Bank efficiency and regulations: Evidence from new EU member states

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Abstract

This paper investigates the relationship between cost efficiency and regulations and structural reforms in credit, financial, labor and business in a sample of banks from Central and Eastern Europe from 2004 to 2009. Moreover, we use an assortment of information, not used before such as indicators of the European Bank for Reconstruction and Development (EBRD), on the degree to which regulations/reforms in credit/financial labor and business market may impede competition and distort bank behavior and, as a result, generate cost inefficiency in the mix of inputs used by banks. Cost inefficiency scores for banks in ten new EU member countries of Central and Eastern Europe are estimated using a stochastic frontier analysis. These are then employed in panel models, both static in terms of standard fixed effects models but also dynamic and panel-VAR models that count for endogeneity issues, to estimate the impact of regulation on bank specific efficiency in transition countries so as to determine the impact of regulation and liberalisation that accession to the EU requires. Overall, the results indicate that structural reforms exert a positive impact on bank efficiency.

Keywords: *Regulation; reforms; bank cost efficiency; new EU member states.*

JEL Classification*: G21, P34, P52*

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1. Introduction

The Basel Committee on Banking Supervision (BCBS) has updated the general framework of guidelines for capital and banking regulations so that Basel III aims to strengthen global capital and liquidity regulations further after the 2008 financial crisis exposed the vulnerability of the banking system. However, concerns about the health of the European Union (EU) banking system have escalated more recently as a result of the direct exposure of European banks to troubled sovereigns reinforced by a weaker growth outlook for the European Union region and stressed global funding markets. Furthermore, as the new regulatory standards are put into effect European banks and EU lawmakers have started to realize the great challenges banks face to comply with increased capital and liquidity requirements. Against the backdrop of continuing financial market turbulence, falling lending volume compounded by exposures to distressed sovereigns, banks find it even more difficult to remain profitable which brings into the forefront the issue of efficiency.

Prior to the financial crisis forces such as globalization, technological change, and deregulation contribute to the progressive process of financial integration and increased competition in the financial services industry have fundamentally transformed the European banking system (ECB 2010, Fiordelisi and al. 2010). As a consequence of this, stronger emphasis is put on the importance of improved efficiency in the banking sector. Given the restructuring that took place in the last decade, empirical studies focusing on banks from Central and Eastern Europe (transition countries), especially those that have become EU members in recent years, offer a good ground to investigate the impact of regulations/reforms on bank efficiency and should be of particular interest to policy makers and central banks.

While there is a plethora of studies on bank X-efficiency (see Appendix Table A1 for a summary of the literature review), their focus is typically been on the relationship between ownership structure, asset size and bank efficiency rather than the role of regulation; see for example, the studies of Havrylchyk (2006) and Yildirim and Philippatos 2007) for transition economies. Furthermore many studies cover either individual countries (Asaftei and Kumbhakar 2008, Tochkov and Nenovsky 2011,) or a limited number of transition economies (Weil 2003, Kasman and Yildirim 2006). Passiouras and al. 2009 underline the

fact that the impact of the regulatory environment on bank cost and/or profit efficiency, as opposed to other measures of bank performance has received comparatively little attention.

Our study seeks to fill this gap by examining banking efficiency for 10 countries in the Central and East European region regarding to different types of regulation for the period 2004 to 2009. In this study, we use an assortment of information, not used before such as indicators of the European Bank for Reconstruction and Development (EBRD)[2], on the degree to which regulations/reforms in credit/financial labor and business market may impede competition and distort bank behavior and, as a result, generate cost inefficiency in the mix of inputs used by banks. We investigate the impact to cost efficiency of regulations related to credit market, as well as restrictions on labor and business market, while controlling for other bank-specific and country and institutional-specific characteristics. Our paper contributes to the banking efficiency literature in three directions: (1) using X-efficiency as opposed to standard financial indicators or bank ratings as a measure of bank performance to test the impact of regulations on bank behaviour; (2) evaluating the impact of bank-specific, country-specific and institutional factors on bank efficiency using the Fraser Index of Economic Freedom (Gwartney et. al, 2010) and EBRD indicators which have not been addressed in this framework previously; (3) providing new empirical evidence on the relationship between bank efficiency, credit, labour and business regulation in transition economies.

The structure of the paper is as follows. Section 2 reviews the existing literature on bank efficiency and regulation. Section 3 describes the definition of variables, and the econometric models employed. Section 4 presents the data used and the descriptive statistics. Section 5 discusses the empirical results and section 6 concludes the paper.

2. Bank efficiency and regulations

The last three decades new types of regulation[3] have emerged with the Basel Accords and its capital adequacy requirements and supervision practices. Market failures such as

[2]In the literature the existing studies (e.g. Fries et al. (2006), Koutsomanoli-Filippaki, Mamatzakis, and Staikouras (2009), Brissimis and al. 2008 and Delis and al.2011) have considered the EBRD index of banking sector reform as a structural index. In our study we consider the indicators of different types of regulatory reform and their influence on bank efficiency.

[3]See Mishkin (2000), Barth, Caprio, and Levine (2004), and Allen and Herring (2001) for a review of literature on different types of banking regulation.

externalities, market power or asymmetry of information between lenders and borrowers can justify banking regulation. There are two justifications that are often put forward for regulating banks: the risk of a systemic crisis and the inability of depositors to monitor banks (Goodhart et al 1998, Santos 2001). The literature on banking economics (e.g. Dewatripont and Tirole 1994, Freixas and Rochet 1997, Barth 2006, 2010, VanHoose 2007) suggests that capital adequacy rules have an impact on bank behavior in two contradicting ways. On the one hand it is clear that capital adequacy regulation plays an important role in the solvency position of banks helping them to avoid bankruptcies and their negative consequences on the financial and economic system. In that case, regulation increases efficiency by pushing banks into competition. Barth 2006 qualifies this view as the "public interest view". From the "private interest view" (Barth 2006) the imposition of capital requirements may increase the risk-taking behavior of banks (Kim and Santomero 1988, Genotte and Pyle 1991, Rochet 1992, Besanko and Katanas 1996, Alexander and Baptista 2006, and VanHoose 2007). We can think that capital adequacy rules need higher capital requirements for loans to private sector comparing with those to the public sector so banks either they will substitute between these two types of assets or they finance more profitable but riskier loans. Thus these adverse incentive effects of regulation can lead to an efficiency loss. Thus as VanHoose (2007) states, stricter capital standards may impact banks' efficiency by influencing the quantity and quality of lending and by substituting loans with alternative forms of assets. Thus if banks respond to capital regulation by making riskier asset choices or failing to devote sufficient resources to evaluating adverse selection or moral hazard risks the cost and/or profit efficiency of banks will be affected: different asset portfolios with different returns will require different types and amounts of inputs.

Empirical research in cross-country studies has analyzed the impact of regulations on bank performance considering different financial measures (Barth, Caprio, and Levine 2004 and 2008), or bank ratings (Pasiouras and al. 2006, Demirgüç-Kunt, Detragiache and Tressel, 2008). In a relatively recent study Barth, Caprio, and Levine (2008) argue that following Basel guidelines many countries strengthened capital regulations and official supervisory agencies, but existing evidence showed that these reforms did not improve bank stability or efficiency. Other cross-country studies have considered financial and non-financial factors to analyze the impact of regulations on bank efficiency (Pasiouras, Tanna, and Zopounidis 2009, Barth and al. 2010, Delis and al. 2011 among others). The efficiency measures for the banks considered at these studies are constructed based on non-parametric methods to

evaluate the performance of the individual banks. They construct the bank's 'best practice' frontier and measure bank efficiency as the distance from that frontier. The results of these studies are not very conclusive as they are existing conflicting results. Barth et al., (2001) in a cross-country investigation, they found that greater regulatory restrictions on bank activities are associated with (1) a higher probability of suffering a major banking crisis, and (2) lower banking-sector efficiency. In a more recent study Bart and al. (2010) in a large sample of banks from 72 countries found that bank regulation, in particular that tighter bank activity restrictions, exert negative impacts on bank efficiency, while the greater capital regulation stringency exerts marginally positive effects on bank efficiency. However, Pasiouras, Tanna, and Zopounidis (2009) in a sample of commercial banks operating in 74 countries found that stricter capital requirements, related to the first pillar of Basel II, had a positive impact on cost efficiency but a negative impact on profit efficiency. Delis and al. (2011) in a sample of banks from 22 countries in transition economies find that regulations relating to the first and second pillars of Basel II, namely, capital requirements and official supervisory power do not have, in general, a statistically significant impact on productivity. In a recent study Brissimis and al. (2008) examined the relationship between banking sector reform and bank performance-measured in terms of efficiency, total factor productivity growth and net interest margin in a sample of banks from 10 countries in transition economies over the period 1994-2005. In order to analyse the reforms in the banking industry they consider a structural index of EBRD banking reform indicators. They found that both banking sector reform and competition has a positive effect on bank efficiency, while the effect on total factor productivity is significant only toward the end of the reform process.

The Fraser Index on Credit market regulation includes ownership of banks (percentage of deposits held in privately owned banks), competition (the extent to which domestic banks face competition from foreign banks), extension of credit (percentage of credit extended to the private sector) and presence of interest rate controls. Recent studies have shown that competition may improve efficiency, reduce costs and limit the vulnerability of the banking sector to adverse shocks (Besanko and Thakor, 1992; Cordella and Yeyathi, 2002). Some studies have analyzed the impact of foreign banks entry on the credit market and the economy and mention the benefits (Levine, 1996; Brealey and Kaplanis, 1996; Claessens et al., 2001; Haas and Lelyveld, 2005). Barth and al. (2004) provide evidence of a positive relationship between barriers to foreign-bank entry and bank fragility. Regarding the ownership structure of banks Barth and al. (2004) find a strong negative correlation between

government ownership and bank development, efficiency, and stability. Pasiouras, Gaganis and Zopounidis (2006), argue that there is no evidence that government owned banks are associated with positive outcomes.

3. Empirical Methodology

This paper opts to measure bank performance using the concept of cost efficiency. This, in detail, measures technical efficiency, based on the assumption that financial firms main objective is to economically optimise, such as cost minimization, and accordingly, are defined in terms of distance to an economic (cost) frontier. In other words, the indicators of cost efficiency count for the degree of achievement of this main economic objective by comparing the observed costs of each bank with the optimum figures (potential minimum costs or potential maximum profits) that it could have obtained (Pastor and Serrano, 2005).

3.1 Measuring Cost Efficiency

To estimate cost inefficiency, we employ the stochastic frontier approach (SFA), as developed by Aigner et al. (1977) and Meeusen and Van den Broeck (1977). This approach incorporates both noise and inefficiency into the model specification in a "composite" error term and imposes distributional and independence assumptions to disentangle the two error components.

In particular, in the case of the cost frontier, we assume the following specification:

$$TC_{it} = f\,(P_{it}, Y_{it}, N_{it}, Z_{it}) + v_{it} + u_{it} \qquad (5)$$

where TC_{it} denotes observed total cost for bank i at year t, P is a vector of input prices Y is a vector of outputs of the firm, N is a vector of fixed netputs and Z is a vector of control variables. The error term is disentangled in two components: the first one, v_i, corresponds to the random fluctuations and is assumed to follow a symmetric normal distribution around the frontier, while the second one, u_i, accounts for the firm's inefficiency that may raise costs above the best-practice level and is assumed to follow a half-normal distribution.

To empirically implement the cost frontier, we opt for the following translog specification:[4]

$$\ln TC_i = \alpha_0 + \sum_i a_i \ln P_i + \sum_i \beta_i \ln Y_i + ½ \sum_i \sum_j a_{ij} \ln P_i \ln Pj + ½ \sum_i \sum_j \beta_{ij} \ln Y_i \ln Y_j$$

[4]For simplification, we omit the subscripts for time ($_t$).

$$+\sum_i\sum_j \delta_j \ln P_i \ln Y_j + \sum_i \varphi_i \ln N_i + ½ \sum_i\sum_j \phi_{ij} \ln N_i \ln N_j + \sum_i\sum_j \xi_{ij} \ln P_i \ln N_j$$
$$+\sum_i\sum_j \zeta_{ij} \ln Y_i \ln N_j + \theta_1 t + ½\theta_2 t^2 \sum_i \mu_i t \ln P_i + \sum_i \kappa_i t \ln Y_i +$$
$$+\sum_i \nu_i t \ln N_i + kD_i + \sum_i \xi_i Z_i + u_i + v_i \qquad (6)$$

Standard linear homogeneity and symmetry restrictions in all quadratic terms are imposed in accordance with economic theory, while we also include both country and time effects. The stochastic frontier model (6) is estimated via a maximum likelihood procedure parameterized in terms of the variance parameters $\sigma_\varepsilon^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2 / \sigma_\varepsilon^2$.

3.2 Determinants of Cost Efficiency

The next part of the analysis uses the cost efficiency scores in 3.1 to estimate the impact of the regulatory environment in these transition economies, using as control variables bank specific characteristics, the structure of the national financial systems and the level of economic development.

3.2.1 *Regulations*

A major focus of the paper is to examine the impact of regulation on the performance of the banking sector and therefore the Fraser Index of Economic Freedom (Gwartney et. al, 2010) was included in the model. The use of this index is common in the economics literature[5] and consists of five factors: size of government; legal structure and security of property rights; access to sound money; freedom to exchange with foreigners; and regulation of credit, labour, and business. These are weighted and form a composite index, with 0 indicating the lowest and 10 the highest level of economic freedom. It is the last component that is of most interest as the emphasis in this paper is primarily on credit regulations and their impact on the banking industry.

Thus, the credit regulations component is decomposed to account for the following: i) ownership of banks measured as percentage of deposits held in privately owned banks, ii) foreign competition defined as domestic banks face competition from foreign banks (rate of approval of foreign bank applications and the share of foreign banks over the total banking sector assets), iii) private sector credit, measuring the extend that government borrowing does

[5]See for example Carlsson and Lundstrom (2002).

not crowd out private borrowing, and iv) negative real interest rates due to interest rate controls and regulations.

The first two sub-components provide evidence on the extent to which the banking industry is dominated by private firms and whether foreign banks are permitted to compete in the market. The final two sub-components indicate the extent to which credit is supplied to the private sector and whether controls on interest rates interfere with the credit market.

The composite labour (LR) and business regulations (BR) components are also added in the analysis to enrich the results. The LR variable is designed to measure the extent to which labour market rigidities are present. In order to earn high marks in the LR component, a country must allow market forces to determine wages and establish the conditions of hiring and firing, and refrain from the use of conscription. The BR variable aims to identify the extent to which regulations and bureaucratic procedures restrain entry and reduce competition. In order to score high in this part of the index, countries must allow markets to determine prices and refrain from regulatory activities that retard entry into business and increase the cost of producing products. They also must refrain from using their power to extract financial payments and reward some businesses at the expense of others.

The EBRD indicators formulated in 1994[6] represented one of the first attempts at quantifying the level of progress achieved in various aspects of transition. Currently, there are nine indicators, covering four broad aspects of transition (EBRD 2010): enterprises (incorporating small- and large-scale privatisation and enterprise restructuring); markets and trade (price liberalization, competition policy, and trade and foreign exchange system); and financial institutions (banking reform and interest rate liberalization and Securities markets and non-bank financial institutions) and infrastructure (overall infrastructure reform). They were measured on a scale from 1 to 4+, where 1 represented little or no progress in reform and 4 meant that a country had made major advances in transition in a particular aspect which corresponds to an advanced industry market economy.

3.2.2*Bank specific factors*

[6]The indicators have since been broadened and refined. For a detailed review of the reform process see EBRD Transition Report 2010.

A number of control variables were used to account for individual bank characteristics: total assets represent size of the loan portfolio of each bank and is expected to have a positive impact on cost efficiency as it may indicate higher diversification (Mester, 1993); the ratio of loans to assets as a proxy for risk, which is also expected to be positive as it represents well functioning intermediation by the bank and represents the biggest portion of earning assets and also conveys information about bank's risk preference; the ratio of equity to total assets as a proxy of capital adequacy or capital risk, captures the risk preferences of the bank and is expected to be positive as a higher ratio suggests management have greater incentives to ensure bank performance and minimise costs; and finally the loan loss provisions is a proxy for default risk or credit risk as it measures the quality of the credit portfolio. The direction of this impact is not easy to predict for this sample as the quality of the loan portfolio may indicate decreased cost efficiency in the short-term but higher cost efficiency in the medium and long-term as the reforms take effect.

To control for financial structure domestic credit to the private sector as a share of GDP represents the level of development of the financial sector and the Hirschman-Herfindahl index (HHI) is a proxy for the level of competition in the sector. Finally to control for the general level of economic development and capture the sophistication of the domestic market, real GDP per capita in purchasing power parity (PPP) terms used.

Panel data methods allow more complex behavioural models to be estimated (Baltagi, 2005) and thus the general form of the model is specified:

$$Inef_{it} = \mu_i + \beta \sum Z_{it} + \gamma \sum X_{it} + \delta \sum reg_{it} + e_{i,t} \tag{5}$$

, where *Inef* is the vector of bank specific cost inefficiency scores from stage one, *Z* is a vector of bank specific explanatory variables, *X* counts for the level of economic development and financial structure variables, whilst *reg* is a vector of regulation/ and reform indicators such as the Fraser and the EBRD indexes described.

3.2.3 *Panel Vector Autoregression (VAR) Analysis*

An important drawback of estimating equation (5) with standard OLS is the endogeneity bias. We could resolve this bias using dynamic panel analysis. This study opts for a more flexible framework using a panel-VAR analysis. Essentially all variables in the panel-VAR are entering as endogenous so as to able to resolve the causality among them. Also, another

advantage of the panel-VAR is that examines the underlying dynamic relationships rather compared with the static functional form of a standard fixed effects model. To this end, we examine the underlying causality links between cost efficiency and bank regulation using a first order 4x4 panel-VAR model:

$$X_{it} = \mu_i + \Phi X_{it-1} + e_{i,t}, \quad i = 1,\ldots, N, \; t = 1,\ldots,T. \tag{6}$$

, where X_{it} is a vector of four random variables, that is, the bank specific cost inefficiency ($Inef_{it}$), equity to assets (EA_{it}), loans to assets (LA_{it}) and various measures of EBRD reforms: e.g. pri2EBRD (small scale privatisation index), compeEBRD (competition index), secEBRD (securities market index), and infrEBRD (infrastructure index).[7] Thus, Φ is an 4x4 matrix of coefficients, μ_i is a vector of m individual effects and $e_{i,t}$are iid residuals. The panel-VAR takes the following form:

$$\begin{aligned}
inef_{it} &= a_{10} + \sum_{j=1}^{J} b_{11j} inef_{1it-j} + \sum_{j=1}^{J} b_{12j} EA_{1it-j} + \sum_{j=1}^{J} b_{13j} LA_{1it-j} + \sum_{j=1}^{J} b_{14j} EBRD_{1it-j} + e_{1i,t} euro \\
EA_{it} &= a_{20} + \sum_{j=1}^{J} b_{21j} inef_{1it-j} + \sum_{j=1}^{J} b_{22j} EA_{1it-j} + \sum_{j=1}^{J} b_{23j} LA_{1it-j} + \sum_{j=1}^{J} b_{24j} EBRD_{1it-j} + e_{2i,t} \\
LA_{it} &= a_{30} + \sum_{j=1}^{J} b_{31j} inef_{1it-j} + \sum_{j=1}^{J} b_{32j} EA_{1it-j} + \sum_{j=1}^{J} b_{33j} LA_{1it-j} + \sum_{j=1}^{J} b_{34j} EBRD_{1it-j} + e_{3i,t} \\
EBRD_{it} &= a_{40} + \sum_{j=1}^{J} b_{41j} inef_{1it-j} + \sum_{j=1}^{J} b_{42j} EA_{1it-j} + \sum_{j=1}^{J} b_{43j} LA_{1it-j} + \sum_{j=1}^{J} b_{44j} EBRD_{1it-j} + e_{4i,t}
\end{aligned} \tag{7}$$

The moving averages (MA) form of the model sets $inef_{it}$, EA_{it}, LA_{it} and $EBRD_{it}$ equal to a set of present and past residuals e_1, e_2, $e_3$and $e_4$from the panel-VAR estimation:

$$\begin{aligned}
inef_{it} &= \mu_{10} + \sum_{j=1}^{J} b_{11j} e_{1it-j} + \sum_{j=1}^{J} b_{12j} e_{2it-j} + \sum_{j=1}^{J} b_{13j} e_{3it-j} + \sum_{j=1}^{J} b_{14j} e_{4it-j} + e_{1i,t} \\
EA_{it} &= \mu_{20} + \sum_{j=1}^{J} b_{21j} e_{1it-j} + \sum_{j=1}^{J} b_{22j} e_{2it-j} + \sum_{j=1}^{J} b_{23j} e_{3it-j} + \sum_{j=1}^{J} b_{24j} e_{4it-j} + e_{2i,t} \\
LA_{it} &= \mu_{30} + \sum_{j=1}^{J} b_{31j} e_{1it-j} + \sum_{j=1}^{J} b_{32j} e_{2it-j} + \sum_{j=1}^{J} b_{33j} e_{3it-j} + \sum_{j=1}^{J} b_{34j} e_{4it-j} + e_{3i,t} \\
EBRD_{it} &= \mu_{40} + \sum_{j=1}^{J} b_{41j} e_{1it-j} + \sum_{j=1}^{J} b_{42j} e_{2it-j} + \sum_{j=1}^{J} b_{43j} e_{3it-j} + \sum_{j=1}^{J} b_{44j} e_{4it-j} + e_{4i,t}
\end{aligned} \tag{8}$$

[7] There are other EBRD reform indexes that we do not include in this section, but they are included in the empirical estimation. Similarly we employ a panel-VAR for the case of Fraser index of regulations. Namely, namely Credit Regulation (CR_{it}), Labour Regulation (LR_{it}) and Business Regulation (BR_{it}). In order to economise space we do not include equations.

Under the endogeneity assumption the residuals will be correlated and thereforethe coefficients of the MA representation are not interpretable. As a result, the residuals must be orthogonal. We orthogonalize theresiduals by multiplying the MA representation with the Cholesky decompositionof the covariance matrix of the residuals. The orthogonalized, or structural, representation is:

$$\begin{pmatrix} \beta_{11j}\beta_{12j}\beta_{13j}\beta_{14j} \\ \beta_{21j}\beta_{22j}\beta_{23j}\beta_{24j} \\ \beta_{31j}\beta_{32j}\beta_{33j}\beta_{34j} \\ \beta_{41j}\beta_{42j}\beta_{43j}\beta_{44j} \end{pmatrix} = \begin{pmatrix} b_{11j}b_{12j}b_{11j}b_{12j} \\ b_{21j}b_{22j}b_{23j}b_{24j} \\ b_{31j}b_{32j}b_{33j}b_{34j} \\ b_{41j}b_{42j}b_{43j}b_{44j} \end{pmatrix} P \begin{pmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ \varepsilon_{3it} \\ \varepsilon_{4it} \end{pmatrix} = P^{-1} \begin{pmatrix} e_{1it} \\ e_{2it} \\ e_{3it} \\ e_{4it} \end{pmatrix}$$

where P is the Cholesky decomposition of the covariance matrix of the residuals:

$$\begin{pmatrix} Cov(e_{1it},e_{1it})Cov(e_{1it},e_{2it})Cov(e_{1it},e_{3it})Cov(e_{1it},e_{4it}) \\ Cov(e_{2it},e_{1it})Cov(e_{2it},e_{2it})Cov(e_{2it},e_{3it})Cov(e_{2it},e_{4it}) \\ Cov(e_{3it},e_{1it})Cov(e_{3it},e_{2it})Cov(e_{3it},e_{3it})Cov(e_{3it},e_{4it}) \\ Cov(e_{4it},e_{1it})Cov(e_{4it},e_{2it})Cov(e_{4it},e_{3it})Cov(e_{4it},e_{4it}) \end{pmatrix} = PP^{-1} \qquad (11)$$

Using the above panel-VAR individual heterogeneity in the levels is ensured by introducing fixed effects in the model, denoted μ_i, following Love and Zicchino (2006) and the data are forward mean-differenced using the Helmert procedure (Arellano and Bover, 1995). Standard errors of the impulse response functions are calculated and confidence intervals generated with Monte Carlo simulations.

4. Data and Descriptive Statistics

The bank data are from IBCA-Bankscope for 2004-2009.The sample includes 168 banks and, after removing errors and inconsistencies, 1,792 bank/year observations remain in an unbalanced panel. This represents the majority of the financial institutions in the new member transition economies. The bank data allows some cross-country comparisons, shown in Table 1. From the Table there are clearly significant differences in mean total assets, ranging from $920 million in Bulgaria to $6,057 million in the Czech Republic. The equity to assets (E/A) ratio suggests relatively weak cross-country heterogeneity, with 9% in the Czech Republic and 16% in Bulgaria while the loans to assets (L/A) ratio ranges from 45% in Latvia to 63% in Hungary. Loan loss provisions as a share of total loans (LLP/L) is centred around 4%, with the exception of the Czech Republic where it is 13%.

The financial structure variables are also different between countries. Competitiveness in the sector (the Hirschman-Herfindahl index) ranges from 60% in Slovenia to 90% in Estonia, with a mean of 67% and the domestic to private sector as a share of GDP from 24.65% in Romania to 58.38% in Estonia. Not surprisingly, the more developed countries in terms of GDP per capita also have the highest level of financial development, that is, the size of the private sector. Finally Bulgaria has the highest interest spread (16.58%), followed by Romania (11.83%) with the mean at 7.19%.

Table 1

The regulatory variables are shown in Table 2. All the new accession countries score highly in the overall index of credit regulations (CR). The mean score is high (0.85) and only Romania is below 0.8. With respect to the components of the CR index a similar picture emerges. The mean score of the CR-Own index, which measures the private banks share in the banking system is 0.81 while again, only Romania has a comparatively low score (0.45). The scores for the CR-Comp index, which measures the foreign banks in each country's share in the banking system, are lower than the overall index of credit regulations (CR) and the majority of the sample is between 0.7 and 0.8. Finally, the scores for the CR-PrS and the CR-Nir components of the index are very high, which means that on average the state does not crowd-out private borrowing and interest rates are determined largely by market forces in this period. Finally, the new member states score relatively low, in comparison with their CR scores, in labour (LR) and business regulations (BR) with mean of 0.62 and 0.57 levels respectively.

Table 2

The time series data on the regulation indices in Table 3 suggest that these countries have significantly improved their scores in the credit regulations over this period. This is especially true for the CR-Own and the CR-Comp indices as they reflect the lower state ownership and the increased presence of foreign banks resulting from the privatisation programmes and further reform to prepare for EU accession. On the other hand, labour regulations (LR) have improved at a slower rate and business regulations (BR) have fallen.

Table 3

5. Results and Discussion

5.1 *Cost Efficiency Estimates*

Table 4 reports cost inefficiency estimates obtained from equation 6 for each country for the period 2004 to 2009. Country specific inefficiency results indicate a wide range of cost inefficiency scores across countries ranging from 11.3% to 27.1%. According to the SFA results the average cost inefficiency level for 10 transition countries under examination is 20.1% indicating that about 20% of bank resources are wasted during the provision of banking services in transition economies and could reduce its cost by the same amount thus matching its performance with the best-performance bank. The banking system in Estonia (11.3%) is the most cost efficient system and Bulgaria (27.1%) seems to be the least efficient during the sample period. Our results corroborate previous studies for transition economies (e.g. Kasman and Yildirim 2006, Mamatzakis and al. 2008).

Table 4

The results in Table 5 indicate that the average estimated cost inefficiency scores from 2004 (date in which all countries joined the European Union except Bulgaria and Romania who joined the European Union in 2007) to 2009 has decreased from 24.7% to 13.9% showing that the new members countries made significant performance improvements in their banking system once they join the EU market.

Table 5

5.2 *The Determinants of Cost Efficiency*

The two models are remarkably consistent and the expected signs confirmed. The total assets (lnTA) variable is significant at the 5% level and negative, indicating that on average larger banks reduce their costs in their operations. Larger banks are more diversified and have less risk. This result is in line with other studies that find a positive relationship between size and efficiency (Yildirim and Philippatos 2007, Delis and al. 2011). This might be the result of deregulation on asset restrictions in the banking system that allows banks to accrue economies of scale and scope. The ratio loans to total assets (L/A) is used as a proxy of risk

and conveys information about banks' risk preference. This variable is significant and negative at the 1% level in both specifications indicating that banks with higher ratio of loans to assets are more cost efficient. This result corroborates the evidencereported by(Yildirim and Philippatos 2007). Finally, the coefficient of the equity (E/A) ratio is negative with cost inefficiency but statistically not significant.

Table 6

The results of the financial and macroeconomic variables that are presented in Table 6 indicate that inflation (INF) is significant at the 1% level and positively related to cost inefficiency. High inflation affects bank behaviour and induces banks to compete through excessive branch networks (Kasman and Yildirim 2006).The next significant variable at 1% level is concentration (HHI) as a proxy for market power which is negatively related to cost inefficiency. This means that higher concentration is associated with lower costs resulting of either superior management or greater efficiency of the production process (Demsetz 1973). Our result is line with other studies that find a negative relationship between cost inefficiency and concentration (e.g. Yildirim and Philippatos 2007) and in contradiction with Delis and al (2011) who found a positive relationship.

5.3The impact of Fraser Index and EBRD Regulations

First of all we consider the impact of credit regulation (CR), labour regulation (LR) and business regulation (BR) on cost inefficiency (see table Table 7). The results from table 7 indicate that the three variables are not significant. To investigate further the impact of credit regulation on bank efficiency we consider its main components as defined by CR-Comp that is foreign bank presence in the domestic market, by CR-PrS that is government borrowing that does not crowd out private sector borrowing and CR-Nir that is the negative interest rate. The results from table 8 show all these variables are not significant determinants on cost inefficiency except the total assets (lnTA) variable is significant at the 10% level and negatively related to cost inefficiency.

Table 8

To investigate the impact of EBRD reforms on bank inefficiency we consider the main indicators that are small- and large scale privatisation (pr1ebrd) and (pr2ebrd) respectively, enterprise restructuring (entebrd), competition (compebrd), price liberalization (pcebrd),

banking reform (bank ebrd), securities markets reforms (secebrd), and infrastructure reforms (infraebrd). Table 9 presents the results using the EBRD reform indicators and bank-specific characteristics as the independent variables. The results in column 5 indicate that Loan loss provisions as a share of total loans (LLP/L) is significant at the 5% level and positively related to cost inefficiency: a higher level of problem loans is associated with lower cost efficiency level. This ratio is a proxy for credit risk and is expected more efficient banks to better evaluate credit. This result corroborates the evidence reported by Yildirim and Philippatos 2007 and Delis and al. 2011.The variable L/A is as before significant and negative at the 1% level in all specifications. Furthermore the concentration variable (HHI) is as mentioned previously significant at 1% level and negatively related to cost inefficiency. The variable SPR which measures the net interest spread is significant at the 5% level and negatively related to cost inefficiency. As expected an increase in the net interest spread has a positive effect on cost efficiency. A high SPR indicates an effective use of earning assets. Finally the secbrd variable which indicates reforms in Securities markets and non-bank financial institutions is significant at 1% level and negatively related to cost inefficiency. In other words any reform in the financial sector such as for example the development of financial services such as leasing, pension funds and other asset management services have positive effect on bank efficiency.

Table 9

5.3.1 *Panel-VAR IRFs and VDCs of competition reform and efficiency*

As a first step in the panel VAR estimation the optimal lag order j is assumed for the right-hand variables in the system of equations (Lutkepohl, 2006). The Arellano-Bond GMM estimator is used for the lags of j=1,2 and 3.[8] Optimal lag order of one is based on the Akaike Information Criterion (AIC), confirmed by Arellano-Bond AR tests. To test for autocorrelation, more lags are added. The Sargan tests show that for lag ordered one, the null hypothesis cannot be rejected and thus the VAR model is of order one. The lag order of one preserves the degrees of freedom and information, given the low time frequency of the data. In addition, normality tests for the residuals use the Sahpiro-Francia W-test.[9]

[8] Results are available upon request.
[9] The results do not show violation of the normality. Panel Var results are available under request.

Table 10

Table 10 reports cost inefficiency determinants in a dynamic analysis considering one lag. The inefficiency estimate with one lag is positive and significant at the 1% level. This means that past inefficiency exert a positive impact on current inefficiency. The next significant variable at 10% is the ratio equity to assets (E/A) used as proxy to capital risk which is negatively correlated to cost inefficiency. The negative sign for E/A suggests that better capitalized banks are more efficient. This finding is consistent with the results of Berger and Mester 1997, Yildirim and Philippatos 2007, Delis and al. 2011. The EBRD index of enterprise reform (pr1ebrd and pr2ebrd) which correspond to small- and large scale privatization respectively are significant at the 5% level and positively related to cost inefficiency. This mean selling off large and/or small stated-owned enterprise or utility to private ownership and encouraging market forces does not necessarily lead to greater efficiency and ultimate benefits to consumers unless there is a regulator in place to enforce rules and ensure fair competition (EBRD 2010). Finally, the EBRD index of market reform relatively to the competition policy (compebrd) is significant at the 5% level and negatively related to cost inefficiency. Liberalisation as well continuous improvements in law enforcement and changes to competition law have a positive impact on cost efficiency.

5.3.2 IRFs and VDCs of competition policy reform EBRD index and inefficiency

As a first step in the panel VAR estimation the optimal lag order j is assumed for the right-hand variables in the system of equations (Lutkepohl, 2006). The Arellano-Bond GMM estimator is used for the lags of j=1,2 and 3.[10] Optimal lag order of one is based on the Akaike Information Criterion (AIC), confirmed by Arellano-Bond AR tests. To test for autocorrelation, more lags are added. The Sargan tests show that for lag ordered one, the null hypothesis cannot be rejected and thus the VAR model is of order one. The lag order of one preserves the degrees of freedom and information, given the low time frequency of the data. In addition, normality tests for the residuals use the Sahpiro-Francia W-test.[11]

[10] Results are available upon request.
[11] The results do not show violation of the normality. Panel Var results are available under request.

The impulse response functions (IRF) derived from the unrestricted panel-VAR in the case of bank cost efficiency are in Figure 2. The plots show the response of each variable in the panel-VAR (1) to its own innovation and to the innovations of the other variables. The first row shows the response of inefficiency (inef) to one standard deviation shock in equity to assets (EA), loan to assets (LA) and competition policy reform as measured by EBRD (comebrd). It is clear from the figure that the response of inefficiency to reform is negative over the six years of the study, reaches a pick after two periods and then converges towards equilibrium of zero thereafter. This is an interesting result as it highlights that reform efforts, in particular regarding competition policy, bring rewards in terms of raising bank performance. The present dynamic analysis shows that indeed the impact of comEBRD on bank efficiency is positive and the causality is from the former to the latter rather than the other way around.

There is resorted a similar negative response of inef to EA, insinuating that raising equity would benefit bank performance. On the other hand, the response of inef to LA is not as clear, though it carries a negative sign it takes values close to zero.

The panel-VAR importantly emphasizes the positive impact of bank specific reform efforts on the bank efficiency in line with Demirguc-Kunt et al. (2004) and Barth et al. (2006), Kondeas et al. (2008). Moreover, in terms of magnitude, it appears that business and credit regulation have the dominant effect on efficiency. The response of inefficiency to one standard deviation shock of competition policy reform reaches is pick of 0.025 in the second period, implying that a one 1% shock in competition reform causes a 0.025 reduction in cost inefficiency.

Figure 2

Table 11 presents the variance decomposition (VDC) estimations. These results are consistent with the impulse response functions (IRF) and provide further evidence of the importance of reform in explaining the variation in cost inefficiency. Specifically, 4.5% of forecast error variance of cost inefficiency after 10 and 20 years is explained by competition policy reform disturbances. Furthermore, 2.9% of the variation of cost inefficiency is explained by equity to assets shocks, whilst slightly more than 0.9% is explained by loans to assets. Thus, the VDC analysis confirms the importance of competition policy reform to bank cost inefficiency.

Table 11

5.3.5 IRFs and VDCs of other financial institutions (securities markets and non-bank financial institutions) and inefficiency.

The impulse response functions (IRF) derived from the unrestricted panel-VAR in the case of bank cost inefficiency and other financial institutions (see EBRD 2010) are reported in Figure 3. The first row shows that the response of inefficiency to other financial institutions is negative over the six years of the study, reaches a pick after one period and then converges towards equilibrium of zero thereafter, insinuating a very short run dynamic impact on bank performance.

Figure 3

Table 12 presents the variance decomposition (VDC) estimations. These results are consistent with the impulse response functions (IRF) and provide further evidence of the importance of reforms in other financial institutions, which count for the depth of financial markets, in explaining the variation in cost inefficiency. Specifically, a 1.8% of forecast error variance of cost inefficiency after 10 and 20 years is explained by a shock in other financial institutions.

Table 12

5.3.6 IRFs and VDCs of small scale privatisation EBRD index and inefficiency

EBRD constructs two indexes of enterprise reform (pr1ebrd and pr2ebrd), which correspond to small- and large scale privatization respectively. These indexes capture the selling of large and/or small stated-owned enterprise or utility to private ownership and encouraging market forces. Preliminary results show that the predominant, in magnitude, impact on bank inefficiency comes from small-scale privatisations.

The impulse response functions (IRF) derived from the unrestricted panel-VAR in the case of bank cost inefficiency and small-scale privatisations are reported in Figure 3 (similar IRFs for large scale privatisations are available under request). The first row shows the response of inefficiency (inef) to one standard deviation shock in equity to assets (EA), loan to assets (LA) and small-scale privatisations (pr2ebrd). It is clear from the figure that the response of inefficiency to privatisations is negative over the six years of the study, reaches a pick after one period and then converges towards equilibrium of zero thereafter, insinuating a very short run dynamic impact on bank performance. There is resorted a similar negative response of

inef to EA, insinuating that raising equity would benefit bank performance. On the other hand, the response of inef to LA is not as clear, though it carries a negative sign it takes values close to zero.

Moreover, in terms of magnitude, it appears that business and credit regulation have the dominant effect on efficiency. The response of inefficiency to one standard deviation shock of competition policy reform reaches is pick of 0.025 in the second period, implying that a one 1% shock in competition reform causes a 5% reduction in cost inefficiency.

Figure 4

Table 13 presents the variance decomposition (VDC) estimations. These results are consistent with the impulse response functions (IRF) and provide further evidence of the importance of reform in explaining the variation in cost inefficiency. Specifically, a massive 20% of forecast error variance of cost inefficiency after 10 and 20 years is explained by small scale privatisations. Furthermore, 2.9% of the variation of cost inefficiency is explained by equity to assets shocks, whilst slightly more than 0.9% is explained by loans to assets. Thus, the VDC analysis confirms the importance of competition policy reform to bank cost inefficiency.

Table 13

5.3.7 IRFs and VDCs of infrastructure and inefficiency.

The impulse response functions (IRF) derived from the unrestricted panel-VAR in the case of bank cost inefficiency and infrastructure (infrEBRD) are reported in Figure 3. The first row shows that the response of inefficiency to infrEBRD is negative over the six years of the study, reaches a pick after one period and then converges towards equilibrium of zero thereafter, insinuating a very short run dynamic impact on bank performance.

Figure 5

Table 14 presents the variance decomposition (VDC) estimations. These results are consistent with the impulse response functions (IRF) and provide further evidence of the importance of reforms in other financial institutions, which count for the depth of financial markets, in

explaining the variation in cost inefficiency. Specifically, 8.6% of forecast error variance of cost inefficiency after 10 and 20 years is explained by a shock in infrastructure.

Table 14

6. Conclusion

This paper investigates the relationship between cost efficiency and regulations/reforms in credit/financial labor and business market in a sample of banks from Central and Eastern Europe from 2004 to 2009. The analysis is conducted using a stochastic frontier analysis to model technology and obtain inefficiency measures. In this study, we used an assortment of information, not used before such as indicators of the European Bank for Reconstruction and Development (EBRD), on the degree to which regulations/reforms in credit/financial labor and business market may impede competition and distort bank behavior and, as a result, generate cost inefficiency. First we estimate the average cost inefficiency levels for a panel of 168 banks for ten countries. Then we regress these inefficiency scores to see whether they depend on particular bank-specific or country-specific factors. More precisely we investigate the impact to cost efficiency of regulations related to credit market, as well as restrictions on labor and business market, while controlling for other bank-specific and country and institutional-specific characteristics. The inefficiency scores are then employed in panel models, both static in terms of standard fixed effects models but also dynamic panel-VAR models that counts for endogeneity issues, to estimate the impact of regulation on bank specific efficiency in transition countries so as to determine the impact of regulation and liberalisation that accession to the EU requires. The results indicate that in dynamic analysis reforms in the enterprises and markets sectors exert a positive impact on bank efficiency. The effect of bank size, risk and concentration is negative meaning lower costs, while the effect of inflation is positive to cost inefficiency.

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Table 1: Selected Financial Sector Indicators

	Bank-Specific				Financial-Structure			Development
Country	**TA**	**E/A**	**LLP/L**	**L/A**	**DCPS**	**SPRD**	**HHI**	**GDPcppp**
Bulgaria	920.16	0.16	0.05	0.52	40.49	16.58	0.64	9,348
Czech Rep.	6,056.91	0.09	0.13	0.46	51.28	4.7	0.7	19,275
Estonia	2,243.10	0.11	0.02	0.61	58.38	4.42	0.9	13,603
Hungary	4,634.17	0.11	0.02	0.62	48.03	2.94	0.71	15,720
Latvia	1,057.68	0.14	0.04	0.45	55.69	6.09	0.52	11,716
Lithuania	1,773.92	0.11	0.03	0.58	35.33	4.48	0.8	12,824
Poland	4,645.65	0.14	0.01	0.57	34.67	4.93	0.64	13,805
Romania	2,291.56	0.15	0.03	0.5	24.65	11.83	0.66	9,328
Slovakia	2,847.45	0.12	0.02	0.47	42.54	4.59	0.77	16,068
Slovenia	2,252.03	0.1	0.03	0.56	40.93	4.91	0.6	21,880
EU-10	**3,050.59**	**0.13**	**0.04**	**0.53**	**41.55**	**7.19**	**0.67**	**14,292**

Note: Figures are in means, millions of constant 2000 $ in column 1, in % in columns 2 – 7 and constant 2005 international $ in column 8. TA: Total assets, E/A: equity to assets ratio, LLP/L: loan loss provisions to total assets ratio, DCPS: domestic credit provided to the private sector as % of GDP, SPRD: net interest spread, HHI: TheHerfindahl–Hirschman Index (in this study HHI is measured in %, indicating for each country the assets of the largest banks as a share of assets of all commercial banks), GDPcppp: GDP per capita in purchasing power parity (PPP) constant 2005 international $.

Source: Fitch-IBCA for the bank-specific variables, the 2010 version of the “"New Database on Financial Development and Structure" developed by Beck et al. (2000) for the HHI variable and the World Development Indicators of the World Bank for the GDPcppp, SPR) and the DCPS variables.

Table 2: Regulation in the New Accession Countries (2000-2008)

Country	CR	CROwn	CRComp	CRPrS	CRnir	LR	BR
Bulgaria	0.89	0.90	0.83	0.99	0.97	0.65	0.53
Czech Republic	0.86	0.85	0.78	0.87	1.00	0.71	0.56
Estonia	0.94	0.98	0.81	1.00	0.98	0.55	0.70
Hungary	0.83	0.91	0.75	0.66	0.99	0.66	0.63
Latvia	0.90	1.00	0.72	0.94	0.95	0.60	0.60
Lithuania	0.88	0.84	0.82	0.90	0.96	0.52	0.61
Poland	0.84	0.78	0.87	0.78	1.00	0.62	0.50
Romania	0.75	0.45	0.71	0.86	0.94	0.59	0.56
Slovakia	0.90	0.96	0.83	0.80	1.00	0.72	0.55
Slovenia	0.84	0.73	0.73	0.96	1.00	0.50	0.58
EU-10	**0.85**	**0.81**	**0.78**	**0.86**	**0.98**	**0.62**	**0.57**

Note: Figures are in means and scaled to a 0-1 ratio. Higher values denote a more liberal regulatory environment. CR: composite credit regulations index, CR-Own that is the percentage of deposits held in privately owned banks, CR-Own that is foreign banks presence in the domestic market, CR-PrS that is government borrowing that does not crowd out private sector borrowing, CR-Nir that is the negative interest rates, LR: composite labour regulations index, BR: composite business regulations index.
Source: The 2010 version of the Fraser Index of Economic Freedom

Table 3: Regulation over time in the New Accession Countries (2000-2008)

Year	CR	CROwn	CRComp	CRPrS	CRnir	LR	BR
2000	0.73	0.55	0.59	0.85	0.98	0.48	0.62
2001	0.76	0.68	0.59	0.85	0.97	0.48	0.48
2002	0.81	0.81	0.74	0.80	0.97	0.59	0.56
2003	0.82	0.80	0.72	0.87	0.98	0.59	0.57
2004	0.82	0.80	0.77	0.85	0.99	0.62	0.59
2005	0.89	0.87	0.86	0.87	0.97	0.64	0.58
2006	0.89	0.88	0.86	0.86	0.98	0.65	0.57
2007	0.90	0.88	0.86	0.89	0.98	0.69	0.56
2008	0.90	0.87	0.86	0.88	0.98	0.69	0.56
Total	**0.85**	**0.81**	**0.78**	**0.86**	**0.98**	**0.62**	**0.57**

Note: Figures are in means and scaled to a 0-1 ratio. Higher values denote a more liberal regulatory environment. CR: composite credit regulations index, CR-Own that is the percentage of deposits held in privately owned banks, CR-Own that is foreign banks presence in the domestic market, CR-PrS that is government borrowing that does not crowd out private sector borrowing, CR-Nir that is the negative interest rates, LR: composite labour regulations index, BR: composite business regulations index.
Source: The 2010 version of the Fraser Index of Economic Freedom

Table 4: Country level banking sector cost inefficiency (2004-2009)

	Obs	mean	Std. Dev.	min	Max
BUL	92	0.271562	0.165764	0.054207	0.74037
CZS	70	0.1695	0.104566	0.043091	0.575153
EST	25	0.163428	0.082439	0.056132	0.380601
HUN	77	0.235694	0.183181	0.03151	0.956096
LAT	94	0.174865	0.099439	0.040107	0.64039
LIT	54	0.1955	0.14233	0.037344	0.607512
POL	62	0.219095	0.140832	0.033669	0.761838
ROM	62	0.219095	0.140832	0.033669	0.761838
SLV	47	0.262267	0.153568	0.073358	0.733467
SLO	77	0.113864	0.043675	0.03565	0.254175

Note: The table reports the mean inefficiency scores by country over the 2004-2009 period. The cost inefficiencies were calculated using linear programming assuming variable returns to scale (VRS) and an annual common frontier.

Table 5: Annual Cost Inefficiency in the Banking Sector (2004-2009)

	Obs	mean	Std. Dev.	min	max
inef2004	114	0.247823	0.182842	0.033669	0.761838
inef2005	114	0.229259	0.131381	0.058985	0.685503
inef2006	114	0.21405	0.127923	0.049566	0.747316
inef2007	114	0.228101	0.148641	0.039068	0.750357
inef2008	107	0.19177	0.136375	0.03151	0.797308
inef2009	106	0.139809	0.059334	0.051692	0.320522

Note: The table reports the mean inefficiency scores by country over the 2004-2009 period. The cost inefficiencies were calculated using linear programming assuming variable returns to scale (VRS) and an annual common frontier.

Table 6: Bank Cost Inefficiency Determinants in the new EU member states (2004-2009)

Variables	Bank-Specific	Financial Structure
lnTA	-0,0203165**	-0,0029666
	(0,0099327)	(0,0143366)
E/A	-0,0332757	0,0129394
	(0,1258752)	(0,128432)
LLP/L	0,1505261	0,1410545
	(0,1695748)	(0,1653803)
L/A	-0,297331***	-0,2315178***
	(0,0485918)	(0,0516539)
lnGDPcppp		-0,0536468
		(0,0865734)
INF		0,490996***
		(0,131171)
SPR		0,0621317
		(0,2432809)
HHI		-0,1718964***
		(0,0361434)
constant	0,6830787***	0,9866807
	(0,1372652)	(0,6984391)
Observations	725	725
R-squared	0.0784	0,1173
Number of banks	168	168

Note: The table reports the fixed-effects regression results for the z variable models over the 2004-2009 period. The use of the fixed effects specification is justified after a Hausman test for each model. The dependent variable is the cost inefficiency score in 2003 calculated using a SFA methodology and assuming variable returns to scale (VRS) and a common annual frontier. To avoid collinearity problems with the selected variables, we first analyze correlations of all the selected variables. We observe that there is not a high level of correlation between the variables used in the models. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 7: Credit, Labour and Business Regulations as Bank Cost Inefficiency Determinants in the new EU member states (2004-2009)

Variables	Coeff.	Sdt. Err.
lnTA	-0,82319	0,386941
E/A	-2,00325	2,11813
LLP/L	1,228706	3,03072
L/A	1,006301	0,865465
dcpsgdp	1,711844	1,301642
SPR	-1,3714	1,576057
INF	1,020232	1,503431
HHI	-0,16157	0,458152
CR	0,060175	0,052886
LR	0,03423	0,038212
BR	-0,37018	0,241534
Constant	12,03708	5,646867
Observations	88	
R-squared	0,0176	
Number of banks	74	

Note: The table reports the fixed-effects regression results for the CR (credit regulation), LR (labour regulation) and BR (business regulation) variable models over the 2004-2009 period. The use of the fixed effects specification is justified after a Hausman test for each model. The dependent variable is the cost inefficiency score of 2003 calculated using a SFA methodology and assuming variable returns to scale (VRS) and a common annual frontier. To avoid collinearity problems with the selected variables, we first analyze correlations of all the selected variables. We observe that there is not a high level of correlation between the variables used in the models. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are presented in column 3.

Table 8: Types of Credit Regulations as Bank Cost Inefficiency Determinants in the new EU member states (2004-2009)

lnTA	**-0,89594***	**-0,90367***	**-0,8134***
	(0,420372)	(0,441267)	(0,362499)
E/A	-2,37462	-2,5534	-3,25296
	(2,289706)	(2,433801)	(1,864989)
LLP/L	2,944803	2,707786	3,535879
	(2,869223)	(2,988659)	(2,492674)
L/A	0,115576	0,067318	0,905385
	(0,607992)	(0,674614)	(0,653182)
dcpsgdp	1,523229	1,65962	2,085023
	(1,368369)	(1,457587)	(1,085706)
SPR	-2,19234	-2,07592	-1,18294
	(1,608225)	(1,740691)	(1,307863)
INF	0,243171	0,468032	0,599863
	(1,56405)	(1,641012)	(1,212478)
HHI	-0,05985	-0,11005	-0,09412
	(0,487053)	(0,508825)	(0,40269)
CR-Comp	0,532957		
	(0,57587)		
CR-PrS		0,024043	
		(0,042224)	
CR-Nir			0,085451
			(0,049303)
Constant	12,21084	12,57787	9,733411
	(6,171699)	(6,479013)	(5,493778)
Observations	88	88	88
R-squared	0.0087	0.0086	0.0200
Number of banks	74	74	74

Note: The table reports the fixed-effects regression results for the individual components of the CR index over the 2004-2009 period. CR-Comp that is foreign banks presence in the domestic market, CR-PrS that is government borrowing that does not crowd out private sector borrowing, CR-Nir that is the negative interest rates. The use of the fixed effects specification is justified after a Hausman test for each model. The dependent variable is the cost inefficiency score of 2003 calculated using a SFA methodology and assuming variable returns to scale (VRS) and a common annual frontier. To avoid collinearity problems with the selected variables, we first analyze correlations of all the selected variables. We observe that there is not a high level of correlation between the variables used in the models. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 9: Types of EBRD reform indicators as Bank Cost Efficiency Determinants in the new EU member states (2004-2009)

Variables	EBRD index enterprise sector reform	EBRD index enterprise sector reform	EBRD index enterprise sector reform	EBRD index securities markets sector reform	EBRD all indexes reforms
E/A	**0,119911**	**0,113969**	**0,085501**	**0,114298**	**0,092935**
	(0,126053)	(0,12625)	(0,127549)	(0,125052)	(0,127319)
LLP/L	0,307391*	0,307344*	0,304234*	0,363353**	0,346556**
	(0,173735)	(0,17368)	(0,173316)	(0,173451)	(0,175496)
L/A	-0,30839***	-0,30686***	-0,30247***	-0,2744***	-0,2462***
	(0,054208)	(0,054153)	(0,054116)	0,054884	(0,05642)
DCPS/GDP	-0,05201*	-0,04605*	-0,03895	0,00731	0,041701
	(0,027492)	(0,02756)	(0,027935)	(0,033328)	(0,037243)
SPR	0,003366	0,001226	-0,28768	-0,46464*	-0,79621**
	(0,223385)	(0,222688)	(0,278828)	(0,269789)	(0,352745)
HHI	-0,15735***	-0,14615***	-0,16303***	-0,1297	-0,12647***
	(0,039259)	(0,041709)	(0,039299)	(0,040109)	(0,042928)
pr1ebrd	0,072787				0,057062
	(0,112705)				(0,129918)
pr2ebrd		-0,06274			0,091835
		(0,07651)			(0,089715)
Entebrd			-0,06479		-0,05372
			(0,039655)		(0,044714)
Compebrd					-0,05418
					(0,041063)
Bankebrd					0,047153

					(0,045381)
Secebrd				-0,10116***	-0,12736***
				(0,034723)	(0,04009)
Infraebrd					-0,08821
					(0,062507)
Constant	0,248672	0,76762**	0,727503***	0,78024	0,687376
	(0,417408)	(0,30839)	(0,135166)	(0,099052)	(0,590586)
Observations	655	655	655	655	655
R-squared	0.1548	0.1214	0.0896	0.0634	0.0241
Number of banks	154	154	154	154	154

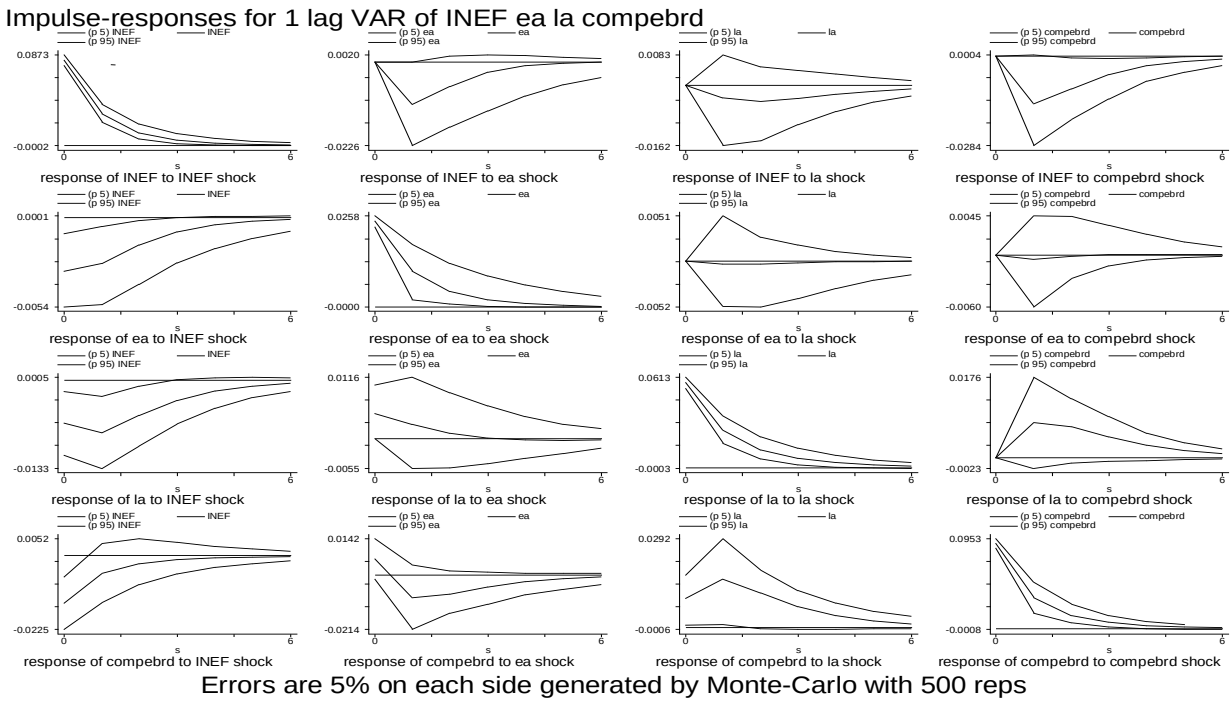
Note: The table report the fixed-effects results for EBRD reform indexes covering four broad aspects of transition (EBRD 2010): enterprises (incorporating small (pr1ebrd)- and large-scale privatization (pr2ebrd) and enterprise restructuring (entebrd)); markets (competition policy (compebrd)); and financial institutions (banking reform and interest rate liberalization (bankebrd) and Securities markets and non-bank financial institutions (secebrd)) and infrastructure (overall infrastructure reform (infraebrd)). The dependent variable is the cost inefficiency score calculated using a SFA methodology for 2003. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 10: Types of EBRD reform indicators as Bank Cost Efficiency Determinants in dynamic panel analysis in the new EU member states (2004-2009)

Variables	Coef.	Std. Err.
Inef2003L1	0,51553***	0,108757
E/A	-0,42275*	0,249315
LLP/L	-0,21486	0,229351
L/A	-0,13298	0,094651
SPR	-0,24753	0,527521
HHI	-0,00014	0,063167
pr1ebrd**	0,760438	0,369681
pr2ebrd**	0,292765	0,128556
entebrd	0,148433	0,146599
pcebrd	-1,00694	1,519384
Compebrd**	-0,22265	0,093208
bankebrd	0,093276	0,069905
secebrd	-0,06539	0,052331
infraibrd	-0,03419	0,081811
Constant	0,69785	5,0297
Observations	497	
R-squared		
Number of banks	135	

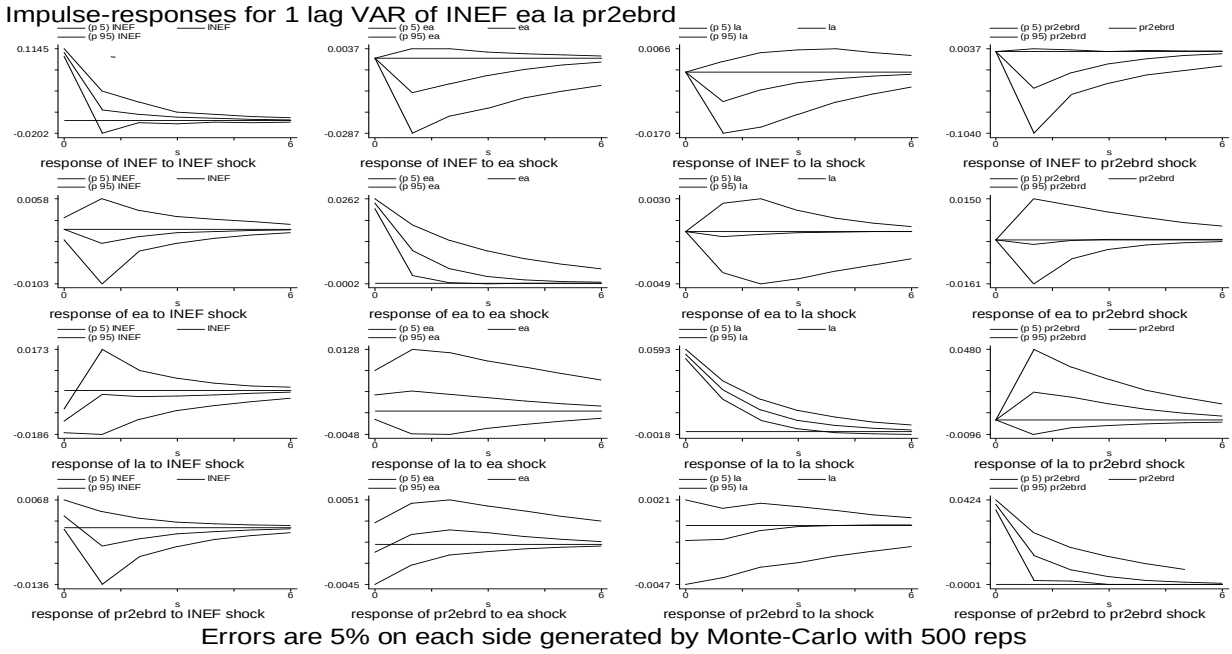
Note: The table report the dynamic panel analysis fixed-effects results with one period lag for EBRD reform indexes covering four broad aspects of transition (EBRD 2010): enterprises (incorporating small (pr1ebrd)- and large-scale privatization (pr2ebrd) and enterprise restructuring (entebrd)); markets (competition policy (compebrd)); and financial institutions (banking reform and interest rate liberalization (bankebrd) and Securities markets and non-bank financial institutions (secebrd)) and infrastructure (overall infrastructure reform (infraebrd)). The dependent variable is the cost inefficiency score calculated using a SFA methodology for 2003. ***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are presented in column 3.

Figure 2: Impulse Response Function (IRF) for one lag of InEf, E/A, L/A and Compebrd



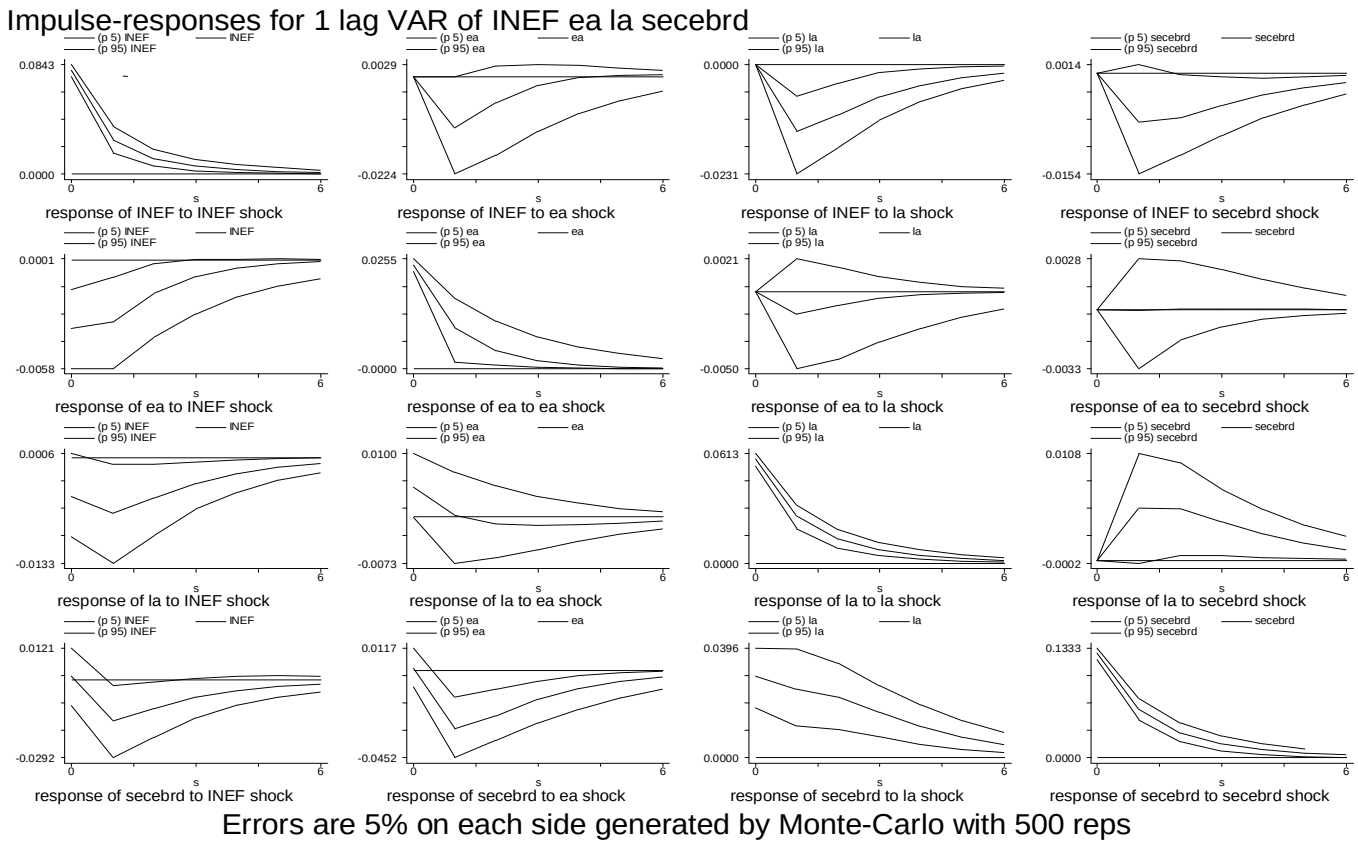
Note: InEf is inefficiency, E/A is the ratio equity to assets (measuring capital risk), L/A is the ratio loans to assets (measuring liquidity risk) and Compebrd is large-capitalisation in s using the EBRD index.

Figure 3: Impulse Response Function (IRF) for one lag of InEf, E/A, L/A and Pr2ebrd



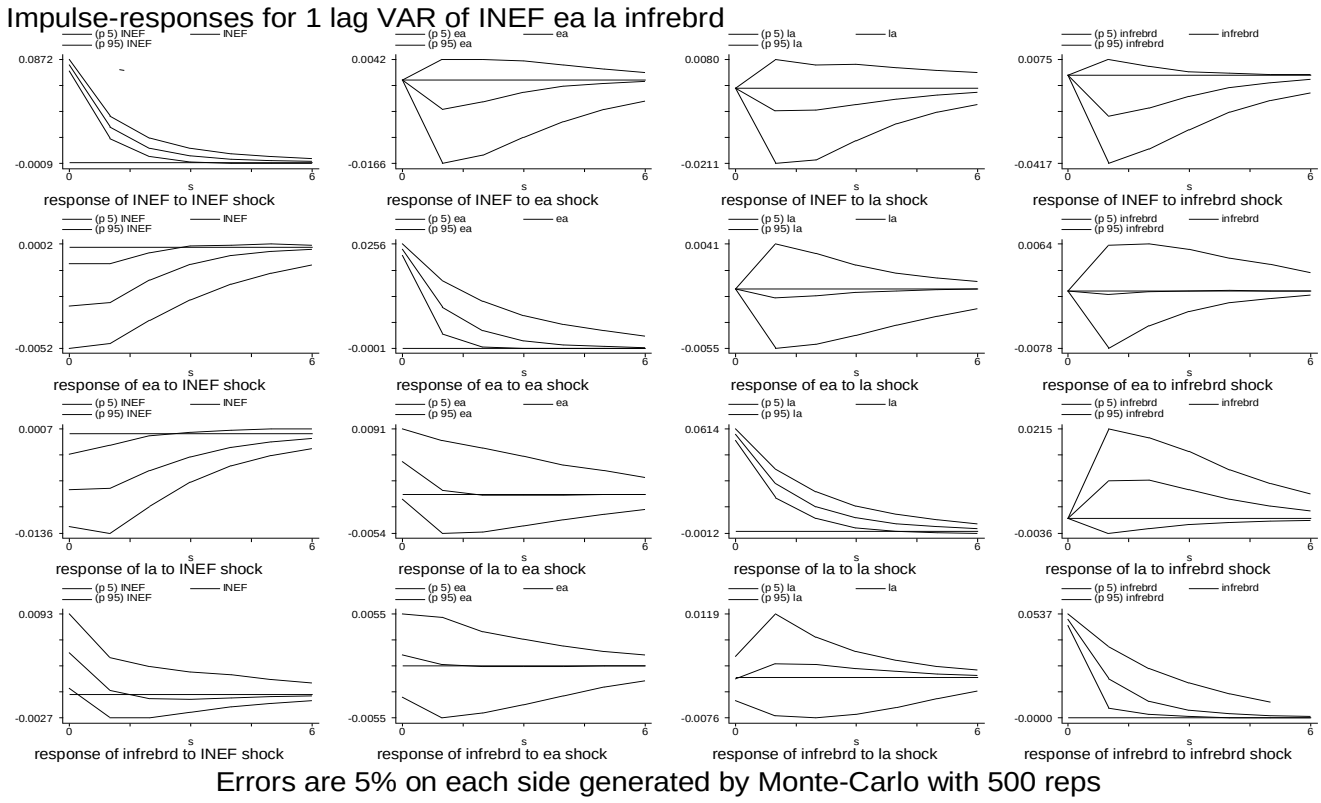
Note: InEf is inefficiency, E/A is the ratio equity to assets (measuring capital risk), L/A is the ratio loans to assets (measuring liquidity risk) and Pr2ebrd is competition policy in markets using the EBRD index.

Figure 4: Impulse Response Function (IRF) for one lag of InEf, E/A, L/A and secebrd



Note: InEf is inefficiency, E/A is the ratio equity to assets (measuring capital risk), L/A is the ratio loans to assets (measuring liquidity risk) and Pr2ebrd is competition policy in markets using the EBRD index.

Figure 5: Impulse Response Function (IRF) for one lag of InEf, E/A, L/A and infrebrd



Note: InEf is inefficiency, E/A is the ratio equity to assets (measuring capital risk), L/A is the ratio loans to assets (measuring liquidity risk) and Pr2ebrd is competition policy in markets using the EBRD index.

Table 11: Variance Decompositions (VDCs) for inef, EA, LA, and compEBRD					
	s	INEF	ea	la	compebrd
INEF	10	0.926846	0.021962	0.006041	0.045151
ea	10	0.029517	0.969766	0.000338	0.000378
la	10	0.032191	0.006992	0.929961	0.030856
compebrd	10	0.02319	0.020081	0.05202	0.904709
INEF	20	0.926843	0.021962	0.006043	0.045152
ea	20	0.029517	0.969766	0.000338	0.000378
la	20	0.032191	0.006993	0.929958	0.030858
compebrd	20	0.02319	0.020082	0.052021	0.904707
Notes: s defines the periods ahead of VDCs. inef is inefficiency.					

Table 12: Variance Decompositions (VDCs) for inef, EA, LA, and secEBRD					
	s	INEF	ea	la	Secebrd
INEF	10	0.909688	0.022537	0.049714	0.01806
ea	10	0.039323	0.956554	0.004113	8.93E-06
la	10	0.025265	0.006172	0.950141	0.018422
secebrd	10	0.016552	0.071573	0.096003	0.815872
INEF	20	0.909659	0.022541	0.049731	0.018069
ea	20	0.039323	0.956554	0.004113	8.95E-06
la	20	0.025268	0.006179	0.950121	0.018433
secebrd	20	0.016555	0.071581	0.096031	0.815833
Notes: s defines the periods ahead of VDCs. inef is inefficiency.					

Table 13: Variance Decompositions (VDCs) for inef, EA, LA, and pr2EBRD					
	s	INEF	ea	la	pr2ebrd
INEF	10	0.766209	0.02138	0.006526	0.205885
ea	10	0.011563	0.984438	0.000384	0.003615
la	10	0.035235	0.010826	0.805228	0.148711
pr2ebrd	10	0.019457	0.00414	0.001439	0.974964
INEF	20	0.766197	0.021384	0.006526	0.205893
ea	20	0.011563	0.984437	0.000384	0.003616
la	20	0.035239	0.010836	0.80518	0.148745
pr2ebrd	20	0.019457	0.004141	0.001439	0.974963
Notes: s defines the periods ahead of VDCs. inef is inefficiency.					

Table 14: Variance Decompositions (VDCs) for inef, EA, LA, and infrEBRD					
	s	INEF	ea	la	infrebrd
INEF	10	0.893881	0.006848	0.013113	0.086158
ea	10	0.028638	0.969451	0.001612	0.000299
la	10	0.031427	0.004274	0.913744	0.050555
infrebrd	10	0.007672	0.000439	0.005338	0.98655
INEF	20	0.893868	0.006848	0.013118	0.086166

ea	20	0.028638	0.969451	0.001612	0.000299
la	20	0.031428	0.004274	0.913726	0.050572
infrebrd	20	0.007672	0.000439	0.00534	0.986549

Notes: s defines the periods ahead of VDCs. inef is inefficiency.

APPENDIX

Table A1: Summary of the literature on measuring cost efficiency using parametric and non-parametric approaches in the transition economies.

Authors	Approach	Countries Considered	Period	Results
Kraft and Tirtiroglu (1998)	SFA	Croatia	1994-1995	OB are more cost efficient
Mertens and Urga (2001)	SFA/TFA	Ukraine	1998	SB are more cost efficient-less profit efficient
Kraft et al. (2002)	SFA	Croatia	1994-2000	FB are more cost efficient/PB do not enhance efficiency
Nikiel and Opiela (2002)	DFA	Poland	1997-2000	FB are more cost efficient/less profit efficient
Jemric and Vujcic (2002)	DEA	Croatia	1995-2000	FB and NB are more cost efficient
Grigorian and Manole (2002)	DEA	17 transition economies	1995-1998	FB are more cost efficient
Hasan and Marton (2003)	SFA	Hungary	1993-1998	FB are more cost and profit efficient
Weill (2003a)	SFA	Poland and Czech Republic	1997	FB are more cost efficient
Green et al. (2004)	SFA	9 transition economies	1995-1999	FB are no more cost efficient
Fries and Taci (2005)	SFA	15 East European Countries	1994-2001	FB and PB are more cost efficient
Rossi et al. (2005)	SFA	9 Central and Eastern European Countries	1995-2002	Low level of cost efficiency, lower level of profit efficiency/efficiency increases
Bonin et al. (2005)	SFA	11 Transition Economies	1996-2000	FB are more cost and profit efficient/PB do not enhance efficiency
Kasman (2005)	SFA	Poland and Czech Republic	1995-2000	FB are more cost efficient (Czech Republic)
Kasman and Yildirim (2006)	SFA	8 Central and Eastern European Countries	1995-2002	FB are more profit efficient
Havrylchyk (2006)	DEA	Poland	1997-2001	FB are more efficient
Yildirimi and Philippatos (2007)	SFA/DEA	12 transition Economies	1993-2000	FB are more cost efficient/less profit efficient
Mamatzakis et al. (2008)	SFA	EU-10	1999-2003	Low level of cost efficiency, lower level of profit efficiency, FB more profit efficient than both PB and SB, ownership structure not clear effect on cost efficiency, cross-country convergence in cost efficiency
Karas et al. (2009)	SFA	Russia	2002 and 2006	FB more cost efficient than domestic PB, Domestic PB more cost efficient than domestic SB
Kosac et al. (2010)	SFA	5 Central and Eastern European Countries and 3 Baltic states	1996-2006	Competition increases cost efficiency, Ownership structure not significant, Improvement of cost efficiency over time, Baltic states more cost efficient than CEEs
T. Poghosyan and A. Poghosyan (2010)	SFA	11 Central and Eastern European Countries	1992-2006	Greenfield FB more cost efficient than domestic banks, efficiency of Acquired FB not significantly different from domestic banks
Fang et al. (2011)	SFA	6 Transition economies in South-Eastern Europe	1998-2008	FB more profit and (moderately) more cost efficient, SB least profit efficient, efficiency gap due to ownership structure narrows over time, institutional development (banking reforms, privatization, corporate governance restructuring) positive impact on efficiency

Note: SFA is the stochastic frontier approach, DEA is the data envelopment analysis, DFA is the distribution free approach, and TFA is the thick frontier approach. Moreover, FB stands for foreign banks, PB for private banks, SB for state-owned banks, OB for old banks and NB for new banks.