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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 712 banks from 84 countries 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 risk-adjusted cost and profit performance into two main components: changes in business conditions and 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

Jel Classification O16 · O57 · G21

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 banks' 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

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to diminish, whilst at the same time supervisors have acted to restore and strengthen banks' capital adequacy. This urges banks 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. 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 to 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 84 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 groups 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. Lozano-Vivas et al. 2001; Radić et al. 2012, 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. Finally, since OBS may expose banks to risk we estimate risk-adjusted cost and profit functions.

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 (in)efficiency.

To estimate the cost and profit function we resort to the cost minimization problem and the alternative profit function. 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:

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

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

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

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

$$\begin{aligned}
&\Delta TOTAL_{\,Ct,\mathrm{t+k}} \\
&= \left\{\exp\left[f_{Ct+k}\left(X_{Ct}\right)\right] / \exp\left[f_{Ct}\left(XC_t\right)\right] \times \exp\left[\ln u_{Ct+k}\right] / \exp\left[\ln u_{cT}\right]\right\} \ (changes in\ productivity) \\
&\times \left\{\exp\left[f_{Ct+k}\left(X_{Ct+k}\right)\right] / \exp\left[f_{Ct+k}\left(X_{Ct}\right)\right]\right\} \qquad (changes in\ businessconditions) \\
&\equiv \Delta PROD_{Ct,t+k} \times \Delta BUSCOND_{Ct,t+k}
\end{aligned} \tag{3}$$

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 follows:

$$\begin{aligned}
&\Delta TOTAL_{Ct,t+k} \\
&= \left\{\exp\left[f_{Ct+k}\left(X_{Ct}\right)\right] / \exp\left[f_{Ct}\left(X_{C_t}\right)\right]\right\} \quad (changes\ in\ best--practice) \\
&\times \left\{\exp\left[\ln u_{Ct+k}\right] / \exp\left[\ln u_{cT}\right]\right\} \qquad (changes\ in\ inefficiency) \\
&\times \left\{\exp\left[f_{Ct+k}\left(X_{Ct+k}\right)\right] / \exp\left[f_{Ct+k}\left(X_{Ct}\right)\right]\right\} \quad (changes\ in\ business\ conditions) \\
&\equiv \Delta BESTPR_{\,Ct,t+k} \times \Delta INEFF_{\,Ct,t+k} \times \Delta BUSCOND_{\,Ct,t+k}
\end{aligned} \tag{4}$$

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] As in previous banking studies, 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 Eq. (1) where the variable cost ($\ln C_{i,t}$) is replaced by the variable profits before tax ($\ln P_{i,t}$).[2]

2.2 Methodology implementation

Since we aim 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 OBS. For the selection of inputs and outputs, we follow the intermediation approach which assumes that banks act as intermediaries 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 net 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.[3] 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[4]; 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.[5] To impose linear homogeneity restrictions we normalize the dependent variable and all input prices by W3. Furthermore, we use shareholders' equity for two reasons. First, it controls for

[1] Berger and Mester (1997) argue that the alternative profit function 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 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] Total cost is defined as: Interest expense + Non-interest expense (i.e. expenses related to commission, fee, trading activities + personnel expenses + other operating expenses). Profit before tax is defined as: Net interest income + net commission income + net fee income + net trading income + other operating income – personnel expenses – other operating expenses – loan loss provisions +/− other adjustments (e.g. non-recurring income, non-recurring expenses, change in fair value of own debt, etc.).

[3] We use the OBS figure reported in the global format of Bankscope, which is calculated as the summation of the nominal values of the following four categories: (1) Acceptances, (2) Documentary credits, (3) Guarantees, (4) Other contingent liabilities. Our definition of OBS is consistent with other recent studies such as Bos and Kolari (2005), Lozano-Vivas and Pasiouras (2010).

[4] There is a debate in the literature as for the appropriate modelling of deposits. In the current paper, we use deposits as an input only. This draws on the well-known asset approach (Sealey and Lindley 1977), and it is consistent with numerous studies like Kwan and Eisenbeis (1997), Berger and DeYoung (2001), Koetter (2006), Chronopoulos et al. (2013), Lozano-Vivas and Pasiouras (2010). The findings of Fethi and Pasiouras (2010) provide further support to our approach, since their review of 151 DEA applications in bank efficiency/productivity reveals that only 20 studies use deposits as part of the output vector.

[5] 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. Altunbas et al. 2001).

differences in the bank capital structure and risk. Second, it serves as an alternative to deposits as a funding source for loans (Berger and Mester 1997). We treat equity as a quasi-fixed input in line with Berger and Mester (1997), and Chronopoulos et al. (2013), among others. We consider this to be a quasi-fixed input rather than a variable input because it relates to stock which has been built up over a long time and it is difficult to adjust quickly. Thus, we take into account that equity is not under management control in the short run, in the sense that managers cannot quickly adapt its quantity in reaction to market changes.

Considering that risk-taking is an integral part of banking as well as that OBS instruments might not only hedge risk but they can also increase the risk exposure of the banks, we estimate risk-adjusted cost and profit functions. More detailed, the performance measure to be explained is the bank cost and profit divided by the standard deviation of profit (σ_P).[6] In a sense, this adjustment expresses cost and profit per unit of risk.

As in Berger and Mester (2003), our specification is estimated separately for each year. Thus, using the multi-product translog specification,[7] Eq. (3) in the case of Model C2 becomes[8]:

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

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 allows us to control for country-specific and bank attributes in a single stage during the estimation of efficiency. Thus, following Battese and Coelli (1995), $v_{i,t}$s in the above

[6] We would like to thank an anonymous referee for highlighting the necessity of accounting for risk in our models, and for suggesting to us to follow this approach. The banking literature has already highlighted the association between risk and OBS (Hassan et al. 1993), while a related strand of the literature examines the association between non-interest income and risk (DeYoung et al. 2001; Stiroh 2004, 2006). Following another suggestion of the anonymous referee, we also re-estimated the models using as dependent variables the cost/equity and the profit/equity, normalized by the standard deviation of profit/equity, i.e. some sort of a Sharpe ratio, which reveals the return per unit of risk (and cost/equity per unit of risk). Obviously, in this case, equity was not part of the right hand side of the model. The conclusions remain the same. Thus, to conserve space we do not present these estimations. However, they are available from the authors upon request.

[7] 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. Radić et al. 2012).

[8] For brevity of space, we present only one of the models. In the case of Model P2 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.

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:

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

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. In the case of profit efficiency, Eqs. (5) and (6) are estimated taking the risk-adjusted profit before taxes (*PBT*) as the variable to be explained.[9] However, the sign of the inefficiency term now becomes negative ($-u_{it}$). The parameters of Eqs. (5) and (6) are estimated in one step using maximum likelihood.[10] 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, concentration in the banking sector, regulatory conditions, and overall development, m_{it} in Eq. (6) is defined by:

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

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. 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. To construct these variables we follow Barth et al. (2001, 2004), Fernandez and Gonzalez (2005), Lozano-Vivas and Pasiouras (2010), and Delis et al. (2011) among several others, to quantify various answers that are available in the World Bank database on "Bank Regulation and Supervision". We briefly discuss these variables below, while further details about the specific questions used for the construction of each variable are provided in Appendix 1.

[9] Additionally, as in previous studies, since a number of banks in the sample exhibit negative profits (i.e. losses), the profit value in the profit model is transformed to, where is the minimum absolute value of over all banks in the sample.

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

CAPRQ is an index of capital requirements that reveals whether the sources of funds counted as regulatory capital can include assets other than cash or government securities and borrowed funds, whether the regulatory or supervisory authorities verify these sources, and whether risk elements and value losses are considered while calculating the regulatory capital. As discussed in Pasiouras et al. (2009) capital requirements can influence bank efficiency, and consequently productivity, due to several reasons such as changes in the volume of aggregate lending and loan quality and/or changes in the portfolio of assets which result in different returns.

SPOWER is a measure of the power of the supervisory agencies. It indicates the information that is communicated to the supervisors (e.g. OBS disclosures, auditors' reports), whether they can change the internal organizational structure of the bank, and the extent to which they can take specific actions against bank management and directors, shareholders, and bank auditors, such as suspend managerial decisions, remove the directors or supersede shareholder rights. 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 (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 (e.g. OBS, risk management procedures) and whether there are incentives to increase private monitoring (e.g. subordinated debt, deposit insurance scheme). 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 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. (2011) 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.

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 they are represented by zero values in all three dummy variables. Appendix 1 and 2 contain detailed information on the construction of the regulatory variables and the development status of the countries in our sample.

2.3 Data and descriptive analysis of the bank activities and environment over time and across country groups of different levels of economic development

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, (ii) had no data for at least 3 years, and (iii) had missing

values in the case of the country-specific control variables, we obtained a sample of 4,894 observations from 712 banks operating in 84 countries during 1999–2006.[11]

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 from the World Bank (WB) database developed by Barth et al. (2001) and updated by Barth et al. (2006, 2008).[12] Data for concentration (i.e. CONC) are collected from the updated version of the WB database on financial development and structure (Beck et al. 2000). 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).

Table 1 shows descriptive statistics for our sample by year and level of development. Although we take the natural logarithms of these variables in the estimations, the table presents the mean and standard deviations in levels to be more informative. There appear to be important divergences among countries of different level of development (Panel A) and an increasing trend for the cost, profit and output level over time (Panel B). More detailed, we observe that banks in major-advanced countries have the highest average absolute level of OBS (Q3), loans (Q1) and other earning assets (Q2), whereas banks in advanced countries are the ones recording the highest level of bank profits (PBT). In terms of price of banking inputs, it seems that the banking intermediation process is more expensive in transitions and developing countries than in major-advanced and advanced countries, as it become evident by the higher cost unit of borrowed funds (W1). Additionally, the evolution of the cost and profit over time (Panel B) shows that they both increase (on average) over time; however, profit increases at a higher rate than cost. Finally, all three outputs increase over time, with OBS increasing at a higher rate than loans and other earning assets during the end of the period.

To explore further the bank-specific differences among the four groups of countries we also provide in Table 2 descriptive statistics on the following financial ratios that have been widely used in the banking literature: (i) OBS over total assets (OBSTA), (ii) non-interest income over interest income (NIIII); (iii) loan loss provisions over total assets (LLRTA), (iv) loans over total assets (LOANTA), (v) deposits over total assets (DEPTA), (vi) liquid assets

[11] We focus on publicly quoted banks because 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 for this type of banks, only.

[12] 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; Demirguc-Kunt et al. 2004; Fernandez and Gonzalez 2005; Beck et al. 2006; Pasiouras et al. 2009).

Table 1 Descriptive statistics for bank-specific variables. This Table reports descriptive statistics (average and standard deviation) for the bank-level variables used in the frontier function. The statistics are presented by level of country development (Panel A), by year (Panel B) and in total (Panel C). TC corresponds to total cost. PBT corresponds to profit before taxes. Q1 corresponds to the first bank output, namely net loans. Q2 corresponds to the second bank output, namely other-earning assets. Q3 corresponds to the third bank output, namely off-balance sheet items. W1 corresponds to the first input price, namely the interest expenses to deposits & short term funding ratio. W2 corresponds to the second input price, namely the non-personnel administrative expenses to fixed assets ratio. W3 corresponds to the third input price, namely the personnel expenses to total assets ratio. EQ corresponds to equity that is used as a quasi-fixed input. Nominal values are in thousands in 1995 US dollars terms

		TC	PBT	Q1	Q2	Q3	W1	W2	W3	EQ
Panel A: Descriptives by level of development										
Major advanced	Average	1,827,714	239,289	24,696,924	21,991,723	10,173,387	0.027	1.282	0.010	2,286,266
	St. Dev	4,994,271	751,361	47,238,432	63,712,363	41,275,183	0.156	2.060	0.013	4,130,368
Advanced	Average	1,438,896	293,362	15,867,810	12,462,193	7,639,661	0.033	2.179	0.015	1,606,859
	St. Dev	4,629,353	794,940	42,562,768	54,493,704	23,764,786	0.020	6.064	0.007	3,787,943
Transition	Average	66,733	14,599	414,836	366,047	696,434	0.055	1.422	0.022	86,610
	St. Dev	137,848	44,375	820,226	910,399	3,363,074	0.029	8.832	0.011	192,964
Developing	Average	288,477	66,192	2,622,452	2,113,380	1,485,130	0.062	1.079	0.017	385,145
	St. Dev	871,074	326,616	12,832,377	10,941,949	5,005,278	0.105	1.619	0.014	1,551,937
Panel B: Descriptives by year										
1999	Average	732,450	86,298	6,273,424	5,015,497	3,195,145	0.069	1.546	0.018	723001
	St.dev	2,528,917	363,883	20,555,437	21,168,328	14,007,465	0.064	2.231	0.016	2164225
2000	Average	761,910	98,037	7,181,890	5,526,571	3,334,415	0.056	1.131	0.017	764349
	St.dev	2,942,826	339,711	21,947,392	21,699,819	16,214,687	0.036	2.148	0.014	2059915
2001	Average	705,577	62,135	6,966,466	5,377,136	3,200,701	0.060	1.198	0.017	704752
	St.dev	2,691,412	324,375	21,617,941	22,068,188	15,197,933	0.169	2.478	0.013	1942217
2002	Average	654,297	74,202	7,795,809	5,896,478	3,325,520	0.048	1.248	0.016	764502
	St.dev	2,472,590	276,376	24,761,176	23,831,417	16,214,336	0.051	2.599	0.014	2204345
2003	Average	735,779	132,555	970,3731	8,231,865	4,521,917	0.041	1.267	0.016	1023852
	St.dev	2,799,526	513,541	30,147,546	36,756,140	22,205,047	0.073	2.615	0.013	2961617
2004	Average	715,803	155,539	10,371,937	9,324,737	4,363,942	0.040	1.347	0.015	1037882
	St.dev	2,857,607	554,800	34,226,399	45,568,261	22,011,132	0.129	3.009	0.012	2997374

Table 1 (continued)

		TC	PBT	Q1	Q2	Q3	W1	W2	W3	EQ
2005	Average	784,171	212,196	11,070,104	10,045,283	5,097,864	0.040	1.519	0.014	1140858
	St.dev	3,205,029	819,651	36,765,529	49,178,481	26,148,126	0.146	4.339	0.012	3318153
2006	Average	1,042,335	236,458	12,768,928	11,829,752	6,320,658	0.042	1.463	0.013	1341050
	St.dev	4,627,490	747,310	44,023,846	60,892,778	34,185,095	0.086	3.344	0.011	3935869
Panel C: All sample										
1999–2006	Average	763,571	131,938	9,036,043	7,668,058	4,167,031	0.049	1.334	0.016	937701
	St.dev	3,069,690	531,484	30,360,389	37,947,400	21,704,992	0.106	4.147	0.013	2782373

over total assets (LIQTA),[13] (vii) other earning assets over total assets (OEATA), (viii) return on assets (ROA), (ix) return on equity (ROE), and (x) equity to assets (EQAS).

These figures reveal that banks in major-advanced countries have the lowest ratio of OBS over total assets; however, they have the highest non-interest income over total income.[14] Additionally, it is interesting to note that banks in advanced countries have a relatively high ratio of OBS over total assets but they also have the lowest non-interest income over total income ratio.[15] Moreover, banks in this group of countries experience one of the lowest credit risk rates, as it is evident by the ratio of loan loss provisions over total assets. In contrast, banks in transition and developing countries engage in higher risk-taking as shown by the high rate of NIII and the loan loss provisions over total assets (LLRTA) while recording a lower rate of loans over total assets (see e.g. Lepetit et al. 2008). Furthermore, banks in transition countries have the highest level of liquid assets over total assets whereas the ones in developing countries have the highest ratio of other earning assets over total assets. Finally, it seems that banks in major advanced countries tend to rely on deposits as the main source of funding, as it is evidence by the relatively higher ratio of deposits over total assets.

Table 3 presents descriptive statistics of the regulatory and economic variables that we use in our estimations. As in the case of the bank-specific variables, we note that there are various differences among both the groups of countries and over time. For instance, while the major-advanced countries impose the lower level of capital requirements (CAPRQ), the developing countries have the most powerful supervisors (SPOWER) and they impose the highest restrictions on bank activities (RESTR). Furthermore, private monitoring (PRMON) appears to be lower in transition countries. In terms of the macroeconomic conditions, transition and developing countries experience the higher rate of GDP growth; however, they also record the higher rate of inflation. As expected, banking activity (CLAIMS) is lower in these two groups of countries than in more developed ones. In terms of the evolution of the environmental variables, (Table 3, Panel B), most of them increase over time, with the exception of INF which decreases and CONC which remains almost unchanged. Thus, on average, banks operate under better macroeconomic conditions but in a stricter regulatory environment over time.

Clearly, the data reveal two important issues that the present paper attempts to address: (i) the OBS activities take an important role in the banking activity over time, and (ii) there exist both bank-specific and country-specific differences among the different groups of countries.

3 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.

At this point it should be emphasized that since we adjust our dependent variables by the standard deviation of profits, the terms “total cost” and “total profit” that we use in the rest of

[13] We calculate liquid assets as: total assets - fixed assets – customer loans - other earning assets. In other words, liquid assets include the following items: loans and advances to banks, reserve repos and cash collateral, cash and due from banks, trading securities and at FV through income.

[14] The figures in Table 1 show that the average bank in major advanced countries uses OBS of the value of $10,173,387 thousands (in constant 1995 terms) compared to only $7,639,661 thousands in advanced countries, $696,434 thousands in transition countries, and $1,485,130 thousands in developing countries. However, due to the extremely larger size of banking institutions operating in major advanced countries, the average OBS to total assets ratio in Table 2 is lower than the one recorded for the rest of the groups.

[15] Since the performance metrics that we use in the present study are adjusted for risk, this could also explain why advanced countries appear to be the ones with the best performance.

Table 2 Banking ratios by level of development (1999–2006). This Table reports descriptive statistics (average and standard deviation) for selected bank-level financial ratios, while distinguishing by level of country development over the period 1999–2006. Figures are shown in %. OBSTA is the off-balance-sheet to total assets ratio. NIIII is the non-interest income to interest income ratio. LLRTA is the loan loss provision to total assets ratio. DEPTA is the deposits to total assets ratio. LIQTA is the liquid assets to total assets ratio. OEATA is the other-earning assets to total assets ratio. ROA is the return on assets ratio. ROE is the return on equity ratio. EQAS is the equity to total assets ratio

Countries		OBSTA	NIIII	LLRTA	LOANTA	DEPTA	LIQTA	OEATA	ROA	ROE	EQAS
Major advanced	Average	13.29	52.49	0.97	60.56	85.40	4.75	33.25	0.64	6.71	6.72
	St. Dev	60.42	216.33	1.40	16.09	13.29	4.33	15.06	2.58	18.81	6.67
Advanced	Average	31.32	27.68	1.28	63.71	78.85	5.85	29.07	1.46	15.64	9.50
	St. Dev	31.24	32.34	1.97	14.49	10.48	3.94	13.68	0.97	9.00	5.05
Transition	Average	29.31	45.85	11.01	53.81	75.95	11.19	30.48	1.78	13.49	13.80
	St. Dev	81.97	47.81	20.39	12.75	12.56	7.16	14.71	2.39	20.14	7.99
Developing	Average	40.64	43.22	5.08	49.42	81.03	10.25	37.68	1.82	18.00	10.32
	St. Dev	93.26	392.58	13.98	16.55	9.06	7.89	16.31	2.46	36.20	6.08

Table 3 Descriptive statistics for country-specific variables. This Table reports descriptive statistics (average and standard deviation) for country-level variables included in the inefficiency term. The statistics are presented by level of country development (Panel A), by year (Panel B) and in total (Panel C). CAPRQ is a proxy for capital requirements. SPOWER is a measure of the power of supervisory agencies. PRMONIT is an indicator of private monitoring. ACTR is an indicator of the restrictions on bank activities. CONC3 is the concentration ratio of the 3 largest banks in the country (%). INF is the inflation rate (%). GDPGR is the Real GDP growth (%). CLAIMS is the ratio of claims to the private sector over GDP. All figures are calculated using the number of bank observations and not country-observations (e.g. 4,894 observations in all sample)

		CAPRQ	SPOWER	PRMONIT	ACTRS	CONC	INF	GDPGR	CLAIMS
Panel A: Descriptives by level of development									
Major advanced	Average	4.954	10.636	5.425	2.557	43.290	0.646	1.775	1.061
	St. dev	0.912	2.266	0.730	0.497	11.978	1.324	1.217	0.337
Advanced	Average	5.568	9.960	5.558	2.238	79.409	2.333	2.805	1.209
	St. dev	1.432	1.938	0.828	0.447	10.689	1.269	1.819	0.431
Transition	Average	5.180	10.903	4.705	2.276	56.815	9.390	5.601	0.290
	St. dev	1.459	1.822	0.857	0.506	17.770	11.509	3.202	0.143
Developing	Average	5.479	12.035	5.555	2.787	56.074	7.220	4.813	0.398
	St. dev	1.626	1.841	1.195	0.556	17.798	9.722	3.587	0.267
Panel B: Descriptives by year									
1999	Average	5.183	10.714	5.124	2.429	59.930	7.666	2.498	0.542
	St.dev	1.492	2.410	1.179	0.585	18.691	15.027	3.117	0.451
2000	Average	5.204	10.853	5.091	2.508	57.027	6.255	4.555	0.706
	St.dev	1.487	2.284	1.112	0.608	18.030	12.774	2.346	0.595
2001	Average	5.428	11.284	5.392	2.555	58.087	5.406	2.292	0.633
	St.dev	1.396	1.946	1.016	0.546	19.331	8.740	2.914	0.440
2002	Average	5.390	11.213	5.358	2.554	57.846	4.813	2.543	0.630
	St.dev	1.373	1.942	1.010	0.545	19.466	7.402	3.007	0.432
2003	Average	5.518	11.418	5.468	2.587	57.233	4.774	4.032	0.639
	St.dev	1.312	2.001	1.006	0.573	20.108	6.368	3.743	0.431
2004	Average	5.348	11.557	5.629	2.698	54.141	4.480	5.504	0.639
	St.dev	1.544	2.091	0.987	0.535	18.867	4.409	3.310	0.429
2005	Average	5.333	11.538	5.656	2.696	54.641	4.814	4.907	0.680
	St.dev	1.571	2.085	0.989	0.555	18.459	4.468	2.768	0.464
2006	Average	5.356	11.637	5.682	2.705	59.217	4.882	5.246	0.725
	St.dev	1.572	2.010	0.997	0.552	19.581	3.885	2.646	0.510
Panel C: All sample									
1999–2006	Average	5.349	11.287	5.430	2.594	57.182	5.337	3.957	0.650
	St.dev	1.471	2.115	1.056	0.569	19.163	8.644	3.253	0.474

the paper refer to "cost per unit of profit risk" and "profit per unity of profit risk." Similarly, the terms "profit productivity" and "cost productivity" refer to "profit productivity per unit of profit risk" and "cost productivity per unit of profit risk", respectively.

3.1 Overall cost and profit productivity growth with and without OBS

Table 4 presents the results for the risk-adjusted 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

Table 4 Measured gross changes in cost and profit. This Table presents the decomposition of cost (profit) changes in the various components. The figures are obtained following the approach described in Section 2. Models C1 (cost) and P1 (profits) assume that banks have two outputs namely net loans and other earning assets. Models C2 and P2 assume that banks have three outputs namely net loans, other earning assets, off-balance sheet items. All the models are risk-adjusted. ΔTOTAL corresponds to the total change. ΔPROD corresponds to the productivity change. ΔBUSCOND corresponds to the business conditions change. ΔBESTPR corresponds to the best-practice frontier change. ΔINEFF corresponds to the inefficiency change. ΔEFF corresponds to the efficiency change. A number higher than one indicates rising costs (profits) and a number lower than one indicates falling costs (profit)

Panel A: Model C1	$\Delta TOTAL_c$	ΔBUSCOND	ΔPROD	ΔINEFF	ΔBESTPR
1999–2000	0.9148	0.9314	0.9822	0.9758	1.0066
2000–2001	0.9468	0.9482	0.9985	1.0020	0.9965
2001–2002	0.9450	1.0204	0.9261	0.9786	0.9463
2002–2003	1.0909	1.0901	1.0007	1.0203	0.9783
2003–2004	0.9883	1.0066	0.9819	0.9192	1.0681
2004–2005	1.0641	1.0578	1.0060	1.0676	0.9423
2005–2006	1.3506	1.3065	1.0338	1.0037	1.0300
1999–2006 (Geometric mean)	1.0345	1.0456	0.9894	0.9948	0.9946
Panel B: Model C2	ΔTOTAL	ΔBUSCOND	ΔPROD	ΔINEFF	ΔBESTPR
1999–2000	0.9151	0.9322	0.9817	0.9811	1.0006
2000–2001	0.9488	0.9483	1.0005	0.9984	1.0021
2001–2002	0.9387	0.9768	0.9610	0.9618	0.9992
2002–2003	1.0878	1.0842	1.0033	1.0213	0.9824
2003–2004	0.9893	1.0076	0.9818	0.9207	1.0664
2004–2005	1.0626	1.0575	1.0048	1.0679	0.9409
2005–2006	1.3603	1.3145	1.0348	1.0176	1.0170
1999–2006 (Geometric mean)	1.0344	1.0395	0.9952	0.9946	1.0006
Panel C: Model P1	$\Delta TOTAL_\Pi$	ΔBUSCOND	ΔPROD	ΔEFF	ΔBESTPR
1999–2000	0.8533	1.0510	0.8119	0.9677	0.8390
2000–2001	1.3312	0.9253	1.4387	1.1781	1.2212
2001–2002	0.8665	1.0083	0.8593	0.9660	0.8896
2002–2003	1.1539	0.8717	1.3237	0.9328	1.4191
2003–2004	0.6257	0.9308	0.6722	0.8577	0.7837
2004–2005	1.3298	1.1429	1.1636	1.0643	1.0933
2005–2006	1.0323	1.1185	0.9230	1.0157	0.9087
1999–2006 (Geometric mean)	0.9964	1.0023	0.9941	0.9931	1.0010
Panel D: Model P2	$\Delta TOTAL_\Pi$	ΔBUSCOND	ΔPROD	ΔEFF	ΔBESTPR
1999–2000	1.0568	0.9875	1.0702	1.0204	1.0489
2000–2001	0.8574	0.9229	0.9290	1.0167	0.9138
2001–2002	1.0394	1.0629	0.9779	0.8364	1.1691
2002–2003	1.1291	0.8523	1.3248	1.1130	1.1903
2003–2004	1.0116	1.0389	0.9737	1.1152	0.8732
2004–2005	0.8872	0.8875	0.9996	0.9512	1.0509
2005–2006	1.2732	1.1619	1.0958	1.0237	1.0705
1999–2006 (Geometric mean)	1.0282	0.9826	1.0464	1.0068	1.0393

decomposition of these total changes into their cost (profit) productivity change (ΔPROD), business condition change (ΔBUSCOND), best-practice frontier change (ΔBESTPR), 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.

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 3.45 %. 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 1.06 % over 1999–2006; however, changes in business conditions increased costs by 4.56 %. Decomposing $\Delta PROD_C$ further, we observe a small improvement in the best practise and an equally slight decrease in inefficiency (0.52 %).

The inclusion of OBS as an additional output in the cost function (Panel B) returns an overall similar picture. $\Delta TOTAL_C$ now equals 3.44 % showing that OBS activities have a negligible influence on the costs of banks. As before, these cost changes are due to the changes in business conditions rather than cost productivity.

Turning to Model P1 (Panel C), the results indicate that changes in business conditions have a small positive impact on profits (0.23 %) but the productivity change contributes negatively to the change in profits (−0.59 %). The latter is due to a decrease in efficiency (0.69 %) which offsets the positive shift in best practice (0.10 %).

When we include OBS in the profit function (Model P2, Panel D) we observe that there are important differences, leading to an increase in terms of total profit changes compared to Model P1. More detailed, the $\Delta TOTAL_{\Pi}$ figure shows that the profits of the average bank increase now by 2.82 % compared to −0.36 % in the case of model P1. Similarly to the model without OBS (i.e. P1), profit productivity change exercises a higher influence (4.64 %) than business conditions change (−1.74 %) on profits. Additionally, there is a difference as for the direction of the impact, with business conditions having a negative impact and productivity having a positive influence on profit changes. We also observe that the efficiency improves (0.68 %) and at the same time the change in best practice becomes more favourable (3.93 %), compared to Model P1.

Therefore, it seems that as banks offer a wider range of services, and more specifically as they engage in OBS, they experience almost no change in costs but they record higher changes in profits. Moreover, it seems that OBS activities: (i) have a positive effect on profit productivity and almost no effect on cost productivity, (ii) improve profit efficiency (to an extent), and (iii) have a large impact on improving best practice for profit. These results suggest that OBS activities exercise a favourable shift in profit frontier but they increase somewhat the divergences of banks with respect to the best practice profit frontier. Since we estimate risk-adjusted models, it is likely that the risk which is associated with OBS activities is compensated by the additional profits generated by these activities. This could also explain while OBS does not have an important impact on cost productivity, even though having a significant positive impact on profit productivity. In other words, it seems that the financial innovation that banks introduced over time by increasing their OBS levels (see Table 1), allowed them to record a profit progress. Furthermore, the fact that the introduction of OBS does not generate a significant technical cost progress provides some evidence that the progress in profits is due to improvements on the revenue side.

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

We turn now our attention to the second aim 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 5 presents the disaggregation of our measures by level of development.[16]

The results from both cost models indicate the increase of ΔTOTALc, except for major-advanced and developing countries. Furthermore, there are important differences between the four groups. For instance, the results from Model C1 indicate that the change in the cost of the average bank varies between −4.22 % in major advanced countries to 11.94 % in advanced countries. When we consider OBS (Model C2) we observe a slight change in the cost in all the groups of countries that is consistent with the results discussed in Section 3.1. More detailed, the change in total costs is now equal to −4.27 % for major-advanced countries (compared to −4.22 % in Model C1), 12.73 % for advanced countries (11.94 % in Model C1) 9.02 % for transition countries (9.14 % in Model C1), and −2.30 for developing countries (−2.07 % 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.[17] According to Model C1, changes in business conditions decrease cost by 4.78 % for the average bank in major-advanced countries and increase cost by 12.73 % (11.50 %) in advanced (transition) countries. The impact of business conditions in increasing costs supports Stiroh (2000). Furthermore, the results obtained for the group of major-advanced countries are in accordance with those obtained by Berger and Mester (2003) who report that business conditions put downward pressures on costs of U.S. banks. We believe that the increase in costs due to changes in business conditions for some groups of countries is not surprising over the period that we examine. Barth et al. (2008) show that between 1999 and 2006 most countries have empowered somewhat the banking environment conditions. Particularly, the fact that transition countries are strongly influenced by the changes in business conditions is not surprising since these countries experienced fundamental changes in recent years such as restructuring and privatisation of state banks, policies 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 (see e.g. Bonin and Wachtel 2003). Obviously, these changes have altered the operating environment of banks.

The introduction of OBS slightly changes cost productivity for the four groups of countries with a small deterioration. Further decomposition shows that OBS activities increase efficiency in major-advanced and developing countries. Nevertheless, all groups of countries experience a slight deterioration in best practice.

Turning to Model P1 (Panel C), we observe an increase in total profits ($\Delta TOTAL_{\pi}$) for the average bank in all groups of countries; however, the magnitude of this increase differs substantially among groups, ranging from 1.71 % in transition to 10.08 % in advanced countries. In contrast to the cost models, we now observe that the profit productivity change contributes intensively to the total profits change in most of the countries. The decomposition of $\Delta PROD_{\pi}$ shows a positive change in best practice in all cases. Additionally, there is a large variation in the case of the change in best practice, ranging from 5.28 % in transition countries to 8.62 % in major advanced countries.

The disaggregation by level of development illustrates that the inclusion of OBS in the model increases $\Delta TOTAL_{\pi}$ in all cases except for transition countries that record a small

[16] 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.

[17] 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.

Table 5 Measured gross changes in costs and profits by level of development. This Table presents the decomposition of cost (profit) changes in the various components, by level of country development. The figures correspond to geometric averages over the period 1999–2006, and are obtained following the approach described in Section 2. Models C1 (cost) and P1 (profits) assume that banks have two outputs namely net loans and other earning assets. Models C2 and P2 assume that banks have three outputs namely net loans, other earning assets, off-balance sheet items. All the models are risk-adjusted. ΔTOTAL corresponds to the total change. ΔPROD corresponds to the productivity change. ΔBUSCOND corresponds to the business conditions change. ΔBESTPR corresponds to the best-practice frontier change. ΔINEFF corresponds to the inefficiency change. ΔEFF corresponds to the efficiency change. A number higher than one indicates rising costs (profits) and a number lower than one indicates falling costs (profit)

Panel A: Model C1	$\Delta TOTAL_c$	ΔBUSCON	ΔPROD	ΔINEFF	ΔBESTPR
Major-advanced	0.9578	0.9534	1.0046	1.0012	1.0034
Advanced	1.1194	1.1333	0.9878	0.9911	0.9966
Transition	1.0914	1.1230	0.9718	0.9729	0.9989
Developing	0.9793	0.9816	0.9977	1.0069	0.9909
Panel B: Model C2	$\Delta TOTAL_c$	ΔBUSCON	ΔPROD	ΔINEFF	ΔBESTPR
Major-advanced	0.9573	0.9522	1.0054	0.9993	1.0061
Advanced	1.1273	1.1273	1.0054	0.9996	1.0059
Transition	1.0902	1.1150	0.9778	0.9736	1.0043
Developing	0.9770	0.9752	1.0019	1.0043	0.9976
Panel C: Model P1	$\Delta TOTAL_\Pi$	ΔBUSCON	ΔPROD	ΔEFF	ΔBESTPR
Major-advanced	1,0295	0.9571	1.0757	0.9903	1.0862
Advanced	1,1008	1.0314	1.0674	0.9871	1.0857
Transition	1,0171	0.9918	1.0255	0.9741	1.0528
Developing	1.0328	0.9957	1,0372	0.9671	1.0725
Panel D: Model P2	$\Delta TOTAL_\Pi$	ΔBUSCON	ΔPROD	ΔEFF	ΔBESTPR
Major-advanced	1.0792	0.9762	1.1054	0.9933	1.1129
Advanced	1.1395	1.0264	1.1103	0.9837	1.1287
Transition	1.0121	0.9908	1.0215	0.9855	1.0365
Developing	1.0442	0.9978	1.0465	0.9689	1.0800

decrease, with the major-advanced and advanced countries experiencing the highest change. Furthermore, the comparison with Model P1 shows that OBS activities improve profit productivity in all cases, with the exception of transition countries. The highest improvement in profit productivity is achieved by the advanced countries, followed by major-advanced and developing ones. The change in profit productivity, when OBS is taken into account, is due to an advance in best practice (for all groups of countries except for transition countries) as well as an increase in efficiency (for all groups of countries).

Overall, considering that the performance metrics that we use in the present study are adjusted for risk, as well as that they take into account simultaneously various inputs and outputs (i.e. loans, other earning assets), the appearance of the banks from advanced countries as the best performers is consistent with their overall profile described in Section 2.3. Recall that banks in advanced countries bear the lowest credit risk rates and the highest absolute level of profit. At the same time they have a relative high rate of OBS over total assets and a high rate of loans to total assets that is associated with a low rate of non-interest income over total income. In a similar way, the poor profit productivity of banks in transition and developing countries could be related to their high risk-taking. As Lepetit et al. (2008) show, bank expansion into non-interest income activities is associated

with higher risk and higher insolvency risk compared to banks which mainly supply loans.[18]

3.3 Further analysis

The inclusion of the regulatory and other environmental conditions as determinants of efficiency (e.g. Pasiouras et al. 2009; Lozano-Vivas and Pasiouras 2010) allows us to investigate the impact of these conditions on bank efficiency change depending on whether OBS activities are included in the output vector or not.

In the discussion that follows, we focus on profit efficiency changes since the previously discussed results show that banking cost is not influenced significantly by the addition of OBS as an output. A closer look at the impact of the environmental conditions on the profit efficiency change estimated by year, shows that: (i) the inclusion of OBS does not influence the directional impact of the environmental conditions on profit efficiency; however, the environmental factors result, on average, in a higher improvement in profit efficiency when OBS activities are included in the output vector. These results are consistent with the ones obtained in Lozano-Vivas and Pasiouras (2010); (ii) among all the environmental variables, the regulatory conditions are the ones that exercise a more intense influence on profit efficiency change. More specifically they improve profit efficiency, an improvement that is higher for banks in major-advanced and advanced countries than for the ones in developing and transitions countries; (iii) the regulatory variable that has almost the same impact (on average) on the profit efficiency of all the groups of countries, once OBS is incorporated in the analysis, is the CAPRQ. This variable exercises a negative impact on efficiency. The rest of the regulatory variables contribute to an improvement in profit efficiency regardless of the inclusion of OBS; however, their impact is lower once OBS is incorporated in the model. Additionally, we observe that the regulatory variable SPOWER contributes with much lower intensity to the improvement in profit efficiency in the case of transition and developing countries, compared to major-advanced and advanced countries, once accounting for OBS. Finally, consistent with Lozano-Vivas and Pasiouras (2010), imposing restrictions on bank activities results in an improvement in profit efficiency; (iv) the average impact of the two macroeconomic conditions (GDP and INF) on profit efficiency change is more prominent in developing and transition countries than in major-advanced and advanced countries, worsening profit efficiency.

Thus, these results indicate that the impact of environmental factors on profit efficiency change is not uniform across all the groups of countries and it could depend on other conditioning factors.

[18] It is interesting to note that the poor performance of banks in transition and developing countries appears to be in contradiction with their high level of ROA and ROE shown in Table 2. However, one should keep in mind that: (i) the two profitability ratios obtained from the raw data are not adjusted for risk. The mean risk adjusted ROA (i.e. ROA/st. dev. ROA) for major advanced countries equals 2.25, for advanced ones it is equal to 4.52, for transition ones it equals 2.61, while the corresponding figure for developing countries is 3.38. The corresponding figures in the case of the mean risk-adjusted ROE (i.e. ROE/st. dev. ROE) are: 2.31 (major advanced, 4.92 (advanced), 2.98 (transition), 3.23 (developing), (ii) the use of financial ratios to measure bank performance is not without its criticisms (Halkos and Salamouris 2004), (iii) the use of efficient frontier approaches is considered superior to the use of traditional financial ratios—such as ROA or the cost/revenue ratio—in terms of measuring performance (Berger and Humphrey 1997; Bauer et al. 1998), and (iv) as mentioned in the main body of the text the productivity measures take into account simultaneously various inputs and outputs (i.e. loans, other earning assets).

4 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 4,894 observations from 712 banks operating in 84 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). To control for cross-country specific characteristics the cost and profit frontiers were estimated using the Battese and Coelli (1995) model. Furthermore to account for bank risk, the performance metrics to be explained are the cost and profit per unit of risk, i.e. cost and profit are normalized by the standard deviation of profits.

We found that the cost of the average bank rose by 3.45 % over the period of our study, while the inclusion of OBS does not have a significant impact on the obtained estimations. Using the average-practice cost function to decompose the costs changes we observed that, regardless of the model under consideration, the increase in costs was due to changes in business conditions rather than cost productivity. As it concerns profit, not accounting for OBS, resulted in a decrease in the profits of the average bank by 0.36 %. However, when we included OBS in the model we observed an improvement in almost all the components, resulting in a higher increase in total profits that was equal to 2.82 %. In contrast to the cost model, it was profit productivity rather than the change in business conditions that drove the results. Considering that we estimated risk-adjusted models, one could assume that the risk which is associated with OBS activities has generated additional revenues that offset the marginal increase in costs, leading to a higher increase in profits.

When we disaggregated our measures by level of development, we observed that total cost increased in two cases, with major advanced and developing countries being the exception. However, there were important differences between the four groups. The transition countries were heavily influenced 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, we observed an increase in total profits in all cases; however, the magnitude of this increase was substantially different among countries. As before, profit productivity change rather than the change in business conditions, was the main driver of the total profits change. Thus, it seems that the financial innovation that banks introduced over time by increasing OBS activities, allowed then to reach a profit progress. The disaggregation by level of development illustrated that the inclusion of OBS in the model increases profits, with the major-advanced and advanced countries experiencing the highest change. In general, what differs among the groups of countries is the magnitude of the change with the highest improvement in profit productivity being recorded by the advanced countries followed by major-advanced and developing ones.

The results also revealed two interesting findings as for the environment in which banks operate. First, the inclusion of OBS does not influence the directional impact of the environmental conditions on profit efficiency; however, the environmental factors enhance the improvement in profit efficiency when OBS activities are part of the output vector. Second, among all the environmental variables the regulatory conditions appear to contribute the most on profit efficiency change, with the impact being different not only among the groups of countries but also between the regulatory variables.

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. Particularly, the results show that cost productivity alone seems unable to capture the likely benefits of the change in the product mix of banks due to the development of OBS activities. 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. Overall, the results suggested that while the developments of financial innovations by using OBS have spread in the banking systems around the world, the impact on productivity differs among groups of countries. Our exercise could be of interest to various stakeholders due to the importance of OBS activities in the operation of the banks around the world, over the last decade. Furthermore, our findings may have policy implications as the supervisory agencies may consider the impact of OBS activities on bank productivity while developing regulations related to restrictions on bank activities.

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Appendix 1

Table 6 Information on regulatory variables. This Appendix provides details on the calculation of the regulatory variables that are included in the inefficiency term. The individual questions and answers were obtained from the World Bank database developed by Barth et al. (2001, 2006, 2008)

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 ex change 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

Table 6 (continued)

Variable	Category	Description
		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.

Appendix 2

Table 7 Countries by development status. This Appendix presents the classification of the countries in the sample by development status on the basis of information from the International Monetary Fund and the European Bank for Reconstruction & Development

Development status	Country
Major advanced	Canada, France, Germany, Italy, Japan, USA
Advanced	Australia, Austria, Cyprus, Denmark, Finland, Greece, Hong Kong, Iceland, Israel, Netherlands, Portugal, Singapore, Spain, Sweden, Switzerland
Transition	Bulgaria, Croatia, Czech, Hungary, Kazakhstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine

Table 7 (continued)

Development status	Country
Developing	Argentina, Bahrain, Bangladesh, Bolivia, Botswana, Brazil, Chile, China, Colombia, Costa Rica, Ecuador, El Salvador, Gambia, Ghana, Guyana, Honduras, India, Indonesia, Jamaica, Jordan, Kenya, Kuwait, Lebanon, Malawi, Malaysia, Malta, Mauritius, Morocco, Namibia, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Peru, Philippines, Qatar, Saudi Arabia, South Africa, Sri Lanka, Swaziland, Thailand, Trinidad, Tunisia, Turkey, UAE, Venezuela

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