Does the Entry Mode of Foreign Banks Matter for Bank Efficiency? Evidence from Czech Republic, Hungary, and Poland

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Abstract

This paper investigates the impact of specific modes of entry of foreign banks, i.e. *greenfield investment* versus *merger and acquisition*, on bank performance in three transition economies - Czech Republic, Hungary, and Poland. We use stochastic frontier analysis to model and measure the cost efficiency of banks. We adopt a maximum likelihood approach to estimation in which the variance of the one-sided error term is modeled jointly with the cost frontier, thus enabling us to retrieve efficiency scores, as well as estimating the various determinants of X-inefficiency. We find that foreign banks are generally more cost efficient than their domestic counterparts. Further comparisons of particular modes of entry of foreign banks reveal that such superior cost performance is mainly due to Greenfield banks. No cost difference is apparent between M&As and domestic banks. Comparing the performance of Greenfield banks with M&As, we find that the former outperform the latter. The better performance of greenfield banks can generally be explained by a more selective structure of activities thanks to their focus on servicing multinational clients and big local corporates, and on trade finance. We also find a strong age effect with respect to M&As which suggests that approximately two years after acquisition, the rate at which their cost efficiency improves seems to slow down.

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1. Introduction

The second half of the 1990s witnessed a dramatic increase of foreign participation in emerging markets' banking systems. Central and Eastern European countries, especially Czech Republic, Hungary, and Poland, witnessed the most striking changes, with foreign presence rising from around 10% at the end of 1994 to around 60% at the end of 1999 (Mathieson & Roldos, 2001). The transformation of the communist mono-bank system into a two-tier one has led the authorities to open up the banking system to new entries and foreign banks have taken this opportunity to make their presence felt through greenfield investments. The banking crises that resulted from state-owned banks granting huge amounts of non-performing loans forced the governments of these countries to undertake vast programs of bank privatization that eventually drew in foreign banks through mergers and acquisitions of domestic banks. The need to comply with the requirements of membership in the OECD and the prospects of European Union accession has provided Czech, Hungary, and Poland a further impetus to the removal of barriers to entry (Mathieson & Roldos, 2001).

The presence of foreign banks competing alongside domestic banks triggers the unavoidable question of whether there is a difference in performance between these two categories. Several hundreds studies have attempted to answer this question for developed countries, especially in the U.S context and to a lesser extent in the E.U[2]. As for developing economies, the literature is filling in quickly with such studies. Studies on bank performance in transition countries taking into account the role of foreign ownership often indicate that foreign banks are more efficient than domestic banks. Nevertheless, this literature suffers from a main drawback. Indeed, although trying to distinguish either between levels of foreign involvement in bank ownership, between types of foreign owners (strategic partners, institutional investors…) or between countries of origin of foreign banks, few studies take into account their modes of entry. A likely reason for this deficit is the difficulty in tracking evolution in bank ownership over time. Recent studies (Havrylchyk (2006), Havrylchyk & Jurzyk (2006), Haas & Lelyveld (2006) and Claeys & Hainz (2006)) have attempted to bridge this gap but have not focused on bank efficiency per se. Yet, the literature on international banking emphasizes the important role of the entry mode of banks on their activities and their performance.

Our paper proposes to bridge this gap in the literature by investigating the impact of specific modes of entry of foreign banks[3], i.e. *greenfield investment* (hereafter GRs) versus *merger and acquisition*[4] (hereafter M&As), on their cost performance in Czech, Hungary, and Poland. It represents one of the first attempts at analyzing whether modes of entry matter for foreign bank performance in the context of increasing foreign bank participation in developing economies. For this purpose, we use stochastic frontier analysis to measure the cost efficiency of the bank relative to the frontier. We adopt a

[2] For a good overview of studies on developed economies, see Berger et al. (2000) and Clarke et al. (2001).
[3] We define foreign banks as those in which foreign owners (Companies + Individuals) hold at least 50% of total share capital.
[4] *Greenfield* foreign banks are those that enter a domestic market by establishing a branch or a subsidiary. *Merger and acquisition* foreign banks are those that enter by acquiring an existing domestic institution.

maximum likelihood approach to estimation in which the variance of the one-sided error term is modeled jointly with the cost frontier. This approach allows us to simultaneously estimate the cost frontier and therefore retrieve inefficiency scores, as well as estimating the various determinants of X-inefficiency.

Our paper is related to the literature on measuring bank efficiency in general, and on that on banking efficiency in transition economies in particular. Our contribution to the literature is twofold. First, as discussed, we account for the differential implications of entry modes of foreign banks on their performance. In other words, we compare the performance of greenfield institutions with M&A foreign banks. Moreover, we also investigate the comparative performance of foreign banks as a whole with domestic banks, and of GRs and M&As as two separate groups with their domestic peers. Second, we seek systematic econometric evidence of the origins of the differences in bank performance. In terms of methodology, we approach both the above issues through a one-stage approach to estimation that jointly models the cost frontier and the determinants of inefficiency. This one-stage approach gets round the recurrent criticisms inherent in the two-stage estimation approach.

The following section provides an account of foreign bank participation in the three transition economies. Section 3 reviews the literature on foreign bank entry and efficiency. Section 4 discusses the estimation methodology and a description of the data is provided in section 5. Section 6 presents and discusses the results. A concluding section follows.

2. Foreign Bank Entry into Czech Republic, Hungary, and Poland

As mentioned earlier, Czech Republic, Hungary and Poland witnessed the most dramatic increase in foreign banks participation amongst transition economies in the mid to late 1990s, as evident from figure 1.

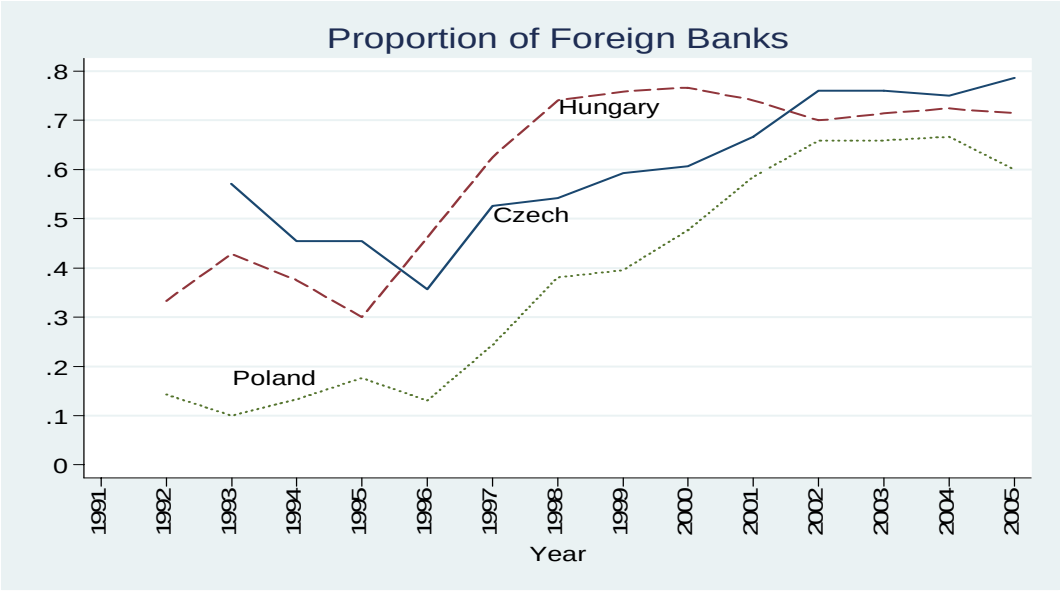

Figure 1

Two major events have triggered the entry of foreign banks into these three transition economies. First, the transformation of the communist mono-bank system into a two-tier one has led the authorities to open up the banking system to entries of new banks. Foreign banks have taken this opportunity to set up theirs greenfield investments. This can effectively be described as the first wave of foreign bank entry into these countries. Nevertheless, the creation of a two-tier banking system on its own was not sufficient to resolve structural problems, since bank managers of state-owned banks continue to grant loans to state-owned companies on no commercial basis. Then came banking crises in which state-owned banks suffered from a huge amount of non-performing loans. The governments therefore decided to undertake vast programs of restructuring and recapitalizing banks in order to deal with their bad loan problems with an eye on privatizing them later on. This is these privatization processes that drew a second wave of foreign bank entries through mergers and acquisitions of domestic banks.

Both internal and external factors have led the authorities in these countries to open their banking systems to foreign competition. Indeed, the openness to foreign trade and investment, and the aim to build up more efficient and stable banking systems in the aftermath of crises have motivated the gradual removal of barriers to entry of foreign institutions. Moreover, the need to comply with the requirements of membership in the OECD and the prospects of European Union accession has provided Czech, Hungary, and Poland a further impetus to the removal of barriers to entry (Mathieson & Roldos, 2001). In what follows, we provide an account of these factors for each of the three countries.

2.1 First wave of entry: transformation from a monobank to a two-tier banking system.

Czech Republic

The creation of the two-tier banking system in Czech Republic took place in 1990 (Tuma, 2002). This was followed by the passing of the Act on Banks in February 1992 which allowed the licensing of foreign banks. The Act did not limit foreign stakes in individual banks or in the foreign share of total banking sector assets (Simonson, 2001). Between 1989 and 1993, several foreign-owned banks were set up, all specialising in investment banking and services to companies and high-revenue households. They were created as either subsidiaries or branches of foreign banks (Weill, 2003).

Poland

In January 1989, two new acts were voted by the Parliament: the Act on Banking and the Act on the National Bank of Poland. The Act on Banking opened up the market to foreign investors. During the first two years of transition (1990−1991) there were 4 banking institutions which established in Poland. Three of these banks established under their brand names, namely Raiffeisen-Centrobank (established together by Raiffeisen Zentralbank Osterreich AG and Centro Internationale Handelsbank AG), Creditanstalt and Citibank. Two renowned banks: ING Bank N.V. and Societe Generale established branches in Warsaw. Seven other foreign banks were established in the years 1990−1993 by a number of other foreign banks, investment funds, foreign companies and, in some cases, with a small participation of Polish state-owned banks or enterprises and state agencies (Balcerowicz & Bratkowski, 2001).

Hungary

Between 1986 and 1987 the Hungarian government authorized foreign banks to enter via foreign majority-owned joint ventures with Hungarian banks. The influx of foreign banks effectively began in 1990. The government liberalized the entry rules further and ING Bank became the first foreign bank to establish a wholly owned subsidiary. At present, most of the de novo entries is via wholly owned subsidiaries and foreign owners have bought out the Hungarian partners in the early joint ventures (Tschoegl, 2003a, Appendix 4).

2.2 Second wave of entry: Privatization of state-owned banks.

Czech Republic

The Czech Republic was involved in two waves of privatisation of state-owned banks. The first wave of privatization was by voucher. The large Czech banks were transformed into joint-stock companies in 1992 and partially privatized within the first wave of "voucher privatisation" (Tuma, 2002). Three of the four large banks were subject to voucher privatization (Ceskoslovenska Obchodni Banka, henceforth CSOB was excluded because of its unique involvement in foreign financial markets)[5] The state, nevertheless,

[5] The government feared that voucher privatization might alter CSOB's viability and have deleterious effects on the nation's monetary stability (Simonson, 2001, p. 201).

kept controlling stakes in these banks[6], in line with the state applied principles adopted in 1991, according to which the state would retain control of at least 40-50% of the basic capital, foreign participation would be held to a 25% maximum, and no single foreign investor would be permitted more than a 10% stake (Simonson, 2001). The only one state-owned bank that was wholly privatized was the Zivnostenka Banka, which was sold to foreign investors in 1992 (Weill, 2003).

Inadequate governance and lack of effective corporate restructuring led to a fragile banking system with relatively low foreign participation (IMF, 2000). This meant that the first wave of privatization proved to be a failure in resolving structural problems of banks. By 1998, Czech government stakes were 65.7% in CSOB, 45% in CS, 36.3% in IPB, and 48.7% in KB (Simonson, 2001, p. 201). The weaknesses of the state-owned banks with large holdings of non performing loans, and the goal of accession to the European Union has pushed the newly elected government to adopt a new privatization program aiming at selling the large banks to foreign banks. The privatization process gathered speed in the second half of 1999 with the sale of CSOB to Belgium's second largest bank – bringing foreign participation in the system to 47.3% of total assets. In February 2000, Austria's second-largest banks agreed to buy a 52% stake in Ceska Sporitelna (the second-largest Czech bank), bringing foreign participation to about 54%. The privatization process for the largest bank (Komerchi) has been underway for some time and the government has reportedly received 10 preliminary letters of interest from domestic and foreign banks (including Bayerische HypoVereinsbank, Citigroup, and Deutsche Bank) (IMF, 2000).

Poland

The first wave of privatization there took place over the period 1993 to 1997. The original program of the privatization of state-owned banks was approved in March 1991 but the privatization process did not start until 1993. In April 1993, Wielkopolski Bank Kredytowy (WBK) was privatized, and it was followed by Bank OEl¹ski (BSK) towards the end of the year. Both banks were sold via Initial Public Offerings and in both cases a foreign strategic investor became a shareholder[7]. Yet, the strategic investors' share in stock was limited to 28.5% and 25.9% respectively and the State Treasury retained a vast share in equity (44.3% in WBK; 33.16% in BSK). As a result, the privatization of these two banks was far from being complete. In January 1995, the third commercial bank, Bank Przemyslowo-Handlowy (BPH) was put to sale exclusively in a public offer. Due to a limited demand, an underwriting contract was executed and EBR&D took over 15.06% of shares. More than 48% of shares remained with the State Treasury. In December 1995, the fourth commercial bank, Bank Gdañski (BG) was privatized via IPO. Another domestic bank, BIG S.A. (established in 1989) turned out to be the biggest investor. Together with its daughter companies, BIG SA bought 26.75% of shares. Another 25.1% of shares were sold to foreign investors with the use of a new instrument on the Polish market- Global Depository Receipts (GDR). The State Treasury retained 39.94% of

[6] The government's stake was over 50% in Česká Spořitelna (CS) and Československá obchodní banka, 47.4% in Investiční a poštovní banka and 44% in Komerční banka) (Tuma, 2002)
[7] EBR&D and ING Bank respectively.

shares. By the end of 1995 out of a total of nine commercial banks only four were partly privatized.

In October 1995, an "Outline of the Program of Consolidation and Privatization of State-Owned Banks" was prepared. Although the program envisaged continuation of privatization, emphasis was on the consolidation of the state-owned banking sector. The political aim of the consolidation and the privatization policy was to halt a further foreign capital involvement in privatization of financial institutions in Poland. After a long-lasting discussion and a strong opposition of managers of some state-owned banks, the Ministry of Finance revised its program. Instead of merging banks, in July 1996 a decision was taken to form a banking group[8]. Three commercial banks that had been finally chosen- Bank Depozytowo Kredytowy (BDK), Powszechny Bank Gospodarczy (PBG) and Pomorski Bank Kredytowy (PBKS)- formed a bank group together with PEKAO S.A. The latter bank was to be a dominant partner for the other three subordinate banks. At that time a new bank group, called PEKAO Group, was the biggest banking institution in Poland in all terms, i.e. as far as capital, assets, deposits and network were concerned. In a 2-years time this move turned out to be an unsuccessful attempt due to the fact that managing boards of individual banks took advantage of legal settlements of the consolidation in order to resist a merger [Wioeniewska 1998 and1999].

While the government was pre-occupied with concepts of consolidation, and was rather reluctant to foreign strategic investors, two banks (PBK − one of the nine state-owned commercial banks, and Bank Handlowy) worked out their own privatization plans and successfully pressed for their acceptance by the government. In the first half of 1997 both plans were realized. The minority of shares of PBK was sold to 3 financial institutions- Creditanstalt, the Polish insurance company WARTA and the former domestic Kredyt Bank (altogether 39%). The State Treasury retained over 50% of shares. The concept of BH privatization was an even more sophisticated version of the insider privatization. The State Treasury sold 25.96% of shares to three foreign investors (J.P. Morgan, Swedbank and Zurich Insurance Company) and 59% was sold by IPO. The State Treasury kept only 7.9% of votes at the general assembly of shareholders and 28−30% of shares via convertible bonds. As a result, the State Treasury deprived itself of decision making, the ownership was dispersed and it was the bank management that governed the bank.
Finally, it is worth pointing out that the last state-owned commercial bank (Bank Zachodni) was to be privatized separately, whereas privatization of two other major Polish banks: BG¯ and PKO BP was further postponed, this time till after the year 2000.

The second wave of privatization in Poland came after the election of the new pro-reform coalition government (AWS − Election Action "Solidarity" and UW − Freedom Union) in the September 1997 parliamentary election. The party speeded up privatization of the remaining state-owned banks. The main concept of the privatization policy adopted at that time by a new Minister of State Treasury was to choose reputable foreign strategic investors in order to achieve a good governance structure in banks and receive capital and technology injections. An additional aim was to collect substantial privatization revenues in order to provide financial support to the forthcoming pension reform. In a three-year

[8] Only one and not two, as originally planned.

period (1998−2000) the privatization of the remaining 4 state-owned commercial banks had been completed, and two other big banks had been privatized as well. The 3 state-owned commercial banks (BDK, PBG, PBKS) and PEKAO were merged during 1998, and the merged Bank PEKAO was sold in 1998 by IPO (15%) and in 1999 to a strategic investor: Uni-Credito Italiano (52.09% together with Allianz). The last-standing state-owned commercial Bank Zachodni was sold to Allied Irish Banks[9]. The remaining shares of the State Treasury in already partly privatized banks were sold to dominant shareholders, resulting in a clearer structure of ownership. Finally, the Ministry of State Treasury cleaned up the two cases where the ownership structure was dispersed due to insider privatization conducted at the beginning of 1997. With the cooperation of the Ministry of State Treasury, PBK was finally taken over by Bank Austria Creditanstalt, while Bank Handlowy was bought in 2000 by Citibank.

Hungary

The lauch of the Government's privatization program in 1994 is really what kick-started the privatization of banks in Hungary. The first significant privatization took place with the partial sale of Hungarian Foreign Trade Bank (HFTB) in the summer of 1994. The winning bid was made by the pair EBRD (financial investor with a share of 16, 68%) and Bayerische Landesbank (strategic investor with a 25,01% share), whose stake increased two years later when the state sold its 25 percent share. The same scheme characterized the sale of Budapest Bank in 1995 to GE Capital[10] and the EBRD. During 1996-97 MHB, K&H and other commercial banks were sold to strategic foreign investors, according to the basic scheme of the Hungarian bank privatization that privileged the pursuance of a strategic foreign presence (Várhegyi, 2001). A second scheme was followed by the Hungarian authorities with the partial sale in the summer of 1995 of the largest retail bank, National Savings and Commercial Bank (OTP). By forbidding the presence of strategic investors (by preserving a 25 percent stake in public hands) and by promoting a prevalent domestic ownership, the Government wished to create a diversified proprietary structure, dominated by institutional investors. Overall, the privatization of the Hungarian banking system was practically completed by the end of 1997. By that time state ownership had dropped to 21 per cent of bank capital while the foreign stake had increased to over 60%. At the end of 2000 state ownership had dropped to 19% while the foreign stake had increased to over 66% (Majnoni, Shankar & Várhegyi, 2003).

2.3 Entry modes, motives and activities of foreign banks.

Institutional modes of entry

Two institutional entry modes correspond to the two waves of entry described earlier. At the beginning of the 1990s, foreign banks entered these countries mostly by establishing greenfield investments (branches or subsidiaries), as acquisitions of domestic banks'

[9] They held 80% of the shares as at 1999.

[10] Since 1995 GE (General Electric Company) as owner provides solid financial background for the bank (99,69% GE ownership at the end of 2005). *Source: http://www.ge.com/hu/en/ourBusiness/consumer_finance.html*

shares were still restricted and regulated. Over time, as the need for involving foreign capital into the processes of restructuring and privatization of domestic banks became clear, the local authorities liberalized the acquisitions of domestic banks by foreign banks, which led to a massive second wave of entry. This trend is apparent in figure 2 which shows that initially, a high proportion of the foreign banks entered the local markets in each country through greenfield investment. Over time, however, it can be seen that this has diminished sharply, suggesting other modes of entry, such as mergers and acquisitions of domestic banks.

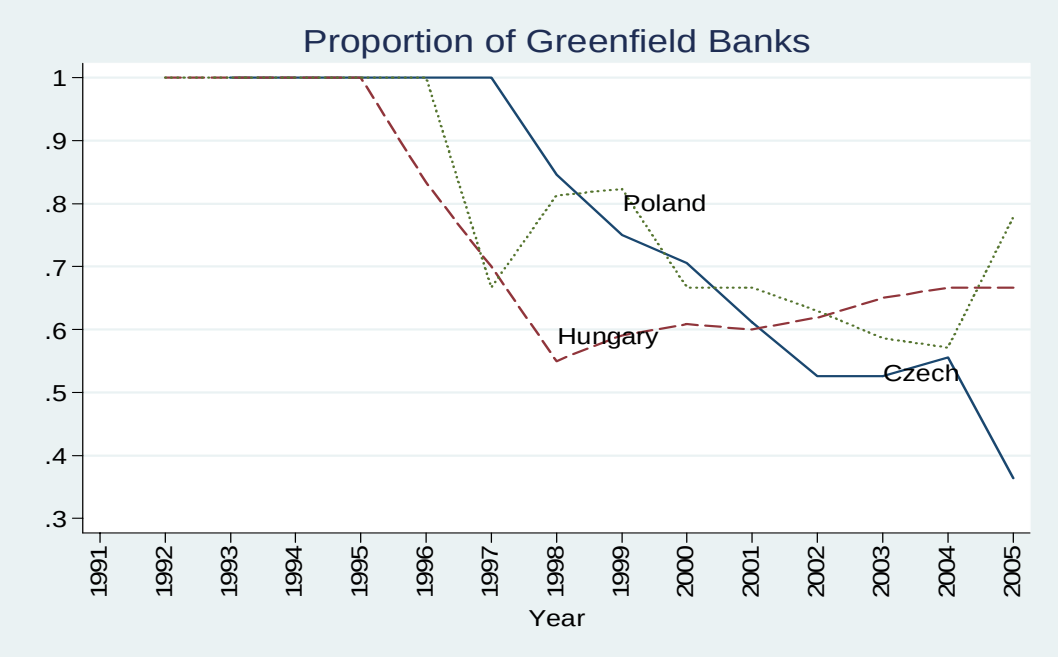

Figure 2

Motives for foreign banks entry

There are a host of factors that encourage foreign banks to penetrate domestic markets. For the specific case of Czech Republic, Hungary, and Poland, a survey by Konopielko (1999) revealed that two location-specific factors play a major role in this process. In fact, foreign banks first enter by the need to follow and support their multinational clients. Then, depending on the level of economic and legal environment of the host country, they also look for new business opportunities.

Areas of activity.

The most important areas of activity, especially of greenfield foreign banks are corporate financing and trade services (foreign exchange trading, and trade finance). Retail activities are perceived as being the least important. The main reasons for this might be the low level of individual wealth, as well as high set-up costs in this market. For instance, in Poland, foreign banks engage around 40% of their assets in interbank operations and trade finance. In Czech Republic, the results of foreign banks are better

than the sectoral average. In terms of asset structure, the share of credits in their balance sheet is slightly lower than in large domestic banks, as is the share of tradable securities. On the liabilities side, the foreign banks depend heavily on interbank markets, having a much lower level of clients' deposits in their portfolios. This underlines the "corporate-oriented" approach of foreign banks (Konopielko, 1999).

3. Literature Overview

The literature on banking efficiency is huge and principally encompasses three main dimensions. First there is the focus on methods and techniques for measuring scale, scope and X-inefficiency within the context of the banking sector[11]. Second, there is the focus on the application of these techniques to test particular hypotheses of interest. Third, there is an interest in applying the techniques and testing particular hypotheses in the banking systems of particular countries and this has generated a distinct set of studies that on the one hand focuses on developed economies and on developing economies, on the other hand. The techniques and issues related to measuring bank efficiency are well established, so we do not engage in a discussion of this aspect in our paper, other than describing the technique we use for our study. Regarding the second strand of the literature, we focus here on the particular hypotheses of interest to our paper and provide a review of these here. With respect to the third dimension, it is recognised that there exists a sharp contrast between results for mature and emerging markets. For instance, in an empirical study of developed economies, Berger et al. (2000) find that foreign banks are less efficient than domestic banks in terms of cost and profit efficiency. However, some banking organizations, particularly from the United States, are found to consistently operate at or above the efficiency levels of domestic banks. In contrast, empirical evidence on developing economies point out that foreign banks are more efficient than domestic banks. The contrasting results may reflect differences in initial conditions – economic and financial developments – (Lensink & Hermes, 2004), (Hermes & Lensink, 2004), (Mathieson & Roldos, 2001). This may also be explained by significant differences in the reasons for entry as well as in the competitive and regulatory conditions between mature and emerging economies (Claessens et al., 2001). We review the results in transition economies after explaining the analytical arguments that underpin the hypotheses we test in this paper.

3.1 Foreign bank entry and efficiency-the hypotheses

Analytical arguments[12] generally suggest that foreign bank entry will help improve the efficiency of domestic banks. This happens through spill-over effects or through competition effects. In terms of spill-over effects, foreign banks are believed to help improve the quality, pricing, and availability of financial services as providers of such enhanced services. Moreover, a transfer of technology occurs if the authorities allow high-quality international banks with solid reputations to enter and permit the

[11] For surveys of this literature, see (Berger et al., 1993), and Berger & Humphrey (1997).
[12] For an overview of these arguments, see IMF (2000).

immigration of skilled banking personnel. Since these banks will also hire local bankers with a better knowledge of the local economy, these local bankers will assimilate the practices and technology of the international banks, which they retain when they move back to domestic banks.

In terms of competition effects, there is a well established argument in the industrial organization literature on the effect of competition on performance in a static framework.[13] Originally put forward by Hicks (1935), the argument is that market power enables managers to appropriate their share of rents through discretionary expenses or a reduction in their efforts (X-inefficiency). Liebenstein (1966) further clarified the nature of such relationship by showing the existence of a challenge-response mechanism that reduces managerial slackness under competition. The idea is that there exist asymmetries in the level of information between owners and managers (the principal-agent problem). The production function is in fact not wholly known by owners, who therefore find it difficult to check the level of effort exerted by managers. The latter, on the other hand, seem to enjoy a certain amount of discretion in the effort they produce, at the potential detriment of the company's efficiency and productivity. Competition is thought to reduce X-inefficiencies in two ways. First, in the presence of competitors managers have the incentive to increase their efforts in order to avoid the bankruptcy of their companies (Schimdt, 1994). Secondly, in a competitive environment new firms can enter the market. This gives owners the opportunity to compare the performance of their own company against the rivals, and thus judge the efforts made by their own management. Managers are fully aware of this, and feel further pressure to increase their commitment and reduce inefficiency. Such arguments can be put forward to explain how foreign banks can help improve efficiency through competition with domestic banks. However, another strand of this literature focuses on the efficient-structure hypothesis, put forward by Demsetz (1973), which argues that greater efficiency (X-efficiency &/or scale economies) leads to lower costs, hence higher market share. Given the above arguments, we attempt to test if the data corroborate two sets of hypotheses:

Hypothesis 1: Greenfield institutions outperform their domestic peers, while the comparative performance between M&As and domestic banks need investigations. That greenfields are more efficient than their domestic counterparts is in line with the literature on developing economies, whose findings point out that foreign banks enjoy better performance than their domestic counterparts. However, the comparison between M&As and domestic banks seems more ambiguous, because the mergers and acquisitions, often of banks in financial distress, would not lead immediately to an improvement in the performance of these banks as it would take time for M&As to get rid of bad inheritances from the old domestic banks.

Hypothesis 2: Greenfield foreign banks outperform M&As banks. It is widely believed that the portfolio of greenfields banks is more selective than those of other banks, which could be conducive to their better performance. Indeed, their primary areas of activities are servicing multinational clients and big local corporates and financing international trade thanks to their superior banking know-how. Moreover, we seek to test whether bank

[13] A disting This literature

size plays a role, as most Greenfield banks are generally smaller than M&As and domestic banks.

3.2 Foreign bank entry and efficiency-the evidence on transition economies

Common findings in empirical studies on transition economies generally point to a positive relationship between foreign involvement, foreign ownership, as denoted by different levels of participation of foreign banks in domestic banks, and bank performance (Bonin et al., 2005). Moreover, foreign bank entry, as measured by the change in the ratio of the number of foreign banks to total number of banks or by the change in the ratio of foreign bank assets to total bank assets, is associated with greater efficiency of domestic banks (Claessens et al., 2001).

The methodology used across various studies of bank performance in transition economies is on the whole similar. Almost all of them first calculate the indicators of bank performance based on data on financial statements of individual banks. Typically, three sets of indicators are used to measure bank performance. First are the standard measures of financial performance, namely Return on Assets (ROA) and Return on Equity (ROE). Second are accounting measures of performance and third are efficiency measures constructed through frontier estimation techniques. Then these studies, regress these indicators on a set of explanatory variables, especially ownership variables, in order to assess the importance of various determinants of bank performance. With respect to efficiency measures constructed through frontier estimation techniques, this second stage regression is what has commonly become a two-stage approach, which has attracted a lot of criticisms in the literature.

There are a few studies on transition economies and some have focused on the countries of interest to this paper. For instance, Sabi (1996) compares the performance of domestic and foreign banks in Hungary for the period 1992-1993. At this time, the foreign banks that are present in Hungary are mostly greenfield investments. Using data on financial statements of banks from the Hungarian Financial and Stock Exchange Almanac, the author constructs accounting measures of bank performance that reflect profitability, liquidity and credit risk, and commitment to the market economy of both types of banks. He then uses t- test and Kruskal–Wallis test, and finds that there exists significant differences in these indicators generally in favor of foreign banks.

Weill (2003) studies bank efficiency in Czech Republic and Poland in 1997, with data from BankScope. He estimates cost efficiency scores using Stochastic Frontier Analysis. The results show that foreign banks are more cost efficient than domestic banks on average, and in a two-stage regression, he confirms that this finding was not due to the smaller size of foreign banks.

Hasan & Marton (2003) study bank efficiency in Hungary over the period from 1993 to 1998 using data from the Hungarian Financial and Stock Exchange Almanac. They compute cost and profit efficiencies using Stochastic Frontier Analysis. The results

suggest that domestic banks are both less cost- and profit-efficient than those with foreign participation, which coincides with those obtained by Weill (2003) for Czech and Poland. Moreover, they divide foreign banks into four groups based on the extent of foreign involvement, and find that the higher the foreign participation in bank ownership, the higher is the efficiency. Finally, the average inefficiency scores of all banks exhibit a significant improvement over the sample years both in cost and profits.

Havrylchyk (2006) studies bank efficiency in Poland from 1997 to 2001. Using data from Monitor Polski B (an official publication of the Polish government), she computes cost, allocative, technical, pure technical, and scale efficiency scores for foreign and domestic banks using Data Envelopment Analysis. The results show that foreign banks are significantly more cost-efficient than domestic banks confirming the findings of Weill (2003). Nevertheless, over the period studied, the efficiency of both foreign and domestic banks appear to have deteriorated on average, which are in contrast with the findings of Hasan & Marton (2003) for the case of Hungary.

3.3 Entry modes and bank efficiency

As discussed earlier, although trying to distinguish either between levels of foreign involvement in bank ownership, between types of foreign owners (strategic partners, institutional investors…) or between countries of origin of foreign banks, only a few studies on transition countries have taken into account their modes of entry. Indeed, (Claeys & Hainz, 2006) investigates the impact of entry modes of foreign banks on the degree of competition in the local banking markets, and consequently on banks' lending rates. It shows that competition is stronger when market entry occurs through greenfield investments, which will cut down domestic banks' interest rates. (Haas & Lelyveld, 2006) studies credit behavior of foreign and domestic banks in Central and Eastern Europe from 1993-2000, and finds that during crisis periods, domestic banks contracted their credit base, whereas greenfield banks did not. Moreover, the credit behavior of greenfield institutions depends on their home countries' economic growth and the health of their parent banks. Thus, the focus of these studies is not on bank performance.

(Majnoni et al., 2003) is one of the first studies that take into account the implications of foreign banks' mode of entry on bank performance in the context of Hungary from 1995 to 2000. Using accounting measures of banks' costs and profits, they find that in terms of operating, employment costs as well as profitability, greenfield banks outperform M&As. (Havrylchyk, 2006) studies the efficiency of the Polish banking industry, and also compares the performance of greenfield, M&A, and domestic banks between 1997 and 2001. Her results are consistent with (Majnoni et al., 2003), that is greenfield investments outperform both M&A and domestic banks. (Havrylchyk & Jurzyk, 2006) considers the profitability of foreign banks in ten Central and Eastern European countries from 1995 to 2003. They also try to take into account the two modes of entry of foreign banks, and find that greenfield institutions are more efficient than domestic banks. However, this is not the case of takeover banks.

Our paper differs from those reviewed above in several ways. First, differently from (Majnoni et al., 2003) and (Havrylchyk & Jurzyk, 2006) that use accounting measures of performance, and (Havrylchyk, 2006) using non-parametric techniques, we use frontier techniques to estimate cost efficiency of banks. Moreover, we are the firsts to seek systematic econometric evidence of the sources that lead to the differential performance between greenfield and M&A banks.

4. Estimation Methodology

The literature on measuring firm performance is huge and there are multitudes of measurement techniques currently available. The measure of performance we focus on in this paper is cost efficiency, i.e. the distance of the firm relative to the best practice frontier. To construct this measure, we therefore need to estimate the cost frontier as a starting point. The literature on frontier estimation abounds with techniques ranging from nonparametric to parametric ones.

A particularly popular parametric technique is Stochastic Frontier Analysis (henceforth SFA). SFA methodology was originally proposed independently by Aigner, Lovell and Schmidt (1977) and Meeusen and Van Den Broeck (1977), and has since generated an extensive literature, both methodological and empirical (e.g. Forsund, Lovell and Schmidt, 1986; Bauer, 1990; Battese, 1992 and Greene, 1993). Explicit assumptions about the distribution of the measurement errors and the X-inefficiency terms allow the frontiers to be estimated and scale economies or diseconomies revealed. As they are assumed to capture the effect of measurement error, the v_{it} terms are typically assumed to be random errors independently distributed as $N(0,\sigma_v^2)$. These are therefore often referred to as the "two-sided" error terms as they are symmetrically distributed around the "true" frontier. By contrast the inefficiency terms u_{it} are assumed to have an independent distribution which is truncated below by the frontier itself: For this reason these inefficiency terms are often referred to as the "one-sided" error terms. For example, it is sometimes assumed that $u_{it} \sim N^+(\theta,\sigma_u^2)$, where if θ=0 the assumed distribution is half-normal, and if $\theta \neq 0$ the assumed distribution is truncated normal [14].

A less frequently explored issue is the impact of exogenous variables which have a significant influence on the X-inefficiency of the bank. Early empirical papers (e.g. Pitt and Lee, 1981 and Kalijaran, 1981) raised the issue of systematic determinants of the X-inefficiency of firms and adopted a two-stage approach to the problem. In the first stage, the firm-specific inefficiency effects u_i, assumed to be identically distributed, are retrieved from the estimated stochastic frontier. In the second stage, the predicted inefficiency effects are used as a dependent variable in a regression model in which explanatory exogenous variables seek to explain differences in these effects (e.g. Mester, 1993). A recurring criticism of this two-stage approach is that the second stage analysis of systematic determinants of the inefficiency effects contradicts the assumption of an

[14] Alternative distributions have been suggested; Yuengert (1993), for example, uses a gamma distribution to characterise the X-inefficiency effects.

identical distribution of these effects that is made in the first stage, when the stochastic frontier is estimated. This and other criticisms have given rise to a substantial empirical literature on the modelling of the inefficiency effects, leading to the emergence of a one-stage approach, whereby these inefficiency effects are modelled jointly with the frontier[15].

One approach to estimating the effect of systematic influences on X-inefficiency is to assume that the truncation point of the one-sided distribution (θ) shifts depending on the exogenous factors assumed to determine efficiency. This is known as the conditional mean approach (Huang and Liu (1994); Battese and Coelli (1995)), where the one-sided error is modelled as $N^+(\gamma' s_i, \sigma_u^2)$ where s_i is a vector of systematic influences on mean efficiency. In these models the two-sided error is typically assumed to be $N(0, \sigma_v^2)$.

However, while this approach will identify systematic factors correlated with shifts in the mean of the one-sided error, it retains the assumption that the variances of both types of error are constant. This assumption may be implausible and can lead to inconsistent estimates. The structure of the bank's activities, for instance, is likely to affect the variability of costs. Therefore, any systematic influence on X-inefficiency will potentially lead to heteroskedasticity in the one-sided error term, and Caudill et al (1993) have shown that if this is ignored there can be significant estimation biases which affect both the shape of the estimated frontier and the efficiency effects[16].

In the light of the above, we adopt the procedure suggested by Khumbhakar and Lovell (2000) and explicitly model the variances of both types of error when fitting the cost function. The error variances are modelled simultaneously with the frontier as $u_{it} \sim N^+(0, \sigma_{ui}^2)$ and $v_{it} \sim N(0, \sigma_{vi}^2)$ where

$$\sigma_{ui}^2 = g_u(s_i, \phi_{ui}) \qquad (1)$$

s_i as before denotes a vector of systematic influences[17]; ϕ_{vi} is a vector of coefficient estimates from the one-sided heteroskedasticity model. Khumbhakar and Lovell (2000) point out that this approach offers the possibility of solving two problems at once – correcting for heteroskedasticity and incorporating exogenous influences on X-inefficiency. In our estimates below, we test for the impact of the mode of entry through the structure of the banks' activities on their cost performance.

Maximum likelihood estimation techniques are required to simultaneously estimate the parameters of the stochastic frontier and of the heteroskedasticity models. The cost efficiency scores are then estimated using the formula:

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[15] Contributions to the development of the one-stage approach include Khumbhakar, Ghosh and McGuckin (1991); Reichsneider and Stevenson (1991); Yuengert (1993); Simar, Lovell and Vanden Eeckaut (1994); Huang and Liu (1994); Caudill, Ford and Gropper (1995) and Battese and Coelli (1995), Wang and Schmidt (2002) and Wang (2003) amongst others. For a discussion and review of this literature, see Kumbhakar and Lovell (2000), Ch 7.

[16] For a review of the biases associated with ignored heteroskedasticity in both error terms, see Khumbhakar and Lovell (2000), p115-122.

[17] We assume a loglinear model for these relationships: i.e. $g_v(.)$=exp(.) and $g_u(.)$=exp(.)

$$E_i = \exp(+u_i) \tag{2}$$

Functional form

The analysis of efficiency in the services industry using SFA has led researchers to estimate a wide range of functional forms for the associated frontiers[18]. Generally, the more parameters in the estimated function, the more flexible it is, such that it is possible to estimate a frontier which is as close as possible to the "true" (non-parametric) frontier. The translog function is generally considered a flexible functional form and has been used extensively in the literature on banking efficiency. In this study, we use the same specification, given as:

$$\begin{aligned}\ln\left(\frac{C}{p_3}\right)_{it} &= \alpha_0 + \sum_{k=1}^{2}\beta_k \ln\left(\frac{Y_k}{p_3}\right)_{it} + \sum_{k=1}^{2}\gamma_k \ln\left(\frac{p_k}{p_3}\right)_{it} + \ln\left(\frac{Equity}{p_3}\right)_{it} + 0.5\sum_{k=1}^{2}\phi_k \ln\left(\frac{Y_k}{p_3}\right)_{it}^2 + \\ &0.5\sum_{k=1}^{2}\varphi_k \ln\left(\frac{p_k}{p_3}\right)_{it}^2 + 0.5\ln\left(\frac{Equity}{p_3}\right)_{it}^2 + \sum_{k=1}^{2}\delta_k \ln\left(\frac{Y_k}{p_3}\right)_{it} \ln\left(\frac{p_k}{p_3}\right)_{it} + \sum_{k=1}^{2}\lambda_k \ln\left(\frac{Y_k}{p_3}\right)_{it}\left(\frac{Equity}{p_3}\right)_{it} \\ &+ \sum_{k=1}^{2}\psi_k \ln\left(\frac{p_k}{p_3}\right)_{it} \ln\left(\frac{Equity_k}{p_3}\right)_{it} + COUNTRY_i + v_i + u_i\end{aligned} \tag{4}$$

where C represents total costs, Y represents the outputs of the bank and the *p* variables are the prices of the input variables. All the variables have been normalized with respect to p_3 (price of one of the inputs) to ensure linear homogeneity. The variable equity is included in the cost function to control for risk preferences (see, e.g. Mester, 1996; Altunbas et al, 2000 and Weill, 2003).

The measurement error (v_i) and X-inefficiency term (u_i) are now included in this specification. Because the inefficiency term is expected to increase costs, the sign on u_i is positive. Consistent maximum likelihood estimation of the above function for each bank will reveal both the structure of the cost function and the firm-specific X-inefficiency effects. Our definition of inputs and outputs follows the intermediation approach, whereby banks are seen as accepting deposits from customers and transforming these into loans to clients. The outputs are loans and other income generating activities. We therefore include two outputs in the cost function: Y_1=loans and Y_2=investment assets[19]. We use the prices of labour, physical capital and borrowed funds as the inputs in the estimation of the cost function. The price of borrowed funds is used to normalise each variable to ensure linear homogeneity. Following Altunbas et al (2000), the price of labour is the ratio of personnel expenses to total assets, given the unavailability of data on the number of employees. The price of physical capital is constructed as the ratio of other non-interest expenses to fixed assets and the price of borrowed funds is the ratio of

[18] These include Cobb-Douglas, Box-Cox, quadratic, the composite function, translog and the flexible Fourier form.

[19] This item is denoted as "other earning assets" in BankScope, which are all the earning assets other than loans.

interest paid to all funding. Total costs are the sum of personnel expenses, interest paid and other non-interest expenses.

In terms of the modeling of the inefficiency terms, the inclusion of variables capturing banks' size and their structure of activities will help to identify whether discrepancies in performance through each different type of bank could be influenced by the bank's size and their structure of activities as opposed to simply better management. Thus, we include four variables in our model- the size of the bank, as measured by its assets (assets), the ratio of loans to investment assets (loaninv), the ratio of loans to off-balance sheet items (loanoff) and the market share of the bank (mrktshr) measured as the share of its deposits and short term funding over total banking system's deposits. Each of these variables is interacted with a dummy variable identifying whether the bank is foreign owned, a greenfield bank or a M&A. This is to investigate whether any cost advantage or disadvantage could be due to the particular type of bank having a size or a structure of activities different from the other. All estimation is carried out in using STATA 9.2 inbuilt frontier function.

5. Data Description

For each bank (*i*) and each year (*t*), we have unconsolidated accounting data from the BankScope database on Polish, Czech and Hungarian banks over the period 1994 to 2004. The choice of these three countries is motivated by their very high levels of foreign bank penetration compared with other transition countries, and even with other developing countries. Consequently, greenfield and merger and acquisition entries take place most extensively in these countries. This therefore facilitates the analysis of different modes of entry on banks' cost performance. BankScope has a very large coverage of banks over the world. However, this database provides information on bank ownership only for the current calendar year. Thus, we have had to track the evolution in the ownership of each bank over time through several sources, including banks' official publications and Zephyr (Bureau Van Dijk)[20]. This enabled us to differentiate between foreign and domestic banks, and, among foreign banks, between greenfield investments and merger and acquisition entries. Our analysis focuses on commercial banks only. Table 1 presents some summary statistics with respect to the variables created from BankScope.

[20] We are grateful to R.d. Haas and I.v. Lelyveld from de Nederlandsche Bank for kindly sharing data on bank ownership for the years 1994 to 2001.

Table 1: Summary Statistics

Variables	M&A Banks		Greenfield Banks		Domestic Banks	
	Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***
Outputs						
Loans	1 874.05	2 327.39	356.99	522.95	782.72	1 280.77
Investment Assets	2 117.38	3 379.52	311.72	364.74	856.44	1 450.61
Inputs						
Personnel expenses	27 901.01	52 603.41	3 350.81	6 780.31	14 788.07	29 127.94
Other expenses	45 801.2	101 493.8	5 267.98	10 816.76	17 697.56	35 141.66
Interest paid	76 954.23	157 678.8	11 479.17	21 601.46	57 019.53	113 206.2
Input prices						
Price of labor	6.03	8.83	7.67	12.26	13.43	13.87
Price of physical capital	536.00	1 069.36	2 544.21	6 039.71	823.20	1 193.51
Price of borrowed funds	23.65	37.63	35.26	89.13	173.01	2 010.02
Other characteristics						
Total assets	4 428.43	6 018.02	664.64	793.62	1 886.96	3 003.33
Total costs	155 684.3	284 339.9	21 078.18	38 404.06	95 339.12	174 519.6
Equity	885.53	515.92	575.36	82.30	649.74	241.51
Loans to Investment Assets	1.41	1.37	19.36	140.35	1.74	3.84
Loans to off balance sheet items	2.12	2.41	13.95	68.70	9.50	29.85

6. Results

We report our results by first comparing foreign banks against domestic banks to see if our results are in line with the existing empirical evidence. The parameter estimates from the Translog cost functions are presented in Appendix 2. These are estimates corrected for heteroscedasticity in the one-sided error term. The translog parameter estimates by themselves have little informational value; they are simply means to the end of producing a frontier with which to estimate bank-specific cost efficiency scores. Of more interest are the coefficient estimates from the heteroskedasticity models, which shows the impact of the particular variables on bank cost efficiency. Table 2 shows the results on testing the first hypothesis.

6.1 Hypothesis 1: foreign vs domestic banks

Table 2 shows three variations around hypothesis 1. First, we attempt a comparison of foreign against domestic banks as a whole, second a comparison of Greenfield against domestic banks and third a comparison of domestic banks with Mergers and Acquisitions.

Table 2: Determinants of cost inefficiency-foreign vs domestic banks[21]

	Foreign vs Domestic Banks		***Greenfields vs Domestic Banks***		***M&As vs Domestic Banks***	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Lnass	0.412	0.069***	0.451	0.087***	0.332	0.247
Lnloaninv	0.147	0.706	0.066	0.440	0.230	0.628
Lnloanoff	-1.408	0.154***	-1.293	0.285***	-1.460	0.656*
Lnmrktshr	2.193	0.329***	2.205	0.345***	2.410	1.393
Dummy	-13.892	4.647**	-19.885	7.565**	-0.670	9.380
Dummy*Lnass	1.163	0.465*	2.221	1.013*	-0.155	1.074
Dummy*Lnloaninv	0.344	0.861	1.514	.	-0.044	0.000
Dummy*Lnloanoff	1.678	.	0.521	0.564	1.039	.
Dummy*Lnmrktshr	-1.760	0.599**	-0.791	0.000	-0.515	0.833

Note: the dummy variable represents each type of bank, with domestic banks as the base dummy category.

Looking at the dummy variables on their own suggests the following: Foreign banks are in general more efficient than their domestic counterparts. However, this difference seems to be coming out from the better performance of Greenfield banks compared to domestic banks, which provides some evidence for hypothesis 1. There is no evidence to suggest that M&As are generally more efficient than their domestic counterparts.

An interesting finding across these three sets of results is a strong size effect on inefficiency. Bigger banks are generally less efficient, irrespective of whether they are domestic or foreign-owned. The positive sign on *lnloaninv* seems to suggest that banks turning more of their deposits into loans compared to investments are generally less efficient but this result is insignificant in all three columns. M&As seem to be very cost efficient when engaging into such practices although the coefficient is insignificant. This could point out to some informational advantage acquired from the old domestic banks.

Domestic banks seem to be generally more efficient at engaging into loaning activities as opposed to off-balance sheet activities while the opposite seems to be true, although insignificant, of their foreign counterparts. On the market share variable, the finding seems to be that domestic banks are generally less efficient the higher their market share of deposits. Their foreign counterparts however seem to be more cost efficient as they enjoy higher market share of deposits, a result in apparent contradiction with Liebenstein's challenge-response mechanism. This could possibly suggest other mechanisms at play, e.g. Demsetz's (1973) efficient-structure hypothesis, i.e. foreign

[21] Missing standard errors arise from STATA frontier not reporting the standard errors.

banks are generally more efficient, which enables them to make higher profits and be able to appropriate a higher market share. The relationship between efficiency and market structure therefore runs the opposite way to that suggested by Liebenstein (1966). The one-stage methodology we employ here unfortunately does not allow us to test the efficient-structure hypothesis.

6.2 Hypothesis 2: Greenfield vs M&A banks

It is often argued that M&As frequently inherit the problems of the domestic institution they take over, it is argued that it takes some time for these banks to learn to adjust to these problems. We therefore capture this adjustment process through an age variable. We also use the squared age variable to allow for the possibility that the way cost efficiency adjusts over time may be following a non-linear path. The results are shown in table 3.

It can be seen that almost all the variables are significant. The positive coefficient on *lnass* suggests that bigger M&As are more cost inefficient, although this variable is not significant at the conventional levels.

Table 3: Determinants of cost inefficiency-M&As vs Greenfield banks

Dependent variable: σ_{ui}^2	Coef.	s.e.
Lnass	0.301	0.240
Lnloaninv	-1.187	0.303***
Lnloanoff	-0.010	0.005*
Age	-2.485	0.831***
Age Squared	0.561	0.161***
Greenfield*Lnass	-0.701	0.214***
Greenfield*Lnloaninv	1.148	0.482***
Greenfield*Lnloanoff	0.714	0.299***

Significance levels are respectively 10%, 5% and 1% for *,**,***

The coefficients on *loaninv* and on *loanoff* are both significantly negative. These point out that as M&As increase their loans to investment and to off balance sheet ratios, they tend to become more cost-efficient. A possible explanation could lie in the fact that after having acquired domestic banks, M&As tend to inherit superior knowledge of customers and are therefore able to use their advanced screening technology alongside such knowledge to give out better performing loans.

The adjustment process of MAs through time shows in the coefficient of the age variable. The significantly negative age coefficient suggests that older M&As tend to be more cost

efficient. The older the MAs get, the more likely it is they will have got rid of many of the problems inherited from the acquired domestic banks. The positive coefficient on the age squared variable however suggests that initially and up to a point, the MAs are able to capture these cost advantages quite quickly. However, after some time (this seems to be a little more than 2 years), the rate at which such advantages accrue to them slows down and may even see them facing a reduction in cost efficiency over time. A possible explanation could be that by the time they reach that point, they may have grown quite big and start suffering from size-related inefficiencies. The positive coefficient on *lnass* seems to draw this out although this variable is weakly significant at about the 20% level.

The interaction of the Greenfield dummy with *lnass* aims at investigating whether the cost advantage of Greenfield banks may be accrued to their size. In fact, the coefficient of this interaction variable is significantly negative, implying that larger sized Greenfield institutions are more cost efficient. This result seems slightly at odds with common beliefs and observations that larger sized institutions tend to suffer from X-inefficiencies associated with management problems, organizational problems, etc. However, considering the fact the Greenfield banks are generally small in size and rarely grow to the level that big-sized institutions such as M&As can attain, our results may simply be confounded by banks in the small to medium size range.

The other interaction variables capture the notion that Greenfield banks may have a structure of activities different from M&A banks, which could explain their cost advantage. The significance of all these variables suggests that this is indeed the case. The significantly positive coefficient of *Greenfield*lnloaninv* would imply that Greenfield banks with a higher ratio of loans to investment assets are more likely to be less cost efficient than M&A banks. The coefficient of *Greenfield*loanoff* is significantly positive, suggesting that Greenfield banks with a higher ratio of loans to off balance sheet items tend to be less efficient. These two results show that Greenfields perform better when they engage more in investment and off balance sheet activities than in giving loans. This would mean that beyond their traditional clients – multinational companies and big local corporates – they would have difficulties in lending to other types of clients of often obscure information, especially in the context of transition economies. Their lack of inside knowledge does not enable them to distinguish between good and bad clients in the same way as MAs are able to do. For those Greenfields banks that are willing to establish business relationship with these types of clients, they may do so by being ready to accept bad clients in order to capture higher market share. This is especially the case with multinational banks such as Citigroup.

Thus, the better performance of greenfield banks can be explained by a more selective structure of activities focusing on servicing multinational clients and big local corporates, and on trade finance. Indeed, it is often believed that foreign banks that set up *de novo* investment in Czech, Hungary, and Poland, do it to follow and support its multinational clients in the first place. Then, as the host countries' economic and legal environments improve, they also look for new business opportunities. Their primary areas of activities are servicing multinational companies and big local corporates, and financing international trade thanks to their superior banking know-how.

In table 4, we report the efficiency scores averaged across countries and across the two foreign bank types. We find that average efficiency scores of Greenfields surpass those of M&As. T-tests of these higher average efficiency scores for foreign banks are significant at the 1% level.

Table 4: Mean efficiency scores by country and entry mode

Country	Greenfields	M&As
Czech	0.9563	0.6455
Hungary	0.9456	0.8059
Poland	0.9481	0.8081
Average	0.9501	0.7629

7. Conclusion

This paper uses stochastic frontier analysis to estimate the cost efficiency for foreign-owned banks in three transition economies. Using a one-step approach to estimation, we model the determinants of cost efficiency and find that foreign banks that enter through Greenfield investments (*de novo entry*) are on average more cost efficient than their counterparts that enter through mergers and acquisitions of domestic banks. In an attempt to explain these cost differences, we find that the better performance of GRs can be explained by a more selective structure of activities. We also investigate whether the age of M&As plays a role in the evolution of their cost efficiency, and find that effectively the older the M&As get, the more cost efficient they become. However, after a while, the cost advantage that M&As accrue tends to decrease. We suspect that by this time, M&As may have grown big enough to start facing the X-inefficiencies associated with big-sized companies. These results are new in the literature and we hope that further work on this area will shed more light on our findings.

References

Aigner, D.J., C. A. K. Lovell, and P. Schmidt (1977) 'Formulation and estimation of stochastic frontier production function models', *Journal of Econometrics,* vol 6, no. 1, pp. 21-37.

Battese, G.E. (1992) 'Frontier production functions and technical efficiency: a survey of empirical applications in agricultural economics', *Agricultural Economics*, vol. 7, pp. 185-208.

Battese, G.E. (1992) 'Frontier production functions and technical efficiency: a survey of empirical applications in agricultural economics', *Agricultural Economics*, vol. 7, pp. 185-208.

Bauer, P. W. (1990) 'Recent developments in the economic estimation of frontiers', *Journal of Econometrics*, vol. 46, pp. 39-56.

Berger, A. N., W. C. Hunter, and S. G. Timme (1993) "The efficiency of financial institutions: A review and preview of research past, present and future", *Journal of Banking and Finance*, vol. 17, issues 2-3.

Berger, A. N. and D. Humphrey (1997) 'Efficiency of financial institutions: International Survey and Directions for Future Research', *European Journal of Operational Research*, vol. 98, pp. 175-212.

Berger, A. N., R. Young, H. Genay, and G. F. Udell (2000) 'Globalization of Financial Institutions: Evidence from Cross-Border Banking Performance', *Brookings-Wharton Papers on Financial Services*, 2000.

Bonin, J. P., I. Hasan, and P. Wachtel (2005) "Bank performance, efficiency and ownership in transition countries", *Journal of Banking & Finance*, vol. 29, pp. 31–53.

Caudill, S., J.M Ford and D. M. Gropper (1993) 'Frontier estimation and firm-specific inefficiency measures in the presence of heteroscedasticity', *Journal of Business & Economic Statistics,* vol. 13, pp. 105-111.

Caudill, S., J.M Ford and D. M. Gropper (1993) 'Frontier estimation and firm-specific inefficiency measures in the presence of heteroscedasticity', *Journal of Business & Economic Statistics,* vol. 13, pp. 105-111.

Claessens, S., A. Demirgüç-Kunt, and H. Huizinga (2001) "How does foreign entry affect domestic banking markets", *Journal of Banking & Finance*, vol. 25, Issue 5, pp. 891-911.

Claeys, S. and C. Hainz (2006) "Acquisition versus greenfield: The impact of the mode of foreign bank entry on information and bank lending rates", *ECB WP* N^0 653.

Clarke, George, R. Cull, M. Peria, M. Soledad and S. M. Sanchez (2001) "Foreign bank entry - experience, implications for developing countries, and agenda for further research", *The World Bank Policy Research Working Paper Series* no. 2698.

Forsund, E. R, C. A. K. Lovell and P. Schmidt. (1980) 'A survey of frontier production functions and their relationship to efficiency measurement', *Journal of Econometrics*, vol. 13, pp. 5-25.

Greene, W.H. (1993) 'Frontier production functions', EC-93-20 New York, USA, Stern School of Business, New York University.

de Haas, R. and I. van Lelyveld (2006) "Foreign Banks and Credit Stability in Central and Eastern Europe: A Panel Data Analysis", *Journal of Banking & Finance*, vol. 30. no. 7.

Havrylchyk, O. (2006) "Efficiency of the Polish banking industry: foreign versus domestic banks", *Journal of Banking and Finance*, vol.30, no. 7.

Havrylchyk, O. and E. M. Jurzyk (2006) "Profitability of Foreign and Domestic Banks in Central and Eastern Europe: Does the Mode of Entry Matter?", Available at http://ssrn.com/abstract=881732.

Hermes, N., and R. Lensink (2004) "Foreign Bank Presence, Domestic Bank Performance and Financial Development", *Journal of Emerging Market Finance*, vol. 3, no. 2, 207-229.

Huang, C. J. and J. T. Liu (1994) 'Estimation of a non-neutral stochastic production function', *Journal of Productivity Analysis,* vol. 5, pp. 171-180.

International Monetary Fund (2000) "World Economic and Financial Surveys: *International Capital Markets: Developments, Prospects, and Key Policy Issues*", Chapter VI: The Role of Foreign Banks in Emerging Markets. By a Staff Team led by Donald J. Mathieson and Garry J. Schinasi.

Kalirajan, K.P. **(**1981) 'An econometric analysis of yield variability in paddy production. *Canadian Journal of Agricultural Economics,* vol. 29, pp. 283-294.

Konopielko, L. (1999) "Foreign banks' entry into Central and East European Markets: Motives and Activities", *Post-Communist Economies*, vol.11, no. 4.

Kumbhakar, S. C. and C. A. K. Lovell (2000) 'Stochastic Frontier Analysis', *Cambridge University Press*.

Kumbhakar, S., S. Ghosh and J. McGuckin (1991) 'A generalized production frontier approach for estimating determinants of inefficiency in United States dairy farms, *Journal of Business Economics and Statistics,* vol. 9, pp. 279-286.

Lensink, R. and N. Hermes (2004) "The short-term effects of foreign bank entry on domestic bank behavior: does economic development matter?", *Journal of Banking and Finance*, vol. 2, pp. 553-68.

Majnoni, G., R. Shankar and E. Varhegyi (2003) **"**The dynamics of foreign bank ownership - evidence from Hungary", *World Bank Policy Research Working Paper Series*, no. 3114.

Mathieson, D. J., and J. Roldós (2001) "Foreign Banks in Emerging Markets", In "*Open doors: Foreign participation in financial systems in developing countries*", edited by Robert E. Litan, Paul Masson, and Michael Pomerleano.World Bank/IMF/Brookings Emerging Market Series. Washington, D.C.: Brookings Institution Press.

Meeusem, W. and J. Van Den Broeck. (1977) 'Efficiency estimation from Cobb-Douglas production function with composed error', *International Economic Review,* vol. 18, no. 2, pp. 435-443.

Mester, L. J. (1993) 'Efficiency in the savings and loan industry,' *Journal of Banking & Finance*, vol. 17, pp. 267-286.

Peria, M., M. Soledad and A. Mody (2004) "How Foreign Participation and Market Concentration Impact Bank Spreads: Evidence from Latin America", *Journal of Money, Credit, and Banking*, vol. 36, no. 3, pp. 511-537.

Pitt, M. and L. Lee (1981) 'The measurement and sources of technical inefficiency in the Indonesian weaving industry', *Journal of Development Economics,* vol. 9, pp. 43-54 .

Reifschneider, D. and R. Stevenson (1991) 'Systematic departures from the frontier: a framework for the analysis of firm inefficiency', *International Economic Review*, vol. 32, no. 2, pp. 715-723.

Sabi, M. (1996) "Comparative Analysis of Foreign and Domestic Bank Operations in Hungary", *Journal of Comparative Economics,* vol. 22, pp. 179-188.

Schmidt, P. (1986) 'Frontier Production Functions', *Econometric Review*, vol. 4, pp. 289-328.

Simar, L. C., A. K. Lovell and P. Vanden Eeckaut (1994) 'Stochastic frontiers incorporating exogenous influences on efficiency', *Discussion Paper 9403*, Institut de Statistique, Université Catholique de Louvain, Belgium.

Simonson, D.G. (2001) "Foreign bank influence in the Czech Republic", In "*Open doors: Foreign participation in financial systems in developing countries*", edited by Robert E. Litan, Paul Masson, and Michael Pomerleano.World Bank/IMF/Brookings Emerging Market Series. Washington, D.C.: Brookings Institution Press.

Wang, H. (2003) 'A stochastic frontier analysis of financing constraints on investment: the case of financial liberalisation in Taiwan', *Journal of Business and Economic Statistics,* vol. 21, pp. 406-419.

Wang, H. and P. Schmidt (2002) 'One-Step and Two-Step Estimation of the effects of Exogenous variables on Technical Efficiency Levels', *Journal of Productivity Analysis,* vol. 18, pp. 129-144.

Yuengert, A. M. (1993) 'The measurement of efficiency in life insurance: estimates of a mixed normal-gamma error model', *Journal of Banking and Finance,* vol. 17, pp. 483-496.

Appendix 1: Definitions of variables

Symbol	Description	Source of data
C	Total costs; = personnel expenses + interest paid + other non-interest expenses.	BankScope
Y	Outputs; = Y_1+ Y_2.	
Y_1	Loans.	BankScope
Y_2	Investment assets.	BankScope
p_1	Price of labor; = personnel expenses/ total assets.	BankScope
p_2	Price of physical capital; = other non-interest expenses/ fixed assets.	BankScope
p_3	Price of borrowed funds; = interest paid/ all funding.	BankScope
Equity	Equity.	BankScope
Lnass	Log of total assets.	BankScope
Lnloaninv	Log of loans to investment assets.	BankScope
Lnloanoff	Log of loans to off balance sheet items.	BankScope
Age	A bank's age.	BankScope
Age Squared	Square of the bank age.	BankScope
Foreign	A dummy variable equal to 1 if the bank is a foreign bank, and 0 otherwise.	R.d. Haas, I.v. Lelyveld & authors' own research.
Greenfield	A dummy variable equal to 1 if the bank is a greenfield foreign bank, and 0 otherwise.	R.d. Haas, I.v. Lelyveld & authors' own research.
M&A	A dummy variable equal to 1 if the bank is a merger and acquisition foreign bank, and 0 otherwise.	R.d. Haas, I.v. Lelyveld & authors' own research.

Appendix 2: Cost Frontier Parameter Estimates

Table A1: Foreign Banks versus Domestic Banks

Variables	Parameter	s.e.
Y1	0.4113	0.0659***
Y2	0.5276	0.0457***
X1	-0.0130	0.0847
X2	0.0256	0.0495
X3	-0.8860	0.0864***
time	0.1648	0.0263***
Y1Q	0.1478	0.0151***
Y2Q	0.1826	0.0091***
X1Q	-0.0012	0.0195
X2Q	0.0138	0.0068*
X3Q	0.0342	0.0325
timeQ	-0.0123	0.0050*
Y1Y2	-0.1535	0.0139***
Y1X1	-0.0650	0.0087***
Y1X2	-0.0273	0.0076***
Y1X3	-0.0026	0.0212
Y1time	0.0323	0.0062***
Y2X1	-0.0084	0.0117
Y2X2	0.0324	0.0086***
Y2X3	-0.0298	0.0150*
Y2time	-0.0156	0.0054**
X1X2	0.0276	0.0123*
X1X3	0.0676	0.0136***
X1time	0.0491	0.0065***
X2X3	-0.0003	0.0098
X2time	-0.0061	0.0039
X3time	-0.0155	0.0078*
Hungary	0.1544	0.0632*
Poland	0.4694	0.2004*
Constant	6.7068	0.3290***

N=468
Y1=Loans
Y2=Other Earning Assets
X1=Price of Labour
X2= Price of Capital
X3= A measure of risk

All variables are in logs and normalized with respect to the price of borrowed funds.

Table A2: Greenfield Banks versus Domestic Banks

Variables	Parameter	s.e.
Y1	0.4054	0.0448***
Y2	0.4950	0.0514***
X1	0.0950	0.0764
X2	-0.0231	0.0440
X3	-0.8494	0.0816***
time	0.1592	0.0264***
Y1Q	0.1316	0.0124***
Y2Q	0.1661	0.0095***
X1Q	0.0325	0.0179
X2Q	0.0135	0.0066*
X3Q	0.0080	0.0246
timeQ	-0.0117	0.0050*
Y1Y2	-0.1528	0.0108***
Y1X1	-0.0600	0.0089***
Y1X2	-0.0289	0.0075***
Y1X3	0.0123	0.0136
Y1time	0.0306	0.0062***
Y2X1	-0.0222	0.0121
Y2X2	0.0219	0.0078**
Y2X3	-0.0159	0.0140
Y2time	-0.0143	0.0057*
X1X2	0.0097	0.0105
X1X3	0.0748	0.0151***
X1time	0.0419	0.0057***
X2X3	0.0119	0.0096
X2time	-0.0039	0.0038
X3time	-0.0164	0.0075*
Hungary	0.0951	0.0628
Poland	0.4506	0.1933*
Constant	6.8442	0.2953***

N=369

Table A3: M&A Banks versus Domestic Banks

Variables	Parameter	s.e.
Y1	0.6169	0.0629***
Y2	0.6268	0.0673***
X1	0.5222	0.1135***
X2	-0.1377	0.0605*
X3	-1.0588	0.1007***
time	0.0624	0.0277*
Y1Q	0.1868	0.0206***
Y2Q	0.2012	0.0162***
X1Q	0.1606	0.0361***
X2Q	0.0363	0.0116**
X3Q	0.0973	0.0229***
timeQ	0.0020	0.0059
Y1Y2	-0.1448	0.0121***
Y1X1	-0.0012	0.0136
Y1X2	-0.0206	0.0099*
Y1X3	-0.0436	0.0198*
Y1time	0.0064	0.0083
Y2X1	0.0262	0.0233
Y2X2	0.0108	0.0112
Y2X3	-0.0583	0.0140***
Y2time	-0.0038	0.0069
X1X2	-0.0098	0.0161
X1X3	-0.0241	0.0194
X1time	0.0194	0.0097*
X2X3	0.0148	0.0119
X2time	-0.0117	0.0065
X3time	-0.0018	0.0071
Hungary	-0.4925	0.1578**
Poland	1.3273	0.2938***
Constant	6.6106	0.4346***

N=292

Table A4: Greenfields versus M&As Banks

Variables	Parameter	s.e.
	b	se
Y1	0.8730	0.0842***
Y2	0.3408	0.0618***
X1	-0.2666	0.1157*
X2	0.1347	0.0736
X3	-1.0561	0.1087***
time	0.1740	0.0430***
Y1Q	0.1997	0.0176***
Y2Q	0.1474	0.0118***
X1Q	-0.0809	0.0202***
X2Q	-0.0148	0.0105
X3Q	0.0831	0.0259**
timeQ	-0.0263	0.0073***
Y1Y2	-0.1371	0.0157***
Y1X1	0.0012	0.0163
Y1X2	-0.0768	0.0131***
Y1X3	-0.0680	0.0188***
Y1time	0.0252	0.0079**
Y2X1	-0.0158	0.0137
Y2X2	0.0440	0.0089***
Y2X3	-0.0165	0.0132
Y2time	-0.0030	0.0067
X1X2	0.0515	0.0148***
X1X3	0.0175	0.0178
X1time	0.0342	0.0091***
X2X3	0.0298	0.0149*
X2time	0.0050	0.0054
X3time	-0.0210	0.0091*
Hungary	0.1011	0.0563
Poland	0.6912	0.2257**
Constant	5.8631	0.4597***

N=275