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An Examination of Banks' Cost Efficiency in Central and Eastern Europe

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Abstract

Using a heteroscedastic stochastic frontier model, we will investigate the commercial banks cost efficiency differences in six emerging countries from Central and Eastern Europe over the period 2005 to 2011. Also, we will highlight the determinants of banks cost efficiency. Our analysis is important because, the efficiency of commercial banks became essential for banks stability. The results showed that a high macroeconomic stability supports the efficiency of commercial banks. Also, banks which undertake higher risks are more inefficient. Therefore, banks with less liquidity, with a lower solvency rate and a higher credit risk are more inefficient than more cautious credit institutions. By analyzing the evolution of the cost index, we have noticed that the banks from all the banking systems included in our study managed to increase the level of efficiency until 2008. The year 2009 brought upon it a decrease of the efficiency for the banks from Poland, Romania, Russia and Hungary. At the same time, for the banks from Bulgaria and the Czech Republic we can notice a stagnation of the efficiency index.

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*Keywords:*efficiency; performance; risk; emerging countries.

1. Introduction

The banking systems in most of the countries have been negatively affected by the global financial crisis. In such context, the efficiency and cost optimization have become essential for commercial banks. Moreover, in the emerging countries, the existence of a solid and efficient banking system is a crucial condition for a sustainable economic growth. The banking systems from Eastern Europe have experienced, in the last few decades, similar

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phases in their waytowards a market economy. Passing from a centralized planned economy to a market economy involved the reorganization of the financial system. The liberalization, the reform of the legislative framework and the privatization were the main factors that have influenced the banking activity at the beginning of the 1990s. The end of the century depicted how these banking systems were dealing with transition-specific problems: growth of inflation, negative interest rates and bankrupt banks. Financial and banking crises took place in Bulgaria, over the period 1996 to 1997, in Russia, in 1997 and in Romania, over the period 1998 to 1999. Czech Republic, Hungary and Poland were less affected in comparison with the other countries. The 2000s have marked the beginning of the revival of the economic growth in these countries. In these conditions, in Eastern Europe, the global financial crisis occurred after a period of economic growth, financed mainly by external loans, which generated an economic environment characterized by an increasing disequilibrium. Therefore, the region became vulnerable at the sudden slowdown of the external loans which occurred in the autumn of the year 2008. Hence, Montoro and Rojas-Suarez (2012), Klingen (2013) showed that the banks in Central and Eastern Europe were more affected by the global financial crisis in comparison with other regions.

Taking into account the importance of efficiency, in this study we will focus on the determinants of banks cost efficiency for commercial banks from six emerging countries. Therefore, we will be able to identify the way in which environment variables and control variables influence the level and the variability of cost efficiency. In our study, we have included observations for commercial banks from Bulgaria, the Czech Republic,Poland, Romania, Russia and Hungary over the period 2005 to 2011. The cost efficiency is estimated through the model proposed by Wang (2002). More exactly, we will be able to identify how the development of the financial sector, the credit risk, the solvency risk, the bank's performance, the loan specialization, the level of liquidity, the efficiency of financial intermediation influence the level and the variability of the efficiency. In our opinion, the results are important to understand how the activity of the commercial banks from the emerging countries in Eastern Europe has evolved.

The rest of the article is organized as follows: section 2 reviews the literature on efficiency studies, paying special attention to emerging commercial banks. Section 3 presents the methodology framework adopted in this study. Section 4 describes the data and variables. Section 5 displays the empirical results. Finally, section 6 presents the conclusions.

2. Literature review

In the economic literature there are various studies that use stochastic frontier analysis (SFA) and data envelopment analysis (DEA) to estimate the efficiency of the commercial banks. Hereinafter, we will present the results and objectives of these studies, focusing our attention on those related to the commercial banks from the countries included in our study.

The first category is represented by cross-country studies. Bonin *et al.* (2005) examined the effects of ownership on bank efficiency for eleven transition countries over the period 1996 to 2000, using SFA. Their findings revealed that foreign banks are more cost-efficient than other banks. Moreover, bank size was found to be negatively correlated with efficiency. Fries and Taci (2005) investigated cost efficiency of banks in 15 East European countries over the period 1994 to 2001. The results showed that private banks are more efficient than state-owned banks. The authors underlined the non-linear association between a country`s progress in banking reform and cost efficiency. Koutsomanoli-Filippaki*et al.* (2009) estimated bank efficiency and productivity in Central and Eastern European countries over the period 1998 to 2003. The results revealed that foreign banks are more efficient than domestic private and state-owned banks. Moreover, their findings suggest strong links of competition and concentration with bank efficiency. Yildirim and Philippatos (2007) studied cost and profit efficiency of banks in 12 transition countries over the period 1993 to 2000. The results indicated that foreign banks were more cost-efficient but less profit-efficient relative to state-owned and private domestic banks. Borovička (2007) investigated the relationship between efficiency and cost efficiency in 19 European transition economies. The results indicated that the cream-skimming effect is significant, which implies that foreign investors tend to acquire the most cost efficient banks in the first place. Brissimis*et al.* (2008) studied the relationship between sector reform and bank efficiency in 10 newly acceded EU countries. Their findings revealed that both banking sector reform and competition have a positive effect on efficiency. Moreover, the capital and credit risk have a negative impact on performance, while higher liquid assets reduces the efficiency and productivity of banks. Andrieş (2011) studied the determinants of banks

efficiency and productivity in seven Central and East European countries over the period 2004 to 2008. The results showed that both the efficiency and productivity improved in the analysed period. Fang *et al.* (2011) examined cost and profit efficiency and their determinants in six transition countries of South-Eastern Europe over the period 1998 to 2008. The results revealed a higher efficiency for foreign banks and the fact that the degree of individual banks' competitiveness and institutional development are positively associated with cost and profit efficiency.

Another important category in the efficiency literature is single country studies. Tochkov and Nenovsky (2009) evaluated the efficiency of Bulgarian banks and its determinants over the period 1999 to 2007. Their findings indicated a higher efficiency for foreign banks. Capitalization, liquidity, and enterprise restructuring had a positive effect on efficiency, while banking reforms had an adverse effect.Podpiera andPodpiera (2005) analysed the relationship between banks cost efficiency and bank failures using data for Czech banking sector over the period 1994 to 2003. The results showed that cost inefficient management was a predictor of bank failures during the years of banking sector consolidation. The authors suggested suggest the inclusion of cost efficiency in early warning systems.Molnár and Holló (2011) showed that cost efficiency in Hungarian banking sector is very low in comparison with other 25 EU banking systems. The authors suggested a series of measures that could be adopted to boost competitive pressures.Havrylchyk (2006) examined the efficiency of the Polish banks over the period 1997 to 2001 using DEA. The results indicated that bank efficiency has not improved during the years analyzed. Moreover, foreign banks that acquired domestic institutions have not succeeded in enhancing their efficiency. Karas*et al.* (2010) investigated the ownership effect on bank efficiency in Russia. Their findings showed that foreign banks are more efficient than domestic private banks and domestic private banks are not more efficient than domestic public banks. Asaftei and Kumbhakar (2008) analysed the relationship between cost efficiency and the regulation implemented by central bank in Romania over the period 1996 to 2002 using both SFA and shadow cost functions. The results revealed that the cost of technical inefficiency decreased in the years following tightening of regulation.

As we can see, most ofthesestudiesaimedat identifying the relationship between efficiency and ownership, but was also focused on the factors that influence efficiency. We will focus, in our study, on identifying the determinant factors of cost efficiency.

3. Methodology

Generally, banks cost efficiency is estimated by using either stochastic frontier analysis, or data envelopment analysis. In our study, we have used a SFA model. We have chosen SFA because it allows the specification of a composed error that can be decomposed in two parts: a one-sided error that measures the non-negative inefficiency effects and a classical random error. The DEA does not allow for the presence of a random error term to quantify the error. Therefore, any deviation from the efficiency frontier is associated to inefficiency.

The SFA was independently proposed by Aigner*et al.* (1977) and Meeusen and Van den Broeck (1977). Belotti*et al.* (2012) makes a thorough description of the SFA models that estimate efficiency through panel data. In this article we use Wang's (2002) heteroscedastic stochastic frontier. This model allows us to specify both the mean and the variance of the inefficiency turbulence and to investigate the nonmonotonic effects on efficiency. Moreover, Lai and Huang (2010) showed that Wang's (2002) model is the best specification from eight SFA models.

Wang's (2002) heteroscedastic model, in which the relationship of the expectation of u_{it} to Z_{it} is nonmonotonic, can be expressed as follows:

$$TC_{it} = f(Y_{it}, P_{it}) + v_{it} + u_{it}, \quad v_{it} \sim N(0, \sigma_v^2), u_{it} \sim N^+(\mu_{it}, \sigma_{it}^2)(1)$$
$$\mu_{it} = \delta_0 + Z_{it}\delta(2)$$
$$\sigma_{it}^2 = \exp(\gamma_0 + Z_{it}\gamma)(3)$$

where TC_{it} is the total cost of bank i in year t; Y_{it} and P_{it} are vectors of the output and the price of inputs, respectively, and v_{it} is the stochastic error term with independent and identically distributed normal distribution.

The author assumes that the distribution of u_{it} is $N^+(\mu_{it}, \sigma_{it}^2)$, with an observation-specific mean (μ_{it}) and variance (σ_{it}^2) of its pre-truncated distribution. The Z_{it} has two different coefficients: δ is for the mean and γ is for the variance of the pre-truncation normal. Both μ_{it} and σ_{it}^2 depend on certain determinants (Z_{it}). Moreover, the determinants (Z_{it}) can have both positive and negative effects on the inefficiency effect(μ_{it}).

4. Data

Our sample covers an unbalanced panel dataset of 735 observations over the period 2005 to 2011. The commercial banks included in the study are from Bulgaria (93 observations), the Czech Republic (76 observations), Poland (113 observations), Russia (283 observations), Romania (121 observations) and Hungary (49 observations). The data were extracted from BankScope database.

In order to establish the inputs and the outputs, we used the intermediation approach developed by Sealey and Lindley (1977). Thus, we consider banks to be financial intermediary that uses inputs (labour, physical capital, deposits) to generate assets. The output vector includes total loans and total securities. In order to ensure comparable quality we have subtracted loan loss provisions from total loans. The input prices are price of funds, price of capital and price of labour. The price of funds is measured by dividing total interest expenses by total deposits and other purchased funds. The price of capital is defined by the ratio of other noninterest expenses to total fixed assets. The price of labour is calculated as personnel expenses divided by total assets. Most of the studies measures price of labour as personnel expenses divided by number of employees. Unfortunately, for a significant number of banks data on number of employees were not available. The total cost of each bank is the sum of interest expenses and noninterest expenses. In order to ensure the homogeneity of the cost function, total cost, price of labour and price of capital were normalized by price of funds. All monetary values were deflated by using the Gross Domestic Product (GDP) deflator provided by the International Monetary Fund, with 2005 as the base year. Through the cost efficiency scores, we will identify the differences between the countries, as well as the way in which banks´ efficiency has evolved during 2005-2011.

The main objective of our study is to identify the determinants of the inefficiency. Among the factors that influence inefficiency we have included environment variables and control variables. Domestic credit provided by banking sector over GDP and the real interest rate are environment variables.

Domestic credit provided by banking sector over GDP reflects the development of the financial sector (Lensink*et al.*, 2008). A higher ratio should be associated with higher bank cost efficiency. The real interest rate, calculated as the difference between the lending rate and the inflation rate, affects the demand for loans in economy. Bordo*et al.* (2002) stated that a higher real interest rate will increase the burden of the debt for borrowers and may increase the likelihood of loan defaults.

The Return on Assets (ROA), the net interest margin (NIM), the loans to total assets ratio, the nonperforming loans to total loans ratio, the ratio between loans and deposits and the liquidity rate are control variables.

The ROA and the NIM are measures of bank profitability. Basically, banks with a high profitability rate should be more efficient. Moreover, the two rates are commonly used in the literature to describe the performance of the banks (de Haas and van Lelyveld, 2006; Xu, 2011).Net loans to total assets ratio is a measure of loan specialization. Freixas (2005) posits that a high rate provides informational advantages, which reduce intermediation costs and improve profitability. However, Heffeman and Fu (2010) state that very high ratios could also reduce liquidity and increase the number of marginal borrowers that default. Therefore, the influence of net loans to total assets ratio could either be positive, or negative. Fries and Taci (2005) consider that loans to customer deposits ratio is a measure of the efficiency of the financial intermediation process. Thus, a very low ratio could indicate banks´ incapacity to transform deposits into loans. Other authors see this ratio as a measure of the liquidity risk, higher values indicating an increased liquidity risk for banks (Williams and Nguyen, 2005). Basically, a higher ratio should have a positive impact on efficiency. Nonperforming loans to gross loans ratio is a measure of credit risk. A high rate indicates bigger costs for the banks and implicitly, a decreased efficiency. Berger and DeYoung (1997) state that in order to reduce the level of the nonperforming loans, banks make higher expenses related to: monitoring, negotiating workout arrangements, seizing and disposing of collateral, diverted senior managerial focus. Naturally, banks with a higher non performing loans rate are more inefficient.Equity to total assets ratio is a measure of solvency risk. Its effect on efficiency is rather vague. On one hand, banks with higher ratio benefit from lower borrowing costs, being perceived as more reliable, but they can also ignore potentially profitable investment opportunities. On the other hand, a lower ratio can indicate capital adequacy problems (Heffernan and Fu, 2010).Liquid asset to deposits and short term funding is a measure of liquidity risk. A higher ratio indicates a lower liquidity risk, and reflects banks´ ability to respond to loan demands. Also, banks with high liquidity can cope easily with possible unexpected deposit withdrawals or liquidity crises occurring on the interbank market. The influence

that liquidity risk has on inefficiency should be negative.

5. Results

The estimation of the model was realized through Stata 10.1 software. In the estimation, we use Wang´s (2002) heteroscedastic model. The results are shown in table 1.

Table 1. Estimation results for the cost frontier

Dependent variable ln(TC/PC)	Coefficient
Independent variables	
ln(TL)	0.8047*
ln(TS)	0.2131*
ln(PL/PF)	0.7301*
ln(PC/PF)	-0.1692**
$\ln(TL)^2$	0.0190***
$\ln(TS)^2$	0.0077***
$\ln(PL/PF)^2$	0.2360*
$\ln(PC/PF)^2$	0.0208*
ln(TL) × ln(TS)	-0.0345**
ln(TL) × ln(PL/PF)	-0.0720*
ln(TL) × ln(PC/PF)	0.0683*
ln(TS) × ln(PL/PF)	0.0591*
ln(TS) × ln(PC/PF)	-0.0422*
Year	-0.0246**
$Year^2$	-0.0001
ln(TL) × year	0.0091*
ln(TS) × year	-0.0056*
ln(PL/PF) × year	-0.0017
ln(PC/PF) × year	-0.0036
Constant	0.5479***
Effects on μ_{it}	
Real interest rate	0.0021*
Domestic credit to GDP	0.0008*
ROA	-0.0021*
Net interest margin	0.0050*
Loans to total assets	-0.0090*
Loans to customer deposits	-0.0001***
Impaired loans to gross loans	0.0036*
Equity to total assets	-0.0012**
Liquid Assets to Deposits & Short Term Funding	-0.0008*
Constant	0.8177*
Effects on σ_{it}^2	
Real interest rate	0.0555*
Domestic credit to GDP	-0.0357*
ROA	0.1545*
Net interest margin	-0.0168
Loans to total assets	-0.0929*
Loans to customer deposits	0.0146*
Impaired loans to gross loans	0.1060*
Equity to total assets	0.0998*
Liquid Assets to Deposits & Short Term Funding	-0.0023
Constant	-2.9461*
σ_v	-7.3105*

Notes: *denotes test statistic significance at the 1% level.
**denotes test statistic significance at the 5% level.
***denotes test statistic significance at the 10% level.

As we can see, most of the coefficients related to output and input prices are positive and significant. The coefficient related to PC/PF has a negative influence on total costs. However, the squared coefficient of the PC/PF is positive and significant. Therefore, bigger outputs and higher prices for inputs generate increased costs.

The influence that the environment variables included in the model have on inefficiency reveals important conclusions. Surprisingly, the results indicate that a higher domestic credit provided by banking sector over GDP ratio is related to higher inefficiency. In our opinion this result can be explained by the fact that a high domestic credit over GDP characterizes a tougher competition, which may lead to lower interest margins. Also, banks could reduce the loan standards in their attempt to increase the market share. On the other hand, a higher level of financial intermediation will lead to lower inefficiency variability. A high real interest rate will lead to an increase in the banks´ inefficiency level and also to an increase of the variability of the inefficiency effect. Thus, the increase of the real interest rate will have a negative effect on the loans demand and will decrease the efficiency of the commercial banks. A similar result was also obtained by Sanchez *et al.* (2013).

Hereinafter, we will analyze the influence of the control factors on cost efficiency. Banks with a higher ROA are more efficient. The obtained outcome is similar with the efficiency literature findings that indicate the fact that banks with a higher level of profitability are more efficient (Fries and Taci, 2005; Zajc, 2006; Yildirim and Philippatos, 2007; Hermes and Nhung, 2010). However, an increase in the ROA will lead to an increase in the variability of efficiency.

Surprisingly, the net interest margin has a positive influence on inefficiency. The result can be explained through that fact that a higher interest margin is a sign of higher credit risk. Maudos and de Guevara (2004) and Lepetit*et al.* (2008) make reference to the fact that banks will increase the net interest margin if the credit risk is higher.

The loans to assets ratio, a measure of loan specialization, has a negative effect on inefficiency, a growth with 1% of the loans to total assets ratio will lead to a decrease in inefficiency with 0.9%. Also, a higher level of this ratio will lead to a decrease of the variability of efficiency. In these conditions, a higher ratio of the loans in total assets and an increased lending-focused activity of the banks lead to a higher efficiency for the banks. Loans to customer deposits ratio has a negative influence on inefficiency and a positive influence on the variability of inefficiency. Therefore, commercial banks with a higher level of financial intermediation are more cost efficient.

Banks with an increased credit risk, namely a higher ratio of NPLs in total loans, are more inefficient. Also, a growth of this ratio will lead to an increase in the variability of the inefficiency. The result is in line with expectations, if we take into account that non performing loans generate additional costs for banks. A positive relation between the credit risk and inefficiency was identified also by Lensink*et al.* (2008), Fries and Taci (2005), Sun and Chang (2011).

Equity to total assets ratio, a measure for solvency risk, has a negative influence on inefficiency. Thus, commercial banks with a low solvency risk, namely a higher equity to assets ratio, are more efficient. In these conditions, they are perceived as being more reliable, less indebted, and have lower borrowing related costs. The influence of the equity to total assets rate on the variability of efficiency is positive. Zajc (2006) posits that a higher share of equity implies a smaller share of other liabilities (deposits and issued securities) and implicitly, lower interest related expenses. In line with expectations, banks with a higher liquidity ratio are more efficient. On the other hand, the liquidity ratio does not have a significant influence on the variability of inefficiency. In these conditions, we can state that the banks that respond more promptly to the loan demands and the needs of their customers manage their costs more efficiently.

The following table presents the cost efficiency index for the commercial banks from the countries included in our study. The chronological analysis of the index of efficiency reveals significant aspects.

Table 2.Cost efficiency index

	Bulgaria	Czech Republic	Poland	Romania	Russia	Hungary
2005	0.6845	0.6111	0.6556	0.7097	0.7648	0.7884
2006	0.6805	0.6414	0.6992	0.7166	0.7637	0.7850
2007	0.7362	0.6622	0.7199	0.7701	0.7871	0.7962
2008	0.7650	0.6939	0.7366	0.7765	0.7137	0.7927
2009	0.7773	0.7010	0.7160	0.7187	0.6434	0.7392
2010	0.7607	0.7097	0.7360	0.6875	0.6963	0.7431
2011	0.7712	0.6903	0.7748	0.6998	0.7266	0.7096

Thus, we can observe the fact that over the period 2005 to 2008, the commercial banks from all the countries, except for Russia, have recorded growths of the index of efficiency. Later, for the banks from Bulgaria and the Czech Republic we notice a constant evolution of the index of cost efficiency. The commercial banks from Russia have recorded increases of the efficiency index during 2005-2007. Later on, between 2008 and 2009, the cost efficiency has dropped. Remarkably, in 2009 the efficiency of the commercial banks from Poland, Romania, Russia and Hungary has dropped significantly, tendency being maintained in 2010 for the banks from Romania. In our opinion, the decrease of the cost efficiency index is a consequence of the effects of the global financial crisis that has affected the commercial banks. An outstanding fact to notice is the performance of the banks from Poland, which in 2011 have reached the highest efficiency index.

6. Conclusions

In this article we have analyzed the costs´ efficiency of the commercial banks from 6 European transition countries during 2005-2011, through a SFA model. As we see it, it is important to know the way in which the efficiency of the banks has evolved and its determinants. To reach this objective we have included in the model variables that characterize the level of economic development, the macroeconomic stability, the credit risk, the solvency risk, the bank's performance, the loan specialization, the level of liquidity and the efficiency of the financial intermediation process. Also, through the cost efficiency index we have identified the differences in efficiency in a cross country analysis.

The results revealed important conclusions. The influence of the environment factors on the commercial banks´ efficiency indicates that a high macroeconomic stability supports the efficiency of commercial banks. Surprisingly, a higher ratio of the domestic credit provided by banking sector over GDP influences positively the inefficiently. We have explained this outcome by the ever-enhancing competitiveness.

Commercial banks that focus on the traditional activity of loan granting are more efficient in comparison with the banks that have a lower share of loans to total assets. Also, banks which undertake bigger risks are more inefficient. Therefore, banks with less liquidity, with a lower solvency rate and a higher credit risk are more inefficient than more cautious credit institutions. The banks with higher performance are more efficient. A noticeable fact is that a growth of the net interest margin will lead to a growth of the inefficiency.

By analyzing the evolution of the cost index, we have noticed that the banks from all the banking systems included in our study managed to increase the level of efficiency until 2008. The year 2009 brought upon it a decrease of the efficiency for the banks from Poland, Romania, Russia and Hungary. At the same time, for the banks from Bulgaria and the Czech Republic we can notice a stagnation of the efficiency index.

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