Essays on foreign ownership in transition banking

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Chapter 5

Foreign Bank Entry, Bank Efficiency, and Market Power

5.1 Introduction

In Chapter 2, we provided a detailed analysis of the impact of foreign bank participation on the efficiency of banks in former socialist economies (FSEs). Another important consideration that has motivated local authorities to encourage foreign bank entry was the hope that opening the borders would improve the competitiveness in the domestic banking industries (EBRD, 2005). The outcome of these policies aimed at attracting foreign direct investments into domestic banking systems has been remarkable: the average market share of foreign-owned banks in 11 CEECs has grown from 14% in 1995 to 80% in 2006 (see Figure 5.5), which is the largest increase of foreign bank participation in emerging markets (IMF, 2000).[1] This pattern of foreign bank participation is in contrast to developments in industrial countries, where cross-border bank expansion is rare (Buch and DeLong, 2004).[2] In this chapter, we

[1] At present, foreign banks account for a dominant share of assets in most of CEECs (except for Slovenia), in some cases reaching the staggering level of more than 90%.

[2] The main reason for relatively scarce worldwide evidence of cross-border bank expansion can be the limited success of international takeovers. Major impediments that make banks reluctant to go abroad are geographical distance, language barriers, cultural aspects of home countries, and differences in regulatory and supervisory structures (Buch, 2000, Berger et al., 2001).

analyze the impact of increased foreign bank participation on the competitiveness of banking industries in CEECs, after controlling for the efficiency effects associated with different modes of foreign entry.

Theoretically, the increased foreign bank participation can affect domestic markets via increased market competition and improved banking performance due to spillover effects (Lehner and Schnitzer, 2008). The mode of foreign bank entry (greenfield investments versus cross-border acquisitions) plays a crucial role in the transmission of benefits to domestic customers (Claeys and Hainz, 2007). As opposed to cross-border acquisition, a greenfield entry increases the total number of banks, inducing more competition. On the other hand, the primary motivation for the greenfield investment is usually to follow clients of the bank abroad (Aliber, 1984), which might alleviate the effect of foreign entry on competition. Similarly, the performance of foreign banks in emerging economies constitutes a trade-off. While foreign banks entering the market have lower refinancing costs, host country banks have superior information about the quality of domestic borrowers (Dell'Ariccia and Marquez, 2004).

Empirical literature provides mixed evidence on the impact of foreign bank entry on the performance and competitiveness of banking systems in host countries. Claessens et al. (2001) report that foreign bank entry leads to more competitive pressure and higher efficiency of banks in the host country, implying positive welfare effects for economies liberalizing their banking markets. However, this result holds only for the case of emerging countries, while the conclusions are reversed when considering foreign bank entry into developed economies.[3] For the case of the CEECs, the impact of foreign bank participation on the performance measured

[3] In a related study, Lensink and Hermes (2004) show that the efficiency improvement of domestic banks following the foreign entry is inversely associated to the level of economic development of the host country.

by cost efficiency is also mixed. Some single-country studies report that foreign-owned banks are more efficient than domestic banks (see Jemrić and Vujčić, 2002 for Croatia, Hasan and Marton, 2003 for Hungary, and Nikiel and Opiela, 2002 for Poland), while other studies do not find evidence supporting this view (see Sabi, 1996 for Hungary, Kraft and Tirtiroglu, 1998 for Croatia, and Matoušek and Taci, 2002 for Poland). Evidence from cross-country studies is also inconclusive: studies by Bonin et al. (2005) and Fries and Taci (2005) report that foreign participation tends to improve cost efficiency of domestic banks in CEECs, while Poghosyan and Borovicka (2007) find that the positive effect of foreign ownership on cost efficiency may be biased due to the *cream-skimming* effect (sample selection bias).[4]

Most of this literature, however, does not distinguish between different modes of foreign entry. The mode of entry can be crucial in interpreting the impact of foreign bank participation, since different entry modes are driven by different motives (Claeys and Hainz, 2007, Lehner and Schnitzer, 2008). Havrylchyk and Jurzyk (2008) distinguish between acquired and greenfield banks and provide further evidence on the existence of a selection bias. However, they conclude that the superior performance of CEEC banks acquired by foreigners is earned rather than inherited.[5] Claeys and Hainz (2007) distinguish between greenfield entry and foreign acquisition in CEEC banking sectors and find that bank lending rates have generally declined due to foreign entry, but the impact is mainly driven by the greenfield establishments.[6] A similar conclusion is drawn for the case of Latin American countries by

[4] The *cream-skimming* effect suggests that foreign investors select the best-performing banks for the acquisition (i.e., the domestic bank would perform well even if it was not acquired by foreigners).

[5] Other evidence of selection bias characterizing foreign bank entry is provided by Lanine and Vander Vennet (2007). The authors find that foreign banks explicitly target large banks in CEECs in order to extract benefits from an increase in market power. Poghosyan and De Haan (2008) show that the characteristics of target banks in terms of their size and performance depend on the macroeconomic environment and institutional background of host countries.

[6] It is important to note that the authors acknowledge that greenfield banks can exhibit additional market power by specializing in particular segments of the market, but they do not provide an empirical test of this hypothesis.

Martinez Peria and Mody (2004). They find that interest margins of foreign greenfield banks are lower than interest margins of domestic banks, as well as interest margins of foreign banks that have entered through cross-border acquisitions.

The aim of this chapter is to investigate the relationship between different modes of foreign entry and both cost efficiency and market power of banks in CEECs. Unlike previous studies, this paper explicitly acknowledges the possible interplay between efficiency and competition when examining market power of domestic and foreign banks. Our empirical specification is derived from a simple bank intermediation model, which allows analyzing market power of banks after taking into account the cost efficiency effects. The analysis is performed in two steps. First, the stochastic frontier model (SFA) is applied to evaluate the cost efficiency of banks in CEECs. In the SFA model, time-varying efficiency scores enable us to evaluate the possible spillover effects from the increased foreign bank participation to the efficiency of banks in CEECs. In addition, the efficiency scores are modeled as a function of the bank ownership in order to distinguish between the relative performance of domestic, foreign greenfield, and foreign acquired banks. Secondly, we evaluate the relative market power possessed by banks having different ownership structures using an equilibrium relationship between bank lending rates, deposit rates, and marginal costs (free of inefficiency effects) obtained from the intermediation model.

We find that greenfield banks are characterized by a higher degree of cost efficiency relative to domestic banks and foreign banks that entered through cross-border acquisitions. Performance of the acquired banks deteriorates during the year of entry and improves the year thereafter, resulting in an insignificant overall effect. The hypothesis that banking systems in CEECs are characterized by a competitive market structure is rejected. However, the market power of foreign acquired banks is substantially lower compared to the rest of the banks, confirming the positive impact

of foreign bank entry on competition. Our results remain unchanged when riskiness of bank portfolio, income from non-interest banking activities, and developments in the macroeconomic environment are taken into account.

The remainder of the chapter is structured as follows. The next section presents a simple bank intermediation model and outlines the empirical strategy for testing the proposed hypotheses. Section 5.3 describes the data used in our analysis, while the estimation results are provided in Section 5.4. The last section concludes.

5.2 Methodology

5.2.1 Theoretical background

The theoretical framework is based on the *new empirical industrial organization* approach of Bresnahan (1982), which has been adopted for the case of banking by Shaffer (1989) and extended to the *intermediation model* in more recent studies by Barajas et al. (1999) and Vera et al. (2007).

Consider a representative bank i producing output in the form of loans or earning assets (L_i), and using deposits or financial liabilities (D_i) and non-financial factors (labor and capital) as inputs. Apart from loans, the bank is also required to hold reserves with the monetary authority (R_i) on the asset side. The difference between total assets and deposits constitutes a residual term called other net liabilities (ONL_i).[7] The balance sheet identity for each bank i is: $L_i + R_i = D_i + ONL_i$. Given the reserve requirement ratio ($\rho_i = \frac{R_i}{D_i}$), the balance sheet identity can be rewritten as:

$$L_i - D_i(1 - \rho_i) - ONL_i = 0. \tag{5.1}$$

[7] This term can be further decomposed into bank equity and the rest of other net liabilities. We make use of the fact that the minimal amount of equity hold by the bank given its earning assets is restricted exogenously by the regulatory authorities and focus on competition in deposits and loans markets.

In this simple setup, there is no uncertainty and banks strive for profit maximization. Each bank earns income by the provision of loans ($r_L L_i$) and pays interest on acquired deposits ($r_D D_i$). In addition, each bank incurs real (non-financial) costs from engaging into financial intermediation (C_i), that depend on the output level (L_i), prices for labor and capital (w), and other non-financial inputs (x). Consequently, each bank's profits (π_i) can be expressed as the difference between financial revenues and total (financial and non-financial) costs:

$$\pi_i = r_L L_i - r_D D_i - C_i(L_i, w, x), \tag{5.2}$$

where r_L and r_D are the average lending and deposit rates. Banks maximize their profits by choosing the optimal level of output, given interest rates r_L and r_D. The first order condition for profit maximization is:[8]

$$\frac{\partial \pi_i}{\partial L_i} = r_L + L_i \frac{\partial r_L}{\partial L_i} - r_D \frac{\partial D_i}{\partial L_i} - D_i \frac{\partial r_D}{\partial L_i} - C_{L_i} = 0, \tag{5.3}$$

where $C_{L_i} = \frac{\partial C_i(L_i, w, x)}{\partial L_i}$ is the marginal non-financial cost of loan production. Making use of the relationship between deposits and loans ($\frac{\partial D_i}{\partial L_i} = \frac{1}{1-\rho_i}$) from the balance sheet identity (5.1) and rearranging terms in the first order condition yields the following equation for the interest rate spread:

$$r_L - \frac{r_D}{1-\rho_i} = -L_i \frac{\partial r_L}{\partial L_i} + D_i \frac{\partial r_D}{\partial D_i} \frac{1}{1-\rho_i} + C_{L_i}. \tag{5.4}$$

This equation provides several useful insights. First, the interest rate spread is affected by the reserve requirement imposed by monetary authorities, which represents financial taxation costs incurred by a bank. Second, the size of the spread is

[8] Here we follow a quantity competition approach, in line with the *new empirical industrial organization* literature. However, it is important to note that a more realistic price competition approach would result in a similar equilibrium condition linking marginal revenues and marginal costs of banks, which is used to test our main hypotheses (see Freixas and Rochet, 2008, Chapter 3 for technical details).

affected by the production technology used by a bank. More cost efficient banks use fewer resources to produce the required optimal level of output, which results in a smaller difference between lending and deposit rates. Third, the wedge between the lending and deposit rates is driven by the market power of a bank. In the case of a non-perfect competition, an individual bank will be able to influence the industry-wide interest rates, as indicated by the terms $\frac{\partial r_L}{\partial L_i}$ and $\frac{\partial r_D}{\partial D_i}$.

Shaffer (1989) assumes that deposit markets are perfectly competitive ($\frac{\partial r_D}{\partial D_i} = 0$) and estimates equation (5.4) jointly with the demand function for industry-wide loans. In his formulation, the interest rate elasticity of demand for loans in equation (5.4) is substituted from the aggregate demand function and marginal cost is assumed to be a linear function of input prices and output quantity. The system estimation approach yields a market power parameter estimate for the loans market in the form of a conjectural variation coefficient, as is customary in the *new empirical industrial organization* literature.

We pursue a slightly more restrictive approach suggested by Barajas et al. (1999), which does not require a system estimation.[9] Using the definitions of the interest rate elasticity of demand for loans ($\eta_L = \frac{\partial L}{\partial r_L}\frac{r_L}{L} < 0$) and the interest rate elasticity of demand for deposits ($\eta_D = \frac{\partial D}{\partial r_D}\frac{r_D}{D} > 0$), equation (5.4) can be rewritten as:

$$r_L + r_L\left[\frac{L_i}{L}\frac{dL}{dL_i}\frac{1}{\eta_L}\right] = \frac{r_D}{1-\rho_i} + \frac{r_D}{1-\rho_i}\left[\frac{D_i}{D}\frac{dD}{dD_i}\frac{1}{\eta_D}\right] + C_{L_i}, \tag{5.5}$$

where D and L denote aggregate measures of deposits and loans for all banks. Let us further denote $L_i^{sh} = \frac{L_i}{L}$ and $D_i^{sh} = \frac{D_i}{D}$ as shares of bank i in the loan and deposit markets, respectively. In addition, let us denote $L_i^{resp} = \frac{dL}{dL_i}$ ($D_i^{resp} = \frac{dD}{dD_i}$) as the responsiveness of the total industry supply of loans (deposits) to the adjustment of

[9] Econometric estimations of a system of equations using a full information maximum likelihood method is problematic, since it produces inconsistent estimates for the whole system if one or more of the equations are misspecified. Three-stage least squares method is an alternative estimator widely used in the literature, but it assumes the availability of appropriate instruments.

loans (deposits) by bank i. Using this notation, equation (5.5) can be rewritten as:

$$r_L\left[1+\frac{L_i^{sh}L_i^{resp}}{\eta_L}\right]=\frac{r_D}{1-\rho_i}\left[1+\frac{D_i^{sh}D_i^{resp}}{\eta_D}\right]+C_{L_i}. \tag{5.6}$$

Equation (5.6) explicitly reflects the different effects influencing the market power of banks, which are summarized by the expressions in brackets. An individual bank possesses higher market power if the industry supply is less elastic; the size of bank operations is larger, and the response of the industry output to the individual bank output decisions is greater. Rearranging the equation and expressing the measure of market power in the loan market as $L_i^{MP}=\left[1+\frac{L_i^{sh}L_i^{resp}}{\eta_L}\right]$ and the measure of market power in the deposits market as $D_i^{MP}=\left[1+\frac{D_i^{sh}D_i^{resp}}{\eta_D}\right]$ yields:[10]

$$r_L=\frac{r_D}{1-\rho_i}\left[\frac{D_i^{MP}}{L_i^{MP}}\right]+\frac{C_{L_i}}{L_i^{MP}}. \tag{5.7}$$

Given the sign restrictions on the interest rate elasticities of loan demand ($\eta_L \leq 0$) and deposit supply ($\eta_D \geq 0$), the values for the market power indicators can be derived as $L_i^{MP} \leq 1$ and $D_i^{MP} \geq 1$, respectively.

In the case of a perfectly competitive industry, both indicators take the value of unity and, hence, the coefficient $\frac{D_i^{MP}}{L_i^{MP}}$ is equal to unity as well. In this case, the marginal revenue (interest rate on loans) will be equal to the financial and non-financial marginal costs (deposit rate and derivative of the cost function).

In the presence of market power in at least one of the markets ($L_i^{MP}<1$ and/or $D_i^{MP}>1$), the coefficient $\frac{D_i^{MP}}{L_i^{MP}}$ will be greater than unity. Barajas et al. (1999) and Vera et al. (2007) use equation (5.7) as an alternative framework for testing the competitive market structure hypothesis ($\frac{D_i^{MP}}{L_i^{MP}}=1$), which is more simplistic relative

[10] In the *new empirical industrial organization* literature, the terms L_i^{MP} and D_i^{MP} have been given an interpretation of conjectural variations. However, we would refrain from this interpretation and would rather view these terms as measures of gap between the price of bank output and the marginal cost.

to the system approach used in Shaffer (1989). For this purpose, these studies assume that the marginal cost (C_{L_i}) in equation (5.7) is a linear function of bank output (L_i) and input prices (w). This assumption, however, is not innocuous. It disregards the cost efficiency of banks, which was found to be an important determinant of net interest margins in several recent studies (see, for instance, Maudos and Fernandez de Guevara, 2004). More efficient banks have the opportunity to operate with a lower margin due to the gains from the less expensive conduct of intermediation activities. Therefore, the analysis in this paper improves upon previous work by explicitly taking cost efficiency of banks into account when evaluating their marginal costs. The next subsection provides the details of our empirical approach.

5.2.2 Empirical methodology

The empirical assessment of the market power possessed by domestic and foreign banks in at least one of the markets (loan or deposit) is based on the estimation of the equation (5.7), which can be represented in terms of a linear model:

$$r_{L_{it}} = \beta_0 + \beta_1 \tilde{r}^d_{D_{it}} + \beta_2(\tilde{r}^d_{D_{it}} * D^{GF}) + \beta_3(\tilde{r}^d_{D_{it}} * D^A) + \beta_4 C_{L_{it}}, \tag{5.8}$$

where indices i and t denote bank and time, respectively, $r_{L_{it}}$ is the implicit loan rate, $\tilde{r}^d_{D_{it}} = \frac{r^d_{D_{it}}}{1-\rho_i}$ is the implicit deposit rate adjusted for the impact of financial taxation,[11] D^{GF} and D^A are dummy variables for foreign greenfield and acquired banks, and $C_{L_{it}}$ is the marginal cost of producing an extra unit of output for bank i at time t. Abstracting from interaction terms, a value of coefficient β_1 significantly larger than one would indicate the presence of market power in at least one of the

[11] The level of financial taxation ρ_i is an approximate measure, which serves only as a guideline for banks in their intermediation activities. In reality, banks often hold excess reserves in their accounts at the central bank for liquidity reasons. In addition, banks borrow money from the central bank in case their reserves are not sufficient to fulfill the reserve requirements set up by the regulators. In the empirical estimations, we use country-specific reserve requirements information from the international survey on banking regulation available in Barth et al. (2008).

markets (loans or deposits) for the whole banking industry, including both domestic and foreign banks. Introduction of the interaction terms allows to identify whether the extent of market power differs between domestic and foreign banks. For instance, a significantly negative (positive) coefficient β_2 would suggest that market power of foreign greenfield banks is lower (higher) than market power of domestic banks. The magnitude and sign of the coefficient β_3 can be interpreted in a similar way.

To carry out an estimation of equation (5.8), one needs to introduce a measure of marginal costs. Instead of pursuing the strategy of Barajas et al. (1999) and Vera et al. (2007) and proxying the linear relationship between marginal costs and their underlying factors in an *ad hoc* way, the marginal costs are obtained directly from the data using the stochastic efficiency frontier methodology.[12] The advantage of this approach is that it explicitly takes the impact of the cost efficiency of banks on the marginal cost of producing an additional unit of output into account. By including the *inefficiency-free* measure of marginal costs, we also control for the possible relationship between market power of banks and their efficiency.[13] In addition, using information on the timing of cross-border bank acquisitions, we are able to evaluate whether domestic banks taken over by foreigners improve their operational efficiency after the acquisition or not.

Consistent with the intermediation model described above, let us assume that banks produce one unit of output (L) using labor, capital and borrowed funds as inputs. Let w_1, w_2 and w_3 denote the prices of labor, capital and borrowed funds. To capture the technological progress experienced by banks in CEECs during the

[12] A comprehensive textbook exposition of the stochastic efficiency frontier methodology can be found in Kumbhakar and Lovell (2000) and Coelli et al. (2005).

[13] Efficiency of banks can affect their pricing strategy. For example, more cost efficient banks incur lower marginal costs and can set lower prices compared to the less cost efficient banks. Application of the *inefficiency-free* measure of marginal costs makes it possible to compare the market power parameters (measured as a relative wedge between prices and marginal costs) across banks with different efficiency levels.

last decade,[14] a time trend (*Trend*) is introduced among the determinants of the cost frontier. In line with previous cross-country studies, we also control for possible shifts in the cost frontiers across countries due to differences in macroeconomic conditions and institutional backgrounds by introducing country-specific (C_n) and time-specific (T_m) dummy variables. The final translog specification of the cost function for the stochastic frontier analysis takes the following form:[15]

$$\begin{aligned}
\ln \frac{C_{it}}{w_{it,1}} &= \alpha_{i0} + \alpha_1 \ln L_{it} + \alpha_2 \ln\left(\frac{w_{it,2}}{w_{it,1}}\right) + \alpha_3 \ln\left(\frac{w_{it,3}}{w_{it,1}}\right) + \alpha_4 Trend + \\
&+ \delta_{11}\frac{1}{2}\left(\ln L_{it}\right)^2 + \delta_{12} \ln L_{it} \ln\left(\frac{w_{it,2}}{w_{it,1}}\right) + \delta_{13} \ln L_{it} \ln\left(\frac{w_{it,3}}{w_{it,1}}\right) + \delta_{14} \ln L_{it} Trend + \\
&+ \gamma_{11}\frac{1}{2}\left(\ln\left(\frac{w_{it,2}}{w_{it,1}}\right)\right)^2 + \gamma_{12} \ln\left(\frac{w_{it,2}}{w_{it,1}}\right) \ln\left(\frac{w_{it,3}}{w_{it,1}}\right) + \gamma_{13} \ln\left(\frac{w_{it,2}}{w_{it,1}}\right) Trend + \\
&+ \theta_{11}\frac{1}{2}\left(\ln\left(\frac{w_{it,3}}{w_{it,1}}\right)\right)^2 + \theta_{12} \ln\left(\frac{w_{it,3}}{w_{it,1}}\right) Trend + \rho_{11}\frac{1}{2}(Trend)^2 + \\
&+ \sum_{n=1}^{N} \phi_n C_n + \sum_{m=1}^{M} \phi_m T_m + u_{it} + v_{it}, \qquad (5.9)
\end{aligned}$$

where α_{i0} captures individual bank random effects, $v_{it} \sim N(0, \sigma_v^2)$ is the i.i.d. error term and $u_{it} = B_t u_i$ is the positive inefficiency term varying across banks and over time, which is composed of two parts: a non-stochastic positive time component, $B_t > 0$, that is time-varying but the same for all banks and a stochastic individual component, $u_i \sim N^+(\mu, \sigma_u^2)$, which follows a truncated normal distribution with a conditional mean parameter μ. The inefficiency term can be expressed in a general form as:

$$u_{it} = exp(\eta' Z_{it}) u_i, \qquad (5.10)$$

where Z_{it} is a vector of factors affecting bank efficiency and η is a vector of parame-

[14] See Fries and Taci (2005), Bonin et al. (2005) and Poghosyan and Borovicka (2007) for the recent empirical evidence of the impact of technological progress in transition banking.

[15] This formulation takes into account the adding-up and symmetry restrictions imposed by theory. In addition, the linear homogeneity restriction is satisfied by deflating costs and the second input price by the first input price.

ters. We use several determinants of bank efficiency. First, the efficiency is modeled as a function of time using the specification of Kumbhakar and Wang (2005): $(t - \underline{t})$, where $\underline{t}$ is the beginning of the sample. A significant positive (negative) parameter estimate of this variable would indicate that over the whole sample period, efficiency of banks in CEECs has deteriorated (improved). Since the sample period was marked by increased foreign bank participation, the coefficient of this variable can be interpreted in terms of the overall impact of foreign bank participation on bank efficiency in CEECs. Next, in order to discern the differences in cost efficiency across domestic and foreign banks, we introduce dummy variables for foreign greenfield (D^{GF}) and foreign acquired banks (D^{A}) into the inefficiency specification (5.10). A significant positive (negative) coefficient of these dummy variables would indicate that the post-entry efficiency of the corresponding foreign-owned banks is on average lower (higher), in comparison to their peers. Finally, in a separate set of estimations, we introduce current and lagged dummy variables for the year when the domestic bank was taken over in order to evaluate the dynamic effect of cross-border bank acquisitions on the banks' performance.

Using results from the stochastic frontier model, the estimate of the marginal cost term for bank i at time t ($\hat{C}_{L_{it}}$) is obtained through the partial derivative of the translog function:

$$\hat{C}_{L_{it}} = \frac{C_{it}}{L_{it}} \frac{\partial \ln C_{it}}{\partial \ln L_{it}} = \frac{C_{it}}{L_{it}} \left[\hat{\alpha}_1 + \hat{\delta}_{11} \ln L_{it} + \hat{\delta}_{12} \ln \left(\frac{w_{it,2}}{w_{it,1}} \right) + \hat{\delta}_{13} \ln \left(\frac{w_{it,3}}{w_{it,1}} \right) + \hat{\delta}_{14} Trend \right]. \tag{5.11}$$

The marginal cost term $\hat{C}_{L_{it}}$ is adjusted for the influence of bank inefficiency and can enter as an explanatory variable in equation (5.8). Using the generated regressor $\hat{C}_{L_{it}}$ on the right hand side of (5.8) will influence the efficiency of the coefficient esti-

mates due to the biased standard errors (see Pagan, 1984). Therefore, the standard errors of the coefficient estimates are bootstrapped using 2000 replications to ensure the robustness of our results.[16]

5.3 Data Description

The main source for the bank-specific information is the BankScope database of Bureau Van Dijk, from which the information on individual banks operating in 11 CEECs (Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) is retrieved for the 1992-2006 period. The data set contains information on balance sheets and income statements of 364 commercial, cooperative and savings banks.[17] Unfortunately, BankScope does not provide historical information on bank ownership, which is crucial for our analysis. Therefore, we utilize the information on foreign-owned banks for the years 1992-2004 from the extended data set of De Haas and Van Lelyveld (2006) employed in Havrylchyk and Jurzyk (2008).[18] This data set categorizes foreign-owned banks into two groups: greenfield establishments and banks taken over as a result of a cross-border acquisition. For the remaining two years, we update the missing foreign ownership information using a list of cross-border bank acquisitions from Securities Data Company (SDC) mergers and acquisitions database produced by Thompson Financial. From this source, data on completed (effective) cross-border acquisitions are extracted (i.e. parents of bidder and target banks have different countries of origin), which involve target banks from CEECs and that result in the control of ownership by the bidder bank exceeding 50% of the total equity outstanding.

Table 5.1 displays the evolution of foreign bank entry into CEECs. The dominant

[16] The number of bootstrap replications is chosen based on the optimal criteria suggested by Andrews and Buchinsky (2000).

[17] We use unconsolidated statements of banks, replacing them by consolidated statements whenever information on unconsolidated statements is not available.

[18] We thank Emilia Jurzyk and Iman Van Lelyveld for kindly sharing their data on bank ownership.

mode of foreign entry in the initial stage of transition has been the establishment of greenfield subsidiaries. The number of greenfield banks has grown rapidly by the mid 1990's, remaining at comparable level afterwards. Cross-border acquisitions became a popular mode of entry after the mid 1990's, growing at an accelerating pace with EU enlargement. In the last year of the sample, the share of total banking system assets controlled by foreign banks amounted to 65.3%.[19] Decomposition of this share by the entry modes reveals that 15.1% of banking system assets is controlled by greenfield banks, while the remaining 50.2% is under control of foreign acquired banks.

Table 5.2 lists and describes the variables used and their sources. Before proceeding with the empirical analysis, observations with missing information in at least one of the variables listed in Table 5.2 are dropped. Furthermore, to tackle the influence of extreme observations and reporting errors, all variables are winsorized at the 1^{st} and 99^{th} percentiles.

Descriptive statistics of the resulting data set are reported in Table 5.3. The Table shows that foreign greenfield banks have lower scale of operations and incur lower costs in comparison to the foreign acquired and domestic banks. This is due to the fact that the main mission of greenfield banks is to serve their clients abroad, rather than to engage into full scale operational activities in CEECs. There is also high variation in terms of loan rates: domestic and foreign greenfield banks charge on average more for their loans that foreign acquired banks. However, the variation of deposit rates across banks is relatively modest. This observation can be explained by the fact that depositors find it easier to switch banks when discrepancy in deposit rates is high, while lending rates are to a large extent influenced by relationships of

[19] Difference between the share of total assets controlled by foreign-owned banks in the sample and the EBRD information reported in Figure 5.5 is due to the fact that BankScope does not cover all banks in the economy. In addition, our estimates refer to commercial, cooperative and savings banks only, while the EBRD data covers all banks in the country.

banks with their clients (Petersen and Rajan, 1994). Domestic and foreign banks also differ in terms of the riskiness of their loan portfolios: domestic and foreign acquired banks have higher loan-loss provision reserves relative to the foreign greenfield banks.

To sum up, the preliminary analysis of the descriptive statistics highlights apparent differences between domestic, foreign greenfield, and foreign acquired banks in terms of the scale of their operations, incurred costs, and riskiness. These differences may be related to different missions and strategies employed by these banks, reflected in their portfolio mix. However, the simple comparison made using summary statistics lacks theoretical argumentation and does not allow drawing firm conclusions regarding foreign bank entry effects on efficiency and market power. In the remainder of the paper, these issues are addressed using a more formal framework.

5.4 Estimation Results

5.4.1 Foreign bank entry and cost efficiency

The empirical approach for evaluating the impact of foreign entry on bank efficiency is based on the stochastic efficiency frontier methodology (SFA). We follow the intermediation approach widely used in the banking literature (Sealey and Lindley, 1977) and assume that banks are minimizing their costs given the optimal amount of earning assets to be generated, prices for inputs (labor, capital and financial resources) and technological constraints. Bank costs (C) are measured as the total operating expenses incurred by banks. Bank output (L) is proxied by the total earning assets in the bank's portfolio.[20] Following the literature on bank efficiency, labor prices are

[20] In a separate set of estimations, we subdivided bank output into two categories: total loans and total security holdings. We also did estimations using only total loans as an output. In both cases, the estimation results yielded qualitatively similar outcomes and are available upon request. The possible reason for the similar outcomes is the dominating share of total loans in total earning assets (about 90%) due to underdeveloped securities market in CEECs. Therefore, in the remainder of the text we refer to the total earning assets as bank output L and use terms total earning assets

measured as the ratio of personnel expenses to total assets (w_1), capital prices as the ratio of administrative expenses (other than personnel expenses) to total assets (w_2) and prices of borrowed funds as the ratio of interest expenses to a sum of total deposits and other funding (w_3). We control for the possible influence of environmental differences across countries (e.g., macroeconomic developments, institutional background) and over time (e.g., shocks common to all CEECs), by using country and time dummies.

The outcomes of the SFA model estimations are summarized in Table 5.4. The main focus of this analysis is the determinants of cost inefficiency, shown in the middle panel of the Table. Let us start by introducing time trend as inefficiency determinant in the specification (I). The negative significant coefficient of the trend variable suggests that efficiency of banks in CEECs has on average improved over time, which is in line with the evidence provided by Rossi et al. (2004). Increased foreign bank participation has possibly influenced this general efficiency improvement directly (through the higher efficiency of foreign banks) or indirectly (through the increased competition due to foreign entry and knowledge spillovers).[21]

In order to evaluate the direct impact of foreign bank participation, in specifications (II) and (III) dummy variables for foreign greenfield and foreign acquired banks are introduced. The estimation results suggest that foreign greenfield banks have higher efficiency than domestic and foreign acquired banks. Introducing both dummy variables simultaneously as inefficiency determinants in the specification (IV) does not alter this result. This finding has important policy implications: it highlights the importance of the entry mode on the performance of foreign banks. It

and total loans interchangeably.

[21] In a separate set of regressions, we replaced the time trend by the yearly series on the market share of foreign bank assets from EBRD (2007). In these estimations (available upon request), a significant negative coefficient of the foreign market share variable was obtained, suggesting that the efficiency improvement is correlated with the increased foreign bank participation.

also suggests that the primary motivation behind foreign entry affects the post-entry performance of banks. While foreign greenfield banks are mainly established with the purpose to serve the clients of their parent banks, the entry via cross-border acquisitions is primarily motivated by the efficiency improvements and market power considerations (Lanine and Vander Vennet, 2007). As argued by Detragiache et al. (2008), bank costs after the takeover can increase due to additional expenses related to the need to increase the quality of monitoring activities.[22] In order to capture this dynamic effect, in specifications (V) - (VIII) current and lagged dummy variables for the year when the bank was taken over are introduced.[23] We find two offsetting effects on the efficiency following the foreign acquisition: the immediate impact is significantly positive (deterioration of bank efficiency), while the one period lagged impact is significantly negative (improvement of bank efficiency). These two offsetting effects together with the fact that efficiency gains disappear in the second period, as shown in the specifications (VII) and (VIII), might explain the insignificant overall impact of the acquisition dummy variable in the specifications (III) and (IV).

These findings are also in line with various case studies on foreign bank acquisitions in CEECs. For instance, Abarbanell and Bonin (1997) discuss the impact of privatization of the Polish Bank Slaski (BSK) to a foreign investor in the 1990s. The authors find that the privatization of the bank by foreign investors did not lead to an immediate improvement of its managerial performance. One explanation is that the top management who ran the bank prior to the privatization did not change

[22] Another explanation for the insignificant relationship between the bank acquisition and its subsequent efficiency improvement might be the additional costs incurred in the process of reorganization and restructuring, which most of the banks undergo following the takeover. Still another possibility might be that target banks introduce new services, which requires installation of new equipment and facilities causing an upsurge of costs in the short-run.

[23] This dummy variable captures 64 cross-border bank acquisition events. The number of feasible observations for cross-border acquisitions decreases to 53 (44) when the impact of the takeover is evaluated with a one period (two periods) time lag.

following the privatization, due to the "...strength of personality, political influence, and superior knowledge of banking..." (Abarbanell and Bonin, 1997, p. 46). Similar evidence has been documented in a case study on privatization of the Russian Zhilsotsbank (Abarbanell and Meyendorff, 1997). However, the authors caution that the results of privatization should not be judged only on the basis of the short-run financial performance and that a "...critical lesson to be learned from the privatization of BSK is the importance of a foreign financial investor taking an active role in the development of bank strategy to bring about the fundamental changes necessary to realize the potential franchise value." (Abarbanell and Bonin, 1997, p. 57).

To sum up, we find that the mode of foreign entry has different implications for bank efficiency. Foreign greenfield banks outperform domestic banks in terms of cost efficiency, while the efficiency of foreign acquired banks is not significantly different from that of domestic banks. The later result can be explained by offsetting effects on efficiency following the foreign acquisition.

5.4.2 Foreign bank entry and market power

In order to evaluate the market power of banks, the following variables are used in model (5.8): the implicit lending rate ($r_{L_{it}}$) is defined as the ratio of total interest income to total loans, and the implicit deposit rate ($r_{D_{it}}$) is proxied by the ratio of total interest expenses to total deposits. The deposit rates are adjusted by the corresponding reserve requirement ratios in each of the CEECs (see Table 5.2). To evaluate the impact of foreign ownership on market power of banks, interaction terms of the average deposit rate with a foreign greenfield bank dummy ($r_{D_{it}} * D^{GF}$) and with a foreign greenfield bank dummy ($r_{D_{it}} * D^{A}$) are introduced. Together with the marginal cost estimates ($\hat{MC}$) obtained from the SFA specification (IV) in Table 5.4, these variables can be used for conducting the market power test using model (5.8).

Table 5.5 shows the estimation results of (the augmented) equation (5.8). We account for heterogeneity across banks located in different CEECs with varying levels of economic development and regulatory structures by applying a panel data estimation technique. All estimations are done by fixed-effects method, which was found to outperform the random-effects method based on the Hausman test. Standard errors are estimated using residuals clustered by countries, to relax the assumption of cross-sectional independence. Panel test for serial correlation based on the procedure of Drukker (2003) suggests that residuals in all specifications are free from first order autocorrelation effects.

Specification (I) describes the baseline model. The coefficient of the deposit rate variable is significant and larger than one. The Wald test indicates that the market power coefficient is significantly larger than one, suggesting rejection of the competitive market structure hypothesis for CEECs banking sector as a whole. This finding applies to all banks in CEECs, regardless of their ownership. To evaluate the impact of bank ownership on market power, the corresponding interaction terms are included in specifications (II) and (III). The coefficients of interaction terms suggest that foreign acquired banks have a significantly lower market power compared to domestic and foreign greenfield banks. This finding does not alter when both interaction terms are added to the model simultaneously in the specification (IV). The Wald test suggests that market power coefficient of foreign acquired banks is not significantly different from one, supporting the competitive market structure hypothesis for these banks. This result contrasts the prediction of the Claeys and Hainz (2007) model, in which competition in the domestic banking markets is stronger for the greenfield entry, compared to the acquisition entry.[24] Our results suggest that

[24] Claeys and Hainz (2007) do not consider the *follow clients abroad* motive for foreign bank entry in their model, which might explain this contradictory result.

cross-border bank acquisitions result in a more competitive banking environment, which has important policy implications.

Robustness check

There are several important aspects of banking that are not captured in the theoretical model of market power. The first is the presence of uncertainty and credit risk. To control for the impact of risk, we follow Barajas et al. (1999) and Vera et al. (2007) and introduce the share of loan-loss provisions in total loans as a proxy of quality of bank loan portfolio.[25] The second aspect is the presence of non-interest banking services, which might be considered as additional revenue for banks and might influence their degree of riskiness and market power (Lepetit et al., 2008). To control for the impact of fee-generating activities of banks, we follow Maudos and Fernandez de Guevara (2004) and augment our specification by introducing the ratio of non-interest revenues to total assets as a proxy for implicit interest revenues of banks. Finally, macroeconomic fundamentals might influence the depth of financial intermediation in the country (Cotarelli et al., 2005) and decision of banks to go abroad. We control for the macroeconomic environment by introducing real GDP growth, inflation and exchange rate changes in our specification.

The introduction of additional variables to control for banking risks (LLP), service incomes ($IMPL$) and macroeconomic environment (GDP, $INFL$ and FX) in specifications (V), (VI), and (VII) does not change the main results. In particular, the coefficient of the interaction term with foreign greenfield dummy remains insignificant, implying that even after accounting for credit risks, non-interest banking activities and macroeconomic variables, greenfield banks do not exhibit lower

[25] A more direct measure of loan portfolio quality would be the share of non-performing loans in total loans. However, BankScope is missing information on non-performing loans for more than half of banks in the sample, for which reason we rely on loan-loss provisions as an indicator of loan portfolio quality.

market power than domestic banks. This insignificant decrease in market power can be explained by the absence of alternative sources of bank financing for the customers of greenfield banks, who already established relationships with their long-term partner banks.

In line with the theoretical prediction, banks with riskier loan portfolios and higher share of non-interest banking activities charge higher lending rates.[26] The later result supports the findings of Lepetit et al. (2008), according to which banks expanding to non-interest income activities are riskier than banks focused on lending, which is reflected in higher loan rates. Among macroeconomic variables, we find positive and significant effect of exchange rate depreciation on loan rates, which suggests that currency stability has important implications for lending decisions of banks.

To sum up, the estimation results reject the competitive market structure hypothesis in CEECs, as the estimated market power coefficients are significantly larger than one. This indicates that banks in CEECs possess market power at least in one of the markets (loans or deposits).[27] The market power of foreign acquired banks is significantly lower than that of domestic and foreign greenfield banks, suggesting that increase in competition as a result of the foreign entry is mainly driven by cross-border acquisitions.

[26] Since interest income of banks can be affected by the quality of loan portfolio, using LLP among explanatory variables may introduce endogeneity bias in coefficient estimates. To control for possible endogeneity, in a separate set of regressions we use lagged LLP among explanatory variables. The estimation results are qualitatively similar to the specification with contemporaneous LLP and are available upon request.

[27] Since the deposit market is likely to be more competitive than the loan market due to the negligible bank switching costs for depositors and prevalence of relationship-based lending, we suggest that the main part of the market power comes from the loan markets. Relatively lower variation of deposit rates relative to the loan rates in our sample lends support for this argumentation (see also discussion in Section 5.3).

5.5 Conclusions

This paper has studied the implications of the recent sharp increase in foreign bank participation in CEECs for the post-entry banking performance. The study has highlighted the existence of a complex relationship between different modes of foreign bank entry and both cost efficiency and market power of banks.

Foreign greenfield banks exhibit superior operational efficiency in comparison to domestic and foreign acquired banks. This can be explained by the specialization of greenfield banks to serve customers of their parent banks abroad and already established banking relationships. The performance of foreign acquired banks exhibits an offsetting dynamic pattern: the efficiency deteriorates in the initial year of acquisition, slightly improving in the subsequent year. The overall impact on the post-acquisition performance evaluated for the whole sample is insignificant, which can be due to the poor managerial and financial characteristics of target banks in CEECs inherited by foreign investors.

We also find evidence on differences in market power across domestic and foreign banks. Market power of foreign greenfield banks is not significantly lower than that of domestic banks. This result holds when the impact of credit risks, non-interest banking activities and macroeconomic environment are taken into account, contrasting the evidence from studies, which do not control for the cost efficiency of banks when analyzing market power. Unlike greenfield entrants, foreign acquired banks exhibit a substantially lower degree of market power, which can be explained by their strategic considerations to expand activities in CEECs and subsequent increase of the competitive pressure.

The analysis conducted in this study provides important policy implications. It documents a significant improvement of banking performance in CEECs measured

by cost efficiency during the sample period corresponding to an increase in foreign bank participation. CEECs banks and customers have benefited from foreign participation both directly (superior post-entry performance of greenfield banks) and indirectly (overall increase in bank efficiency due to spillover effects to domestic banks). Opening the borders for foreign entry has also contributed to the competitiveness of the banking industry in CEECs, but largely due to cross-border acquisitions. In this sense, the findings in this study provide support for the conventional belief by the policymakers that liberalization of domestic banking industry and promotion of foreign entry would have a positive impact.

However, these conclusions should be interpreted with caution, since this study has not addressed the issue of financial stability in CEECs. During the recent financial crisis, banking sectors in CEECs have proven to be very vulnerable to systemic external shocks. The impact of the increased foreign bank participation on financial stability is an important topic, which requires the attention of policymakers and needs to be addressed in the future research.

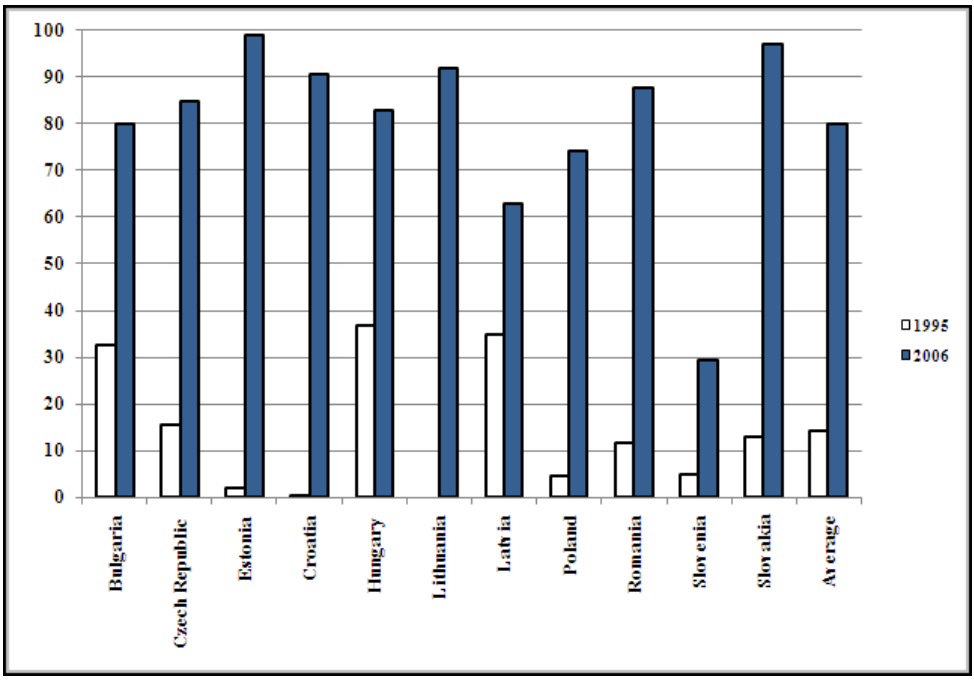

Figure 5.1. Share of foreign-owned banks in terms of total assets (%), 1995 and 2006

Source: EBRD (2007).

Table 5.1. Number of observations for domestic and foreign (acquired and greenfield) banks

Countries	Ownership	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Bulgaria	Domestic	4	9	12	15	17	21	23	17	14	14	12	11	11	10	9	199
	Foreign greenfield	0	0	0	1	2	2	2	3	4	6	7	7	7	7	7	55
	Foreign acquired	0	0	0	0	0	0	1	4	7	7	9	10	9	10	11	68
Croatia	Domestic	12	22	28	31	37	45	38	33	27	26	26	30	19	18	17	409
	Foreign greenfield	0	0	1	1	1	4	4	6	6	6	5	4	2	2	2	44
	Foreign acquired	0	0	0	0	0	0	1	1	4	5	4	4	4	5	6	34
Czech Republic	Domestic	10	14	19	20	22	21	19	16	9	8	7	6	6	6	5	188
	Foreign greenfield	3	7	8	10	12	12	10	10	11	10	10	9	9	9	9	139
	Foreign acquired	0	0	0	0	0	1	3	4	6	7	7	8	7	7	8	58
Estonia	Domestic	3	8	11	16	19	20	8	7	2	2	4	4	3	2	2	111
	Foreign greenfield	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Foreign acquired	0	0	0	0	0	0	1	2	3	3	3	3	3	4	4	26
Hungary	Domestic	18	23	30	34	30	23	19	18	10	10	11	10	8	8	8	260
	Foreign greenfield	4	7	9	11	12	12	11	15	16	13	13	13	12	12	12	172
	Foreign acquired	0	0	0	0	2	6	8	9	8	8	8	8	7	7	7	78
Latvia	Domestic	3	9	16	20	21	25	25	23	16	14	14	15	14	14	13	242
	Foreign greenfield	0	0	1	1	1	2	2	2	2	3	3	3	3	3	3	29
	Foreign acquired	0	0	0	0	0	1	2	2	2	4	4	4	5	5	6	35
Lithuania	Domestic	1	5	9	11	14	17	16	15	8	6	5	5	5	4	4	125
	Foreign greenfield	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Foreign acquired	0	0	0	0	0	0	0	0	2	3	4	4	4	5	5	27
Poland	Domestic	17	24	35	37	41	40	32	28	18	14	12	14	14	13	13	352
	Foreign greenfield	2	4	5	7	11	11	13	11	11	11	13	13	12	12	12	148
	Foreign acquired	0	0	0	0	1	3	4	10	14	16	16	15	15	16	16	126
Romania	Domestic	4	5	9	12	11	13	24	23	16	14	14	11	10	10	8	184
	Foreign greenfield	0	0	0	0	1	3	8	9	9	9	10	10	10	10	10	89
	Foreign acquired	0	0	0	0	0	0	1	1	3	5	6	9	9	9	11	54
Slovakia	Domestic	4	6	9	11	13	16	16	15	10	7	5	4	3	3	3	125
	Foreign greenfield	1	1	2	4	7	9	10	8	10	9	9	9	8	8	8	103
	Foreign acquired	0	0	0	0	0	0	0	0	2	5	7	7	6	6	6	39
Slovenia	Domestic	7	10	13	20	28	27	23	24	17	14	10	12	10	10	9	234
	Foreign greenfield	1	2	2	3	3	3	2	2	2	2	2	2	2	2	2	32
	Foreign acquired	0	0	0	0	0	1	1	1	1	2	4	4	4	4	5	27
Total	**Domestic**	**83**	**135**	**191**	**227**	**253**	**268**	**243**	**219**	**147**	**129**	**120**	**122**	**103**	**98**	**91**	**2,429**
	Foreign greenfield	**11**	**21**	**28**	**38**	**50**	**58**	**62**	**66**	**71**	**69**	**72**	**70**	**65**	**65**	**65**	**811**
	Foreign acquired	**0**	**0**	**0**	**0**	**3**	**12**	**22**	**34**	**52**	**65**	**72**	**76**	**73**	**78**	**85**	**572**

Source: BankScope, Thompson Financial SDC Platinum Database, De Haas and Van Lelyveld (2006) and Havrylchyk and Jurzyk (2008).

Table 5.2. Variable definitions and sources

Variable	Definition	Measure	Source
C	Bank costs	Total operating expenses	BankScope
L	Earning assets	Total earning assets	BankScope
w_1	Price of labor	Ratio of personnel expenses to total assets	BankScope
w_2	Price of capital	Ratio of administrative expenses (other than personnel expenses) to total assets	BankScope
w_3	Price of borrowed funds	Ratio of interest expenses to a sum of total deposits and other funding	BankScope
D^{GF}	Foreign greenfield	Dummy variable that takes value of 1 for greenfield establishments of foreign banks	De Haas and Van Lelyveld (2006), Havrylchyk and Jurzyk (2008)
D^{A}	Foreign acquired	Dummy variable that takes value of 1 for domestic banks acquired by a foreign bank	De Haas and Van Lelyveld (2006), Havrylchyk and Jurzyk (2008), and Thomson's SDC Platinum Database
D^{FE}	Foreign entry	Dummy variable that takes value of 1 in the year when a domestic bank was taken over by a foreign bank	De Haas and Van Lelyveld (2006), Havrylchyk and Jurzyk (2008), and Thomson's SDC Platinum Database
r_L	Implicit loan rate	Ratio of interest expenses to total loans	BankScope
r_D	Implicit deposit rate	Ratio of interest expenses to total deposits	BankScope
MC	Marginal costs	Derivative of the cost function obtained from the stochastic frontier model with respect to output quantity	BankScope and own estimations
LLP	Loan-loss provisions	Ratio of loan-loss provisions to total loans	BankScope
$IMPL$	Implicit interest revenue	Ratio of the net non-interest revenues to total assets	BankScope
ρ	Reserve requirements ratio (%)	Bulgaria=8, the Czech Republic = 2, Estonia = 16, Croatia = 19, Hungary = 5, Latvia = 8, Lithuania = 6, Poland = 3.5, Romania = 20, Slovakia = 2, Slovenia = 2.	Barth et al. (2008)
GDP	Economic activity	Annual real GDP growth	World Development Indicators (WorldBank)
$INFL$	Inflation	Annual growth in consumer price index (CPI)	World Development Indicators (WorldBank)
FX	Currency stability	Annual growth of average exchange rate *vis-a-vis* US dollar	International Financial Statistics (IMF)

Table 5.3. Descriptive statistics

		Bank costs	**Earning assets**	**Price of labor**	**Price of capital**	**Price of borrowed funds**	**Loan rate**	**Deposit rate**	**Marginal costs**	**Loan loss provisions**	**Implicit interest revenues**
		C	L	w_1	w_2	w_3	r_L	r_D	MC	LLP	$IMPL$
Domestic banks	Mean	748.6	17335.5	0.512	0.023	0.068	0.246	0.079	0.076	0.097	0.083
	Median	231.0	3959.8	0.524	0.020	0.054	0.189	0.066	0.068	0.060	0.072
	St. Dev.	1339.6	31630.5	0.201	0.012	0.045	0.186	0.052	0.035	0.106	0.040
	Maximum	9701.8	193000.0	0.849	0.071	0.324	1.847	0.336	0.225	1.000	0.310
	Minimum	13.7	145.0	0.042	0.004	0.011	0.066	0.012	0.012	0.000	0.014
Foreign greenfield banks	Mean	199.2	6311.4	0.585	0.014	0.053	0.265	0.061	0.049	0.019	0.054
	Median	104.3	4663.8	0.643	0.010	0.046	0.161	0.054	0.041	0.016	0.048
	St. Dev.	256.2	6560.5	0.194	0.010	0.037	0.367	0.045	0.027	0.016	0.027
	Maximum	1303.1	30823.7	0.838	0.049	0.244	2.309	0.305	0.148	0.075	0.171
	Minimum	14.8	218.1	0.095	0.004	0.011	0.054	0.013	0.014	0.000	0.019
Foreign acquired banks	Mean	1267.1	28641.7	0.556	0.018	0.046	0.171	0.053	0.066	0.073	0.064
	Median	473.3	13231.3	0.569	0.015	0.036	0.133	0.040	0.054	0.053	0.054
	St. Dev.	2388.1	43985.1	0.173	0.010	0.035	0.111	0.043	0.034	0.076	0.030
	Maximum	21324.9	193000.0	0.845	0.072	0.214	0.605	0.288	0.191	0.361	0.185
	Minimum	18.1	340.0	0.194	0.006	0.012	0.050	0.013	0.021	0.000	0.024
Total (all banks)	Mean	793.0	18371.3	0.524	0.021	0.063	0.235	0.074	0.072	0.088	0.078
	Median	235.9	4583.6	0.540	0.019	0.050	0.179	0.060	0.064	0.054	0.067
	St. Dev.	1536.0	33298.8	0.198	0.012	0.044	0.197	0.051	0.035	0.100	0.039
	Maximum	21324.9	193000.0	0.849	0.072	0.324	2.309	0.336	0.225	1.000	0.310
	Minimum	13.7	145.0	0.042	0.004	0.011	0.050	0.012	0.012	0.000	0.014

Notes: bank costs and earning assets are measured in thousands of US dollars and deflated by the consumer price index (extracted from the World Bank's World Development Indicators database), using 1995 as a reference year. To confront the influence of extreme observations and reporting errors, all variables have been winsorized at the 1^{st} and 99^{th} percentiles.

Table 5.4. Impact of foreign bank participation on cost efficiency: Stochastic efficiency frontier analysis (model (5.9))

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Frontier								
Earning assets	0.5583***	0.5661***	0.5579***	0.5635***	0.5636***	0.5912***	0.6480***	0.6135***
Price of labor/Price of capital	0.5484***	0.5544***	0.5487***	0.5561***	0.5457***	0.5756***	0.5733***	0.5837***
Price of borrowed funds/Price of capital	-0.0751	-0.0774	-0.075	-0.0772	-0.078	-0.1182	-0.2028**	-0.1598
Time trend	0.0028	-0.0009	0.0026	-0.0018	-0.0222	-0.0087	-0.0068	0.0148
(Earning assets)^2	0.0438***	0.0423***	0.0439***	0.0425***	0.0444***	0.0426***	0.0332**	0.0389***
(Earning assets)*(Price of labor/Price of capital)	-0.0009	-0.0008	-0.001	-0.001	-0.0019	0.0004	0.002	0.0059
(Earning assets)*(Price of borrowed funds/Price of capital)	0.0095	0.0104	0.0095	0.0103	0.0078	0.0104	0.0169	0.0076
(Earning assets)*(Time trend)	0.0043**	0.0044**	0.0043**	0.0045**	0.0042**	0.0025	0.0035	0.0012
(Price of labor/Price of capital)^2	-0.0327***	-0.0340***	-0.0327***	-0.0338***	-0.0357***	-0.0516***	-0.0552***	-0.0793***
(Price of labor/Price of capital)*(Price of borrowed funds/Price of capital)	0.0210**	0.0205**	0.0210**	0.0204**	0.0273**	0.0350***	0.0390**	0.0463***
(Price of labor/Price of capital)*(Time trend)	-0.0177***	-0.0175***	-0.0178***	-0.0176***	-0.0160***	-0.0150***	-0.0138***	-0.0097***
(Price of borrowed funds/Price of capital)^2	-0.0583**	-0.0602***	-0.0582**	-0.0598**	-0.0655***	-0.0742***	-0.0729**	-0.0542**
(Time trend)^2	0.0006	0.0007	0.0006	0.0007	0.0012	0.0008	-0.0006	-0.0023
Constant	1.3176***	1.2953***	1.3193***	1.3050***	1.4700***	1.5039***	0.9721**	1.2934**
Inefficiency determinants								
Time trend	-0.0290**	-0.0250**	-0.0287**	-0.0237*				
Foreign greenfield		-0.3727***		-0.3786***				
Foreign acquired			-0.005	-0.0275				
Foreign entry					0.3190***			0.1611*
Foreign entry (1 year lag)						-0.3232**		-0.4637**
Foreign entry (2 years lag)							-0.0701	-0.0563
Constant	-0.4256***	-0.3421**	-0.4358***	-0.4036	-0.7732***	-0.7779***	-0.8076***	-0.8525***
Statistics								
Number of observations	2,067	2,067	2,067	2,067	2,067	1,613	1,290	1,290
Number of parameters	40	41	41	42	40	39	38	40
Log likelihood	-174.4958	-168.9294	-174.4923	-168.8235	-165.812	-52.6434	-64.6417	-2.0239
$\log(\sigma_u^2)$	-0.4128	-0.5215	-0.3929	-0.4018	-0.1867	-0.3858	-0.2521	-0.276
$\log(\sigma_v^2)$	-2.9981***	-2.9965***	-2.9982***	-2.9974***	-3.0042***	-3.1017***	-3.0930***	-3.1885***

Notes: the dependent variable is the ratio of total operating expenses to the price of capital. All variables (except from the time trend) are expressed in the logarithmic form. Estimations are performed using maximum likelihood method based on the Broyden–Fletcher–Goldfarb–Shanno (BFGS) optimization algorithm. σ_u^2 and σ_v^2 stand for the standard deviation of the inefficiency and random error terms, respectively. Each specification also contains dummy variables for countries and time (not shown in the table to conserve space). *, **, and *** denote significance at the 10 percent, 5 percent and 1 percent level, respectively.

Table 5.5. Impact of foreign bank participation on market power (model (5.8))

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
Model							
Deposit rate	2.1462***	2.1571***	2.1270***	2.1364***	2.0572***	1.8219***	1.6451***
Marginal costs	0.4856**	0.4843**	0.4852**	0.4840**	0.2339*	0.2350*	0.3869*
Interaction term (deposit rate × foreign greenfield dummy)		-0.0587		-0.0508	0.4651	0.1334	0.0771
Interaction term (deposit rate × foreign acquired dummy)			-0.6900**	-0.6897**	-0.3720**	-0.4535**	-0.6361**
Non-performing loans					0.1487**		
Implicit interest revenue						1.2013***	
Real GDP growth							-0.0044
CPI inflation							0.0008
Exchange rate changes							0.0018*
Constant	0.0455*	0.0456*	0.0531*	0.0532*	0.0532*	0.0015*	0.0968***
Market power test							
H0: Deposit rate coefficient = 1	10.22	9.32	9.54	8.66	5.78	6.87	3.31
(p-value)	0.0095	0.0122	0.0115	0.0147	0.0371	0.0256	0.0987
H0: Deposit rate coefficient + Interaction term (deposit rate and foreign greenfield dummy) = 1	–	5.32	–	5.37	7.13	4.14	3.74
(p-value)	–	0.0438	–	0.0430	0.0235	0.0691	0.0820
H0: Deposit rate coefficient + Interaction term (deposit rate and foreign acquired dummy) = 1	–	–	1.03	1.17	2.38	1.72	0.00
(p-value)	–	–	0.3341	0.3053	0.1543	0.2187	0.9796
Statistics							
Number of observations	1,988	1,988	1,988	1,988	1,615	1,988	1,966
R^2	0.2178	0.2172	0.2245	0.2241	0.2493	0.2555	0.2668
Log-likelihood	1305.8	1305.9	1314.4	1314.4	1202.8	1381.1	1347.8
Hausman test (p-value)	0.0255	0.0371	0.0153	0.0250	0.0007	0.0447	0.0088
Panel autocorrelation test (p-value)	0.1539	0.1948	0.1398	0.2436	0.1743	0.2195	0.1298

Notes: the dependent variable is the ratio of total interest expenses to total loans. Estimations are performed using fixed effects method with bootsrapped standard errors using 2000 replications. Standard errors are estimated using residuals clustered by country to allow for possible interdependence between banks located in the same country. The Hausman test tests the null hypothesis that random effects model is consistent and efficient (i.e., no systematic difference between coefficient estimates for the fixed effects and random effects models). Panel autocorrelation test (null hypothesis: no first order autocorrelation) is based on the procedure of Drukker (2003). Market power hypotheses are tested using Wald test statistic. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively.