954	1.0050	0.6919	1.5140	0.4570
2001-2002	1.0257	0.9602	1.0682	0.9032	1.1826
2002-2003	1.0765	0.9834	1.0947	1.0224	1.0707
2003-2004	1.2693	1.0045	1.2637	0.7840	1.6119
2004-2005	0.9405	1.0570	0.8898	1.1154	0.7978
2005-2006	0.9964	1.0857	0.9177	1.0910	0.8412
1999-2006 (Geometric Mean)	1.0394	1.0050	1.0342	1.0043	1.0298

Notes: Models C1 (cost) and P1 (profits) assume that banks have two outputs namely loans and other earning assets. Models C2 and P2 assume that banks have three outputs namely loans, other earning assets, off-balance sheet items; ΔTOTAL = total change, ΔPROD = productivity change, ΔBUSCOND = business conditions change, ΔBESTPR = best-practice frontier change, ΔINEFF = inefficiency change; ΔEFF = efficiency change. A number higher than one indicates rising costs (profits) and a number lower than one indicates falling costs (profits).

Table 4 – Measured gross changes in costs and profits by level of development (geometric averages 1999-2006)

Panel A: Model C1	$\Delta TOTAL_c$	ΔBUSCON	ΔPROD	ΔINEFF	ΔBESTPR
Total sample	1.0900	1.0923	0.9979	1.0012	0.9966
Major-advanced	1.0962	1.0894	1.0063	1.0055	1.0009
Advanced	1.0198	1.0290	0.9911	0.9943	0.9967
Transition	1.1411	1.1303	1.0095	1.0130	0.9966
Developing	1.0722	1.0783	0.9944	0.9993	0.9952
Panel B: Model C2	$\Delta TOTAL_c$	ΔBUSCON	ΔPROD	ΔINEFF	ΔBESTPR
Total sample	1.0919	1.0909	1.0010	0.9979	1.0031
Major-advanced	1.0449	1.0441	1.0008	1.0024	0.9984
Advanced	1.1160	1.1250	0.9920	0.9928	0.9992
Transition	1.1232	1.1403	0.9850	0.9872	0.9978
Developing	1.0586	1.0544	1.0040	1.0007	1.0032
Panel C: Model P1	$\Delta TOTAL_\Pi$	ΔBUSCON	ΔPROD	ΔEFF	ΔBESTPR
Total sample	0.9951	1.0037	0.9914	1.0404	0.9529
Major-advanced	1.0230	0.9956	1.0275	1.0299	0.9977
Advanced	1.0135	1.0364	0.9779	1.0327	0.9470
Transition	0.9942	1.0197	0.9750	1.0554	0.9238
Developing	0.9737	0.9903	0.9832	1.0412	0.9443
Panel D: Model P2	$\Delta TOTAL_\Pi$	ΔBUSCON	ΔPROD	ΔEFF	ΔBESTPR
Total sample	1.0394	1.0050	1.0342	1.0043	1.0298
Major-advanced	1.0567	1.0051	1.0513	0.9995	1.0518
Advanced	1.0479	1.0341	1.0134	0.9884	1.0252
Transition	1.1071	1.0892	1.0164	1.0140	1.0024
Developing	1.0209	0.9877	1.0336	1.0076	1.0258

Notes: Models C1 (cost) and P1 (profits) assume that banks have two outputs namely loans and other earning assets. Models C2 and P2 assume that banks have three outputs namely loans, other earning assets, off-balance sheet items; ΔTOTAL = total change, ΔPROD = productivity change, ΔBUSCOND = business conditions change, ΔBESTPR = best-practice frontier change, ΔINEFF = inefficiency change; ΔEFF = efficiency change. A number higher than one indicates rising costs (profits) and a number lower than indicates falling costs (profits).

Appendix A- Information on regulatory variables

Variable	Category	Description
CAPRQ	Capital requirements	This variable 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). (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) Can the initial or subsequent injections of capital be done with assets other than cash or government securities? (8) Can initial disbursement of capital be done with borrowed funds?
PRMON	Private monitoring	This variable 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). (1) Is subordinated debt allowable (or 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) Must banks disclose their risk management procedures to public? (5) Are directors legally liable for erroneous/misleading information? (6) Do regulations require credit ratings for commercial banks? (7) Does accrued, though unpaid interest/principal enter the income statement while loan is non-performing? (8) Is there an explicit deposit insurance protection system?
SPOWER	Official disciplinary power	This variable 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 & reorganization, can supervisory agency or any other government agency (other than court) remove and replace management? (14) Regarding bank restructuring & 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 (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.

Note: The individual questions and answers were obtained from the World Bank database developed by Barth et al. (2001, 2006, 2008)