The impact of foreign bank entry in emerging markets: knowledge spillovers or competitive pressure?

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Abstract

This study examines whether there are managerial knowledge spillovers from foreign to domestic banks in Eastern Europe and Latin America, additional to competition effects. I estimate the 'pure' managerial efficiency teasing out external (environmental) effects in a 3-stage Data Envelopment Analysis (DEA) framework. I then examine the evolutionary pattern of foreign and domestic banks' managerial performance together with that of banking competition. The main results suggest that domestic banks' managerial performance is positively associated with foreign bank presence. Even during the period when competition is relatively low, domestic banks are catching up with foreign banks. These results suggest the strong possibility of knowledge spillovers in addition to competition effects and call for future direct evidence.

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1. Introduction

Both Central and Eastern European countries (CEECs) and Latin American countries (LACs) have undergone massive structural reforms since the early 1990s. The structural reforms took the form of financial market liberalisation, reduced trade barriers, and privatisation to a large extent. As a result, foreign investment in banking has increased significantly in the past decades. The IMF Global Financial Stability Report (IGFSR, 2007) shows that in Eastern Europe, the share of foreign banks in terms of total assets increased from 25%

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in 1995 to 58% in 2005 and from 18% in 1995 to 38% in 2005 in Latin America. Academically, the positive impact of competition promoted by foreign banks is widely accepted in these emerging markets (e.g. Claessens et al., 2001; Claessens and Laeven, 2004; Levine, 2003; Yildirim and Philippatos, 2007; Claessens, 2009; Poghosyan and Poghosyan, 2010; Jeon et al., 2011). However, unlike studies of foreign investment in real sectors, little has been done to understand whether there are knowledge spillovers from foreign banks to domestic banks in addition to competition effects. The importance of such understanding is evident, especially after the break-out of the recent global crisis which raises certain concerns regarding the market-driven model of these emerging markets. According to the European Bank for Reconstruction and Development Transition Report (EBRD, 2009), there are signs of slowing down of transition progress[1]. No doubt, further evidence, even suggestive or indirect, of knowledge spillovers provides additional argument for opening up the banking market. The motivation of this paper is to draw as much evidence as possible in this respect given the data I have. Recognising the invaluable experience of Eastern European and Latin American countries and the limitation of the data, the purpose is to call for future evidence on knowledge spillovers related to foreign investment in banking sector.

The following approach is undertaken to investigate the evidence of managerial knowledge transfer from foreign to domestic banks. Firstly, I aim at measuring the 'pure' managerial efficiency that controls for factors out of the control of bank managers. These factors include environmental characteristics specific to banking sectors in different countries and potential advantages of foreign banks not attributable to superior management skills. By doing so, I expect to obtain estimates of efficiency which are only attributable to management skills (managerial efficiency). The advantage of obtaining a measure of 'pure' managerial efficiency rather than a gross efficiency measurement is that I can tease out these external or environmental effects while studying the evolution of the managerial performance of banks over time and the comparisons across foreign and domestic banks. I consider this as a crucial

[1]According to the report, while capital inflows and foreign bank presence have been a source of growth in the transition region since the mid-1990s, abundant foreign financing, often intermediated by foreign banks, contributed to the credit booms and foreign currency lending that set the scene for the 2008-09 crisis in Central and East European Countries (CEECs).

step for me to derive any evidence on managerial knowledge spillovers. Secondly, considering that the participation of foreign banks may increase competitive pressure forcing domestic bank managers to be more efficient even in the absence of knowledge transfer, evolution of banking competition is also examined around the same period in the two regions. Finally, I examine the evolution of the estimated bank efficiency, especially the gap between foreign and domestic banks and compare such pattern with the evolution of competition over the same period. The purpose is to see, whether domestic banks are catching up with foreign banks in managerial efficiency and whether the catching up, if it happens, can be explained by competition or managerial knowledge spillovers or both.

The main results show that the gap in managerial efficiency between foreign bank and domestic banks is narrowing over time. The gap is narrowing even during the period when significant concentration took place in these banking markets due to the reforming and restructuring (resulting in lower competition). Moreover, the extent of the presence of foreign banks is positively associated with the managerial performance of domestic banks. From these results, I derive the indirect evidence of knowledge spillovers. Recognising the generalisation of the results given the data availability, future direct evidence, for instance, the possible mechanisms through which knowledge spillovers take place, or the asymmetric impacts e.g., arising from different modes of foreign entry (e.g. greenfield investment vs. joint ventures), is called for.

The paper is structured as follows: Section 2 reviews the literature on foreign direct investment and knowledge spillovers in real sectors, competition effects of foreign bank entry in emerging markets, and the context of the foreign bank investment in CEECs and LACs. Based on the literature, I develop the hypotheses to be tested. Section 3 introduces the methodologies employed to measure managerial efficiency and competition, and to examine their evolutionary patterns. Section 4 describes the datasets used for the estimations. In section 5, the empirical results are reported and discussed. Section 6 concludes.

2. Literature Review

2.1. Foreign Direct Investment (FDI) and knowledge spillovers

The evidence regarding the existence of positive knowledge or technology spillovers from FDI in general is far from unambiguous. For instance, Caves (1974) find modest evidence of both competition effects and technology spillovers/transfer in Australian and Canadian Manufacturing industries. In emerging markets, based on evidence prior to 1997, Konings (2001) finds little evidence of positive spillovers. By contrast, recent evidence by Damijan et al. (2009) shows positive impact of foreign firms on total factor productivity growth of local firms in emerging markets. The controversy in terms of the existence of technology or knowledge spillovers could be explained by the large differences in the transmission channels and conditions under which FDIs take place.

Regarding the transmission mechanism of knowledge spillovers, several transmission channels are examined including labour mobility, demonstration effects and direct foreign linkage. Almeida and Kogut (1999) highlight the inter-firm mobility of engineers influences the local transfer of knowledge. Similarly, Fosfuri et al. (2001) identify the mobility of labour as one mechanism through which knowledge spillovers from FDI take place, especially when foreign firms and local firms do not compete fiercely in the product market. However it is important to note that not all mechanisms require weak competition for technology or knowledge spillovers to take place. One of such mechanisms is through demonstration effects. Hamida and Gugler (2009) show that Swiss firms benefit from spillovers through demonstration effects-expressed in terms of foreign sales share and tested according to the level of local absorptive capacity. Their results point to the importance of the demonstration mechanism in benefiting from FDI for local firms with mid-existing level of technological capacity. Javorcik (2004) identifies the backward linkage as directing the spillover effects using firm level empirical evidence from Lithuania. The existence of positive spillovers is shown from contacts with multinational customers, but not the presence of multinational firms. This effect is larger when the multinationals in the sourcing sector are oriented towards supplying the domestic market rather than focusing mainly on exporting. But the effect

is not sensitive whether the multinational customers are partially or fully foreign owned. Based on early (before 1998) evidence in transition economies, Damijan et al. (2003) also suggest that technology is being transferred to firms in CEECs primarily through direct foreign linkages. The spillovers through arm-length trade are only exceptionally present, while horizontal spillovers from foreign to domestic firms are negative or insignificant.

Regarding the determinants of the extent of spillovers, the literature highlights the determinants including cost of technology transfer, ownership structure of foreign firms, origins of foreign firms and absorptive capacity of local firms or existing level of technology. Teece (1977) examines the determinants of the cost of technology transfer including age of the technology, size of the transferee and experience in transference. Based on evidence from Venezuelan manufacturing industries, Aitken and Harrison (1999) illustrate the tendency for MNCs to locate in more productive sectors and firms, thus internalising the spillovers of foreign ownership using joint ventures, driving out entirely domestic owned firms. Similarly, based on evidence from Czech Republic's manufacturing industries, Djankov and Hoekman (2000) conclude positive impact of foreign investment on total factor productivity of recipient firms. But the impact is asymmetric in the sense that firms with majority foreign ownership (over 50% of equity share) benefit more from know-how diffusion than joint ventures as recipient firms, and that majority foreign owned firms and joint ventures together have negative spillovers on domestically owned firms. Evidence from Estonia by Meyer and Sinani (2004) suggests that spillovers are of considerable magnitude in Estonia and that they depend on characteristics of the incoming FDI because labor and sales intensive-FDI generate larger spillovers than equity-intensive FDI. Based on evidence in Chinese manufacturing industries, the results from Buckley et al. (2002) highlight the indirect spillover effects such as the development of high-tech and new products, and the asymmetric spillovers across recipients of different absorptive capabilities and foreign firms of different origins. Sawada (2010) provides a theoretical framework in which technology gap matters in the sense that, up to a critical bound, the larger the initial technology gap between the foreign and home firms, the more the home firm spends to gain spillovers. Past that boundary, the home firm decreases spending. From a different perspective, linking motivation and impact of

FDI, Driffield and Love (2007) allow ex ante classification of FDI motivations to be tested for their ex post effects. Unlike previous literature which infers motivation from the effects of foreign investment, they show that, while the UK gains substantially from inward FDI motivated by a strong technology-based ownership advantage, inward FDI motivated by technology sourcing (technology access or assessing) or efficiency seeking (such as lower labour cost) leads to no productivity spillovers.

Whereas the existence of positive spillovers from FDI is not unambiguous, previous studies provide rich information for us to understand the transmission channels of FDI spillovers and the conditions which determine the extent of spillovers. The effects of FDI are no doubt asymmetric depending on various transmission channels and conditions as documented by the existing evidence. As a result, recent evidence is paying more attention to understanding the asymmetry and dynamics of the impact of FDI. Gorodnichenko et al. (2007) provide evidence of positive spillovers through backward linkage in both manufacturing and service sector firms and through horizontal and forward linkage for established and service sector firms. Fu et al. (2012) focus on managerial knowledge spillovers and examines how the difference between codified managerial knowledge and tacit managerial knowledge affects knowledge spillovers. Ayyagari and Kosov (2010) analyse the impact of FDI on domestic firm entry and firm size distributions in the Czech Republic. They find that larger foreign presence stimulates the entry of domestic firms within the same industry, indicating the existence of positive horizontal spillovers from FDI. They also find evidence of significant vertical entry spillovers-FDI in downstream (upstream) industries initiates entry in upstream (downstream) sectors. They further show that service sectors experience significant entry spillovers which can not be found in manufacturing industries.

As can be seen from the above review, despite enormous effort paid to the evidence in manufacturing sectors and relevant technology know-how diffusion, very little evidence is provided in service sectors regarding the relevant managerial know-how transfer. Evidence is even more scarce in banking sector. To the best of my knowledge, there is only one exception. Taking a different perspective from this paper, Knott et al. (2009) investigate whether spillover is directional using banking industry as an example. They suggest that spillovers

have directionality as indicated by the evidence that cost reduction is related to the amount of knowledge held by more efficient firms rather than by the amount held by the entire set of firms.

2.2. The impacts of the presence of foreign banks on domestic banking

Among the impacts, efficiency and competition impact are most examined. Efficiency impact focuses on the comparison between foreign bank and domestic bank performance. Evidence from the U.S. (see Chang et al., 1998; Hasan and Hunter, 1996; Mahajan et al., 1996) tends to suggest that domestic banks outperform foreign banks while wider evidence including developing countries suggests that the comparison results are not clear-cut (e.g. Berger et al., 2000). Most studies in developing countries found that foreign banks outperform domestic banks (e.g. Grigorian and Manole, 2002; Bonin et al., 2005; Havrylchyk, 2006). Some other studies go further to examine the environmental and institutional factors to explain the difference in performance between domestic and foreign bank (Berger et al., 2000; Lensink et al., 2008; Chen and Liao, 2011). As for competition effects, studies tend to suggest positive impact on domestic banking competition, especially in developing countries (e.g. Claessens et al., 2001; Claessens and Laeven, 2004; Levine, 2003; Yildirim and Philippatos, 2007; Claessens, 2009; Poghosyan and Poghosyan, 2010; Jeon et al., 2011). The above studies therefore highlight the positive impact of foreign bank presence or entry in terms of improved resource allocation through enhanced competition or efficiency. None of these studies aim at investigating any potential knowledge spillovers from foreign to domestic banks in addition to competition effects.

2.3. The context of foreign bank entry in CEECs and LACs

The first step in banking sector reform for most European transition countries since the start of transition involved the creation of a two-tier system with commercial banking activities carved out of the portfolio of the communist national mono-bank. Following the reform,

a lot of state-owned commercial banks (SOCBs) were created together with domestic private banks, foreign banks and joint venture banks forming the second tier of the banking system in most transition countries. This induced the first wave of foreign bank entry into these countries in the early 1990s (see Bonin et al., 2010, for details). However, coupled with the lack of human capital and poor regulation and supervision, serious problems emerged with the creation of the two-tier banking system in these countries. Firstly, SOCBs did not behave like proper commercial banks due to distorted incentives. They continued to lend to large state-owned enterprises as a result of political incentives or long-standing relationships instead of on a commercial basis. Secondly lax entry requirements created a lot of small and undercapitalised private banks based on the notion that competition would be enhanced by easy entry especially in the former republic of Yugoslavia, Russia, and Bulgaria. As a result, bad loans became a very serious problem for these transition economies. After several rounds of privatisation and recapitalisation of banks at huge costs, the governments had little choice but to sell these SOCBs to foreign banks. This induced the second wave of foreign bank entry into these transition countries after half a decade of transition (i.e. around 1995-1999). As a result, the proportion of assets in foreign-owned banks rose from virtually 0 in the early 1990s to more than half in most transition countries a decade after. According to IGFSR (2007), by 2005, the average share of foreign bank assets was 84.5% in the four CEE countries (Poland, Hungary, Czech Republic and Slovakia) and 61.9% in the four South East European (SEE) countries (Slovenia, Croatia, Romania and Bulgaria). Along with the second wave of foreign bank entry was bank restructuring and consolidation. Bonin et al. (2010) (Table 33.2 and 33.2 in Page 856 and 858) show that the pace of restructuring and consolidation increased after 1999.

Latin American countries have also undergone periods of reforms and restructuring of the banking sector at around the same periods as those European transition economies. More importantly, as a result of the reforms, LACs also have experienced two waves of foreign bank entry. Starting with a system in which state authorities created and enlarged state-owned banks, set maximum interest rates and directed credit, the financial liberalisation took place in the 1980s and 1990s in parallel with the liberalisation of the capital account of

the balance of payments. However, again the lack of an adequate system of bank regulation and supervision coupled with fast expansion of banking lending meant that the reform was soon followed by banking crises in several countries. The first wave of reform in Mexico ended up with the 1994 crisis which also had contagion effects on Argentina and Brazil. As a result, led by US and Spanish banks, the second wave of foreign bank entry was induced to recapitalise the banking system in the region except in Brazil[2]. In Mexico unrestricted access was granted to foreign banks in 1997 and foreign banks now dominate the banking system. The share of foreign bank assets increased from 2% in 1990 to 82% in 2004. In Chile, the share of foreign bank assets increased from 19% in 1990 to 42% in 2004; in Argentina, the foreign bank asset share increased from 10% in 1999 to 48% in 2004[3]. In Brazil, foreign bank penetration was not significant for the reasons mentioned above and the share of foreign banks increased relatively modestly from 6% in 1990 to 27% in 2004 (Carvalho et al., 2010). The second wave of foreign bank entry was also accompanied by increased consolidation and restructuring of the banking sectors in Latin America (Carvalho et al., 2010).

As can be seen from what is mentioned above (for further information on banking reforms and restructuring in these regions, see Hasan and Marton, 2003; Bonin et al., 2005, 2010; Carvalho et al., 2010; Domanski, 2005), banking reforms combined with financial crises in the two regions promoted the entries of foreign banks to restructure and recapitalise the banking sectors. In this paper, the sample period (1995-2006) is related to the crises before 1999 and the restructuring after 1999 which also resulted in the second wave of foreign bank entry.

2.4. Development of hypotheses

Hypothesis 1. Given the special background of foreign bank entries in CEECs and LACs, foreign banks have certain ownership advantages that allow them to

[2]In Brazil, panic was avoided at the cost of pushing bank consolidation forward between domestic banks. Foreign banks were only occasionally allowed to buy problem banks in order to prevent excess concentration.

[3]However the deep crisis in Argentina in 2001 led to some decrease in foreign bank participation in Argentina.

have management skills superior to domestic banks.

This is a necessary condition for spillovers to take place. Related to the special context of foreign bank entries as mentioned above, it is highly likely that the domestic banks at the initial stage of the reforms were in a much weaker position in terms of performance than foreign banks. I therefore expect to find evidence of ownership advantages which could be, such as technology/knowledge exploitation (see e.g. Driffield and Love, 2007) resulting in the observation of superior management skills of foreign banks to domestic banks. It is worth noting that controlling for those advantages that are not related to management skills and endogeneity problems (arising from foreign banks select productive domestic markets to enter) is very important as I seek to investigate the 'pure' advantages of managerial know-how of foreign banks.

Hypothesis 2. Domestic banks' managerial performance is expected to increase over time either as a result of competition or knowledge spillovers.

Hypothesis 3. Due to the significant concentration of the banking markets during the period as a result of reforms, competition is likely to have structural breaks rather than increasing steadily.

Hypothesis 4. With the presence of knowledge spillovers, domestic banks are expected to catch up with foreign banks in terms of managerial efficiency, even during the period of relatively low competition.

The test of this hypothesis does not provide direct evidence of knowledge spillovers. However, if the gap between foreign and domestic banks is found to be closing even during the period when competition is relatively low, I interpret it as the highly suggestive evidence that some sort of knowledge transfer must be taking place. In addition, I relate the domestic banks' managerial performance to the presence of foreign banks, to provide further evidence related to the existence of knowledge spillovers.

3. Methodology

3.1. The General Framework

In the above spillovers and FDI literature, spillovers are often measured by the impact of the presence of foreign firms on productivity of domestic firms (in other words, a variable measuring the presence of foreign ownership is inserted in the production function and the coefficient is interpreted to measure the spillovers), without measuring the productivity of firms directly. In this paper, I control for external factors so that efficiencies that reflect banks' managerial skills only can be measured directly. The advantage of this approach is that I could study the evolution of such efficiencies over time across domestic and foreign banks without losing the information on spillovers (since I could still relate this measure of efficiency of domestic banks to the presence of foreign banks). This way, I could also compare the evolution of managerial efficiency with that of competition. To obtain a measure of efficiencies that reflects banks' managerial know-how only, one important step is to control for endogeneity arising from foreign banks selecting efficient domestic banking markets to enter and other advantages of foreign banks which are not attributed to managerial know-how. Secondly, one has to control for other institutional and environmental factors as they contribute to banks' performance but are not attributed to banks' managerial know-how. Finally, one also has to take into account of competition effects that drive banks' performance. After taking all these steps, I could derive evidence of knowledge spillovers from foreign banks to domestic banks by studying the evolutionary pattern of their managerial know-how performance, in other words, the overall trend of each type of banks, the gap between them, and the relation between domestic banks' managerial performance and foreign bank presence. Unlike the bank efficiency studies mentioned in Section 2.2 which focus on the gross efficiency, I aim at measuring the 'pure' managerial efficiency after controlling for the external factors as described above. This is because my research question is focused on evidence of managerial knowledge spillovers rather than on determinants of banks' gross performance. The following explains the approaches I take to make the above steps.

The general empirical framework I use is the frontier method. The essence of any frontier

approach is to measure how close the institutions are to a best-practice frontier based on measures of costs, outputs, inputs, revenue, profits, etc. These methods differ primarily in the assumptions imposed on the data in terms of the functional form of the best-practice frontier i.e., a more restrictive parametric functional form versus a less restrictive nonparametric form. Non-parametric approaches, such as Data Envelopment Analysis (DEA) put relatively little structure on the specification of the best-practice frontier. Parametric approaches, such as the Stochastic Frontier Approach (SFA) specify a functional form for the cost, profit or production relationship among inputs, outputs and environmental factors, and allow for a stochastic component. SFA uses a composite error model in which inefficiency is assumed to follow an asymmetric distribution (e.g. half-normal, truncated normal, gamma). For detailed discussions of different frontier methods, see Berger and Humphrey (1997); Berger and Mester (1997); Battese et al. (2005); Cooper et al. (2007).

To control for various institutional or environmental factors that affect banks' performance, I combine DEA and SFA in a three-stage DEA analysis by adapting Tone (2002)'s cost efficiency framework (Appendix A) to Fried et al. (2002)'s three-stage DEA (Appendix B). This approach allows me to take the advantage of DEA in its little restrictions on the specification of the best-practice frontier, and the advantage of SFA in its power to control for environmental factors. Traditional DEA Linear Programming attributes the whole distance from the frontier to inefficiency. However producer performance is influenced by three very different phenomena: managerial efficiency, the characteristics of the environment in which production activities are carried out, and statistical noise. The first phenomenon is endogenous, while the second and third are exogenous. In the case of cross-country or over-time comparison, even assuming that all managers operate at 100 percent efficiency, they would not all get the top efficiency scores because the managers operate within an environment that differs from the others and impinges on their operations. It is therefore important to control for variable environments when measuring the lack of efficiency truly attributable to management. Fried et al. (2002) propose a 3-stage technique to incorporate the last two factors into DEA framework. In the first stage, DEA is applied to outputs and inputs to obtain initial measures of producer performance. In the second stage, SFA is used to regress

first stage performance measures (e.g. the difference between observed cost and minimised target cost) against a set of environmental variables. This provides a three-way decomposition of the variation in performance into a part attributable to environmental effects, a part attributable to managerial inefficiency, and a part attributable to statistical noise. In the third stage, DEA outputs or inputs are adjusted to account for the impact of the environmental effects and the statistical noise uncovered in the second stage, and DEA is used to re-evaluate producer performance. This approach is based on standard two-stage DEA analysis (for applciations in banking, see for instance Grigorian and Manole, 2002; Casu and Molyneux, 2003; Havrylchyk, 2006; Pasiouras, 2008) with variations. But Simar and Wilson (2007) criticise standard two-stage DEA analysis. They are concerned about the correlations among the estimated efficiency scores in the first stage. However, both Banker and Natarajan (2008) and Johnson and Kuosmanen (2009) offer both theoretical models and simulation results to provide the statistical basis for the two-stage DEA analysis. Banker and Natarajan (2008) show that two-stage DEA analysis outperform both one-stage and two-stage parametric models. Moreover, in a more general framework, Johnson and Kuosmanen (2009) suggest that the two stage DEA coefficients are consistent without the assumption of independence between input variables and environmental variables, or known direction of the environmental variables as imposed by Banker and Natarajan (2008). To take the above debates on the two-stage DEA analysis into account, the one-step parametric method (SFA) using translog cost function proposed by Battese and Coelli (1995) for panel data is also used. While addressing the unsolved debates on the usage of two (or three)-stage analysis is beyond the scope of this paper, I present the results from using both the one-step SFA and three-stage DEA analysis. However due to data constraints, the sample period covered in the one-step SFA is shorter.

The specification of input and output variables follow the standard literature in bank efficiency measurement (see e.g. Chang et al., 1998; Hasan and Hunter, 1996; Mahajan et al., 1996). The environmental variables are selected on the ground that the lack of the firm's freedom of making strategic and operating decisions results from the firm's operating environment over which the firm management has no control. The annual GDP growth,

population density, GDP per capita, internet and telephone users (per thousand people), real interest rate, stock market capitalisation and banking regulations are chosen as environmental variables. Banking regulation variable was also considered but dropped due to high correlation with the control variable of foreign bank selection as mentioned below.

3.2. Controlling for Foreign Banks' External Advantages

FDI theory generally suggests that firms may expand abroad to exploit the internal knowledge advantage created within the firm. The concept of internal knowledge may include technical know-how and managerial know-how. These internal knowledge advantages are accumulated within the firm and considered attributable to management expertise. If these internal knowledge advantages are realised, foreign banks will demonstrate greater managerial efficiency than domestic banks, which is what I want to examine in this study. However, firms may also expand to explore some external advantages. As mentioned earlier, foreign banks enter these transition countries against a special background. For instance, foreign banks may choose a market which is financially undeveloped to give themselves the comparative advantages of easier access to international capital market or lower cost of capital due to parent banks operating in a more developed financial market. Therefore certain market conditions of the host countries reflect external advantages of foreign banks in these countries. And these external advantages have to be controlled for as an environmental variable in the 2nd stage SFA equation to obtain the managerial efficiency of foreign banks. Otherwise the estimated efficiency may reflect the ex-ante location choice of these foreign banks instead of the true knowledge advantage. Therefore, it is reasonable to assume that foreign banks may select a certain host country to exploit the market conditions in that country. To cotnrol for this possibility, I adapt the Heckman two-step procedure as follows. A probit regression is run firstly to see how host country environment affects the probability of a foreign bank being located in a certain country:

$$P(F_i = 1|x_i) = \Phi(x_i\delta) \tag{1}$$

where F_i is the dummy variable which describes the foreign ownership ($F = 1$ if it is a foreign bank), x_i are the host country conditions that might affect the foreign bank selection. The probability of being a foreign bank in a given country is then predicted. Such probability is then interacted with the foreign ownership dummy and used in the SFA model as a control variable to control for external advantages of foreign banks operating in a certain country. The higher the probability of foreign banks located in a certain country, the greater the external advantages foreign banks can gain over domestic banks in the particular country. The host country factors used in the probit regression to catch external advantages of foreign banks include all those environmental factors which are expected to affect bank cost control as mentioned above. In addition, banking regulatory and supervisory variables are included. Three banking regulation indices are included: Overall Activities Restrictions, Capital Regulatory Index, and Entry into Banking Requirements from the database originally constructed by Barth et al. (2001) and updated afterwards[4]. To avoid endogeneity, the independent variables in the above probit regression model cover a relatively long time period from 1998 to 2006.

3.3. Investigating Competition Effects

Finally, bank competition effect is introduced by employing Panzar-Rosse (PR) approach (see Appendix C for details). In this model, an H statistic is computed as the sum of the elasticity of the revenue with respect to input prices. This model introduces interdependence into banks' structural revenue equations via the hypothesis that, in equilibrium, free entry

[4]Three bank activity restrictiveness variables (including banks engaging in securities activities, insurance activities, real estate activities) and two mixing of banking and commerce variables (including banks owning non-financial firms and non-financial firms owning banks) are significantly and positively related with one another according to Barth et al. (2001)'s tests. So these variables are combined into one variable, which is the Overall Activities Restrictions variable. Capital Regulatory Index is the sum of the two measures of capital stringency, i.e. Overall Capital Stringency and Initial Capital Stringency. Overall capital stringency indicates whether there are explicit regulatory requirements regarding the amount of capital that a bank must have relative to various guidelines. Initial capital stringency indicates whether the source of funds counted as regulatory capital can include assets other than cash or government securities and borrowed funds as well as whether the sources are verified by the regulatory or supervisory authorities. Entry into Banking Requirements indicates whether there are specific legal submissions required to obtain a license to operate as a bank.

and exit results in zero profits. Therefore, this measurement of competition, comparing to market structure indicators such as concentration ratios, characterises the interaction between banks. It is worth noting, as illustrated by Shaffer (2004), because the key variables (revenue and input prices) utilise only data from the sample firm(s), the test does not reflect any specific hypothesised definition of the market (either product or geographic). The PR approach, due to its relatively low requirements of data, is widely applied in banking studies (see for instance Claessens and Laeven, 2004; Casu and Girardone, 2006; Koutsomanoli-Fillipaki and Staikouras, 2006; Semih Yildirim and Philipotas, 2007a,b).

However this approach has a major limitation. It assumes that (except for the monopoly case) the test is undertaken on observations that are in long-run equilibrium, and that banks are profit maximising firms with conventional demand and cost structures. Although under the monopoly case, it requires little beyond the profit maximisation hypothesis itself, Shaffer (1982) shows that any profit-maximising firm facing a fixed demand curve, even in a short-run but not long-run competitive equilibrium, will exhibit $H < 0$. Therefore it is important that the observations are in the long-run equilibrium for the test to be effective. Recognising that fixed effects estimation of the H-statistic may be biased if adjustment towards market equilibrium in response to factor input price shocks is partial or not instantaneous, the empirical test for long-run equilibrium developed by Shaffer (1982) is applied. In this test, the dependent variable is replaced by pre-tax profit and the new equation is estimated. Then the F-test is applied with the null hypothesis that $H = 0$. If the null can not be rejected the data is obtained from a system which is in the long-run equilibrium. This test is based on the established principle that in the long-run equilibrium, the maximised profit of the banks should tend to be 0.

The indirect evidence of knowledge spillovers is drawn by comparing the changes in competition over time and the changes in managerial efficiency over the sample period especially the gap between foreign and domestic bank efficiency. Any changes in foreign and domestic bank managerial efficiency gap that can not be explained by the changes in competition will allow me to draw implications on managerial knowledge transfer from foreign to domestic banks. To examine the evolution of bank competition over time in the sample countries,

Chow tests are used to identify possible structural breaks. Potential break points are identified based on the dataset on episodes of 117 systemic banking crises that have occurred in 93 countries and 51 smaller (non systemic) banking crises in 45 countries since the late 1970s established by Caprio and Klingebiel (2003)[5]. A series of tests are conducted on the unbalanced panel dataset (1995-2006), and the balanced datasets (1995-2006 and 1998-2006).

4. Data

For the efficiency measurement, the bank-level data are collected from BankScope database from 1995 to 2006 in 7 Central and South American countries and 12 Central and Eastern European countries including Argentina, Brazil, Bulgaria, Chile, Colombia, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Mexico, Peru, Poland, Russian Federation, Slovakia, Slovenia, Uruguay[6]. BankScope has both unconsolidated and consolidated (integrating all subsidiaries worldwide) financial statements for banks subject to availability. Most of the financial statements are unconsolidated. For consistency, only banks with unconsolidated data are selected. The banks are selected in these countries subject to data availability. The final sample is an unbalanced panel consisting of 970 banks (3423 observations) for the cost efficiency analyses.

For the H statistic using the PR approach, the unbalanced bank-level panel data is used from 1995-2006 for 7 Central and South American countries and 15 Central and Eastern European countries including Argentina, Brazil, Bulgaria, Chile, Colombia, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Mexico, Peru, Poland, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Ukraine and Uruguay. Unconsolidated annual balance sheet and income statement data for the banks were also taken from the BankScope database. The final sample is an unbalanced panel with 4429 observations covering 1258 banks over the period 1995-2006. For robustness check, the empirical model is also estimated using a balanced panel data from 1995-2006 (30 banks consisting of 360

[5]for an updated version, see Laeven and Valencia (2008)

[6]Uruguay is also included since it is regarded as one of the most open economies in Latin America.

observations) and from 1998-2006 (53 banks consisting of 477 observations).
A list of main variables used for the frontier methods and PR approach is provided in the Appendix D with summary statistics and sources.

5. Empirical Results

I first investigate whether and how foreign banks select their host countries in order to find out whether foreign banks have any external advantages over domestic banks. In order to do so, I examine the probit regression results in Table 1, that show the relationship between the macroeconomic environment in host countries and the (resulting) foreign bank presence. Countries with less developed financial market (low stock market capitalisation) seem to attract foreign banks. Great market potential (high population density and high proportion of internet and phone users) and high GDP per capita, which probably indicate high demand for financial service generate a positive impact on the presence of foreign banks. The results suggest foreign banks are more likely to be in countries where entry restrictions into the banking sector are lower and private monitoring of banks is encouraged. In terms of the power of national supervisory authorities, the results seem to suggest that foreign banks actually prefer countries where national supervision authorities have more power. In addition, foreign banks are more likely to be present in countries where overall restriction on banking activities is higher. This may be relevant to the legal form of these foreign banks since foreign branches tend to gain the advantage of being supervised by home country authorities[7]. The alternative explanation is that a number of countries restricted foreign presence to the opening of branches, often in connection with limitations on business activities on the notion that this allowed control over the impact of foreign banks on the domestic financial system given the diversity of investors and strategies (BIS, 2005). However, it is

[7]The legal structure of a foreign bank determines the division of responsibilities among national supervisory authorities. Home countries supervise foreign branches which form part of the parent bank while host countries supervise subsidiaries which are independent legal entities owned by a parent bank. Due to data constraints, no distinction between these two types of banks is made in the sample.

important to recognise that the results in this study are based on a pool of countries involving a considerable degree of generalisation. Specific conclusions about the relation between actual entry strategies, the legal form, and host country supervision and regulation would require a careful case-by-case examination (for instance, a few studies examine the effects of host and home country environment on foreign banks' performance, profitability and entry strategies see e.g. Bertus et al. (2008); Lensink et al. (2008); Chen and Liao (2011)).
Surprisingly GDP growth is negatively related to the presence of foreign banks. During that period there are severe economic crises in the selected host countries. To certain extent, the crisis during that period pushed forward foreign bank entries to recapitalise the banking sectors (see section 2.3). Therefore, high presence of foreign banks is associated with low GDP growth during the studied period. Also, the relationship between GDP growth and foreign bank presence may reflect the possibility of foreign banks reaping net positive diversification benefit from their geographical expansion as suggested by Bos and Kolari (2005). This is also consistent with the findings in Haas and Van Lelyveld (2006) that during crisis periods domestic banks in Central and Eastern Europe contracted their credit base, whereas greenfield foreign banks did not. The negative relationship between the presence of foreign banks and inflation and real interest rates might suggest that foreign banks are less likely to be present in countries where the macroeconomic environment is less stable.

Table 2 gives the probability of foreign banks being located in each of the countries in the sample. It shows that foreign banks are more likely to be present in Slovakia, Czech Republic, Hungary and Uruguay, while less likely to be present in Russian Federation and Brazil. This result is consistent with the reform progress of these economies as mentioned earlier.

In order to control for the advantages of foreign banks shown in Table 1, the probability of foreign bank presence shown in Table 2 is interacted with the foreign ownership dummy as one of the environmental factors in the second stage SFA equation. At this stage, the purpose is also to capture various other environmental impacts on banks' overall performance so that the pure managerial efficiency of foreign and domestic banks can be estimated. The second stage SFA results in Table 3 reveal the environmental effects. As expected, higher

Table 1: External Advantages of Foreign Banks-1

Foreign ownership Dummy F	Coefficient	(Robust Std. Err.)
GDP Growth	-0.626***	0.2146
GDP Per capita	0.194***	0.0531
Population density	0.343***	0.0307
Real Interest rate	-0.567***	0.1848
Internet and Phone User	0.080***	0.0253
Stock market capitalisation	-0.198***	0.0271
Entry into banking Req	-0.678***	0.2518
Activity Restrictiveness	0.867***	0.2296
Capital Regu Req	0.045	0.1539
Supervisory Power	0.765***	0.1744
Independence of Supervisory	-0.532***	0.1233
Private Monitoring	0.825***	0.1058
Inflation	-0.050**	0.0216
No. of Banks	1543	
Pseudo R^2=0.2909		
Percent correctly predicted= 83.07%		

*** indicates that the estimate is significantly different from 0 at the 1 percent level;

** indicates that the estimate is significantly different from 0 at the 5 percent level;

GDP growth and greater stock market development are likely to reduce CS (difference between actual cost and minimised target cost, see Appendix B). The number of internet and phone users also reduce CS as this may reduce branching opening and cut costs of banks. A high real interest rate which is used as a proxy for systemic risk of a country is likely to increase CS. GDP per capita increases CS as shown by the result, which might suggest the significant impact on labour cost. Finally, higher probability of foreign bank presence in a country is related to lower CS as expected. This is because foreign banks are more likely to select these countries to exploit the external conditions in the host country to cut their operational cost thus reducing CS[8].

In Table 4, comparisons between 1st and 3rd stage DEA efficiency scores are presented. This is to show the impact of external environment on banks' overall performance. The mean of the efficiency scores of DEA analysis are relatively low. This is not surprising considering the relatively large size of the sample examined. And each bank's efficiency is

[8]Population density variable is dropped since it is not significant due to its correlation with internet and phone users.

Table 2: External Advantages of Foreign Banks-2

Country	Predicted Probability
Slovakia	0.721
Uruguay	0.651
Slovenia	0.644
Czech Rep.	0.629
Hungary	0.581
Poland	0.574
Croatia	0.542
Macedonia	0.523
Bulgaria	0.460
Lithuania	0.445
Latvia	0.422
Colombia	0.419
Chile	0.410
Mexico	0.369
Argentina	0.365
Estonia	0.317
Peru	0.280
Brazil	0.245
Russian Fed.	0.038

measured against the best-practice bank in the best year[9]. In the table, it shows that the 3rd stage efficiency scores are improved compared to 1st stage DEA. Sample mean tests were also conducted to confirm that the change in the means of 1st and 3rd stage is statistically significant. In addition, the results in the table show that banks in Eastern European

[9]The efficiency scores from this perspective can be inaccurate if some banks are excessively penalised for being in a bad year. However controlling for environmental effects in the second stage using SFA aims to mitigate such distortion. Moreover, it is the relative difference in efficiency between foreign and domestic banks that we are concerned about instead of the efficiency scores.

Table 3: Environmental Effects on cost difference

total cost difference	Coefficient	Std. Err.
GDP Growth	-0.188***	0.0285
GDP Per capita	0.060***	0.0154
Real interest rate	0.096***	0.0368
Internet and Phone user	-0.095***	0.0087
Stock market capitalisation	-0.007	0.0054
Foreign Bank External Adv	-0.062*	0.0367
No. of Obs	3423	
No. of Banks	970	

total cost difference (CS)=observed total cost-minimised total cost

minimised total cost is obtained by solving the minimisation problem of the allocative model

Table 4: Efficiency comparison before and after controlling for environmental effects

	1st stage DEA	3rd stage DEA
	CE_1	CE_3
mean (CEEs)	0.386	0.463
mean (LAs)	0.209	0.290
mean (total)	0.328	0.407

countries are on average more efficient than banks in Latin America[10].

In order for knowledge transfer to take place from foreign to domestic banks, it is expected that managerial efficiency of foreign banks should be higher than those of domestic banks. In Table 5, a comparison of managerial efficiency over time is presented. Tables 5 compares foreign and domestic bank efficiency using the 1st stage DEA and 3rd stage DEA. However it is worth noting that the 1st stage DEA scores are not necessarily the estimates of managerial efficiency since no environmental impact is taken into account. The one step SFA results are also reported in the last two columns. Due to data constraints on input prices[11], the sample of one-step SFA analysis is only a sub-sample (including 2361 observations consisting of 883 banks over 2001-2006) of the DEA analysis. From 1997 to 2001, foreign banks outperform domestic banks and the difference is tested to be statistically significant. This confirms **Hypothesis 1. Given the special background of foreign bank entries in CEECs and LACs, foreign banks have certain ownership advantages that allow them to have management skills superior to domestic banks.** However, the gap between foreign and domestic banks is narrowing since 2000. The one-step SFA results overall confirm the closing gap (insignificant difference) between foreign and domestic banks. But the one-step SFA results even suggest that at the end of the sample period (2006) domestic banks are becoming more efficient than foreign banks, while the 3-stage DEA results suggest that the difference between domestic and foreign banks' efficiency towards the end of the period (in-

[10]Country level efficiency scores are not reported since the sample size at country level is too small to be representative due to data constraints.

[11]note that input prices are not required for the DEA analysis under the cost efficiency framework by Tone (2002) (Appendix A)

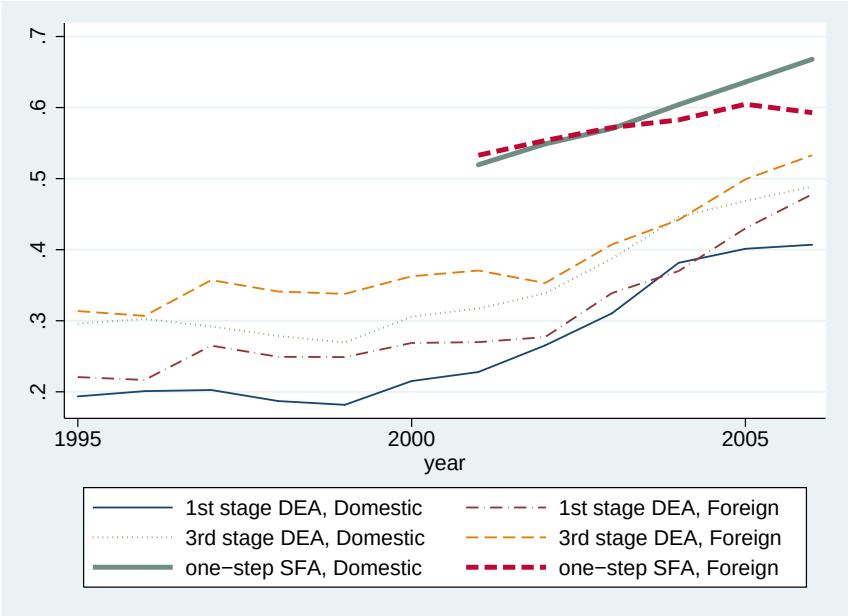
Table 5: Comparisons of Domestic and Foreign Bank Cost Efficiencies

Year	1st stage DEA		3rd stage DEA		one-step SFA	
	CE_{1DEA} domestic	CE_{1DEA} foreign	CE_{3DEA} domestic	CE_{3DEA} foreign	CE_{SFA} domestic	CE_{SFA} foreign
1995	0.194	0.221	0.296	0.314		
1996	0.201	0.217	0.303	0.307		
1997	0.202	0.265	0.292	0.357		
1998	0.187	0.249	0.279	0.341		
1999	0.182	0.248	0.269	0.338		
2000	0.215	0.269	0.306	0.363		
2001	0.228	0.270	0.317	0.371	0.520	0.533
2002	0.265	0.339	0.339	0.353	0.549	0.554
2003	0.310	0.370	0.387	0.407	0.570	0.572
2004	0.381	0.357	0.446	0.442	0.604	0.583
2005	0.401	0.430	0.469	0.499	0.636	0.605
2006	0.407	0.478	0.489	0.533	0.668	0.593

cluding 2006) is not significant[12]. Moreover, on average banks' performance in the sample countries is increasing over the period. This confirms **Hypothesis 2. Domestic banks' managerial performance is expected to increase over time either as a result of competition or knowledge spillovers.** Table 5 also shows the difference in measured managerial efficiency with and without controlling for environmental variables. Without controlling for environmental variables, the efficiency scores are lower and the gap between foreign and domestic banks is wider at the start and end of the sample period (also see Figure 1). But the main patterns are very similar regardless the controlling of environmental effects.

[12]The efficiency scores from the 3-stage DEA are not strictly comparable with that from the one-step SFA as they are obtained from different data samples.

Figure 1: Comparisons of Domestic and Foreign Bank Cost Efficiencies



As can be seen from Figure 1, foreign banks are more managerially efficient than domestic banks for most of the sample period. This provides the necessary condition for knowledge transfer to take place from foreign to domestic banks (**Hypothesis 1**). The overall improvement in the managerial efficiency of the banking sector over the sample period is also necessary for knowledge transfer from foreign to domestic banks (**Hypothesis 2.**). The observation of the narrowing gap since 2000 in the managerial efficiency scores between foreign and domestic banks provides further evidence of the possibility of knowledge transfer.

However the above evidence on banks' managerial efficiency is not sufficient to conclude the presence of knowledge transfer from foreign to domestic banks for the following reasons. Firstly, with the increased foreign bank entry, the banking sector may be getting more competitive and the competitive pressure may force all banks to be more managerially efficient even without the presence of knowledge transfer. Secondly, with increasing competition pressure, knowledge transfer may not necessarily take place between foreign bank and domestic banks. It may take place between domestic banks themselves in the sense that worse performing domestic banks may be learning from better performing domestic banks. For

Table 6: H statistics, F-tests for structural breaks, by sample

95-06 (unbalanced)	Model 1: H_1 95-99 (R-sq)	0.47 (0.82)
	Model 2: H_2 00-02 (R-sq)	0.05 (0.90)
	Model 3: H_3 03-06 (R-sq)	0.33 (0.93)
	H_{null}: $H_1 = H_2$ F-statistic (P Value)	138.44 (0.0000)
	H_{null}: $H_2 = H_3$ F-statistic (P Value)	371.90 (0.0000)
	H_{null}: $Model_1 = Model_2$ F-statistic (P Value)	149.60 (0.0000)
	H_{null}: $Model_2 = Model_3$ F-statistic (P Value)	403.08 (0.0000)
95-06 (balanced)	Model 1: H_1 95-99 (R-sq)	0.89 (0.94)
	Model 2: H_2 00-02 (R-sq)	0.73 (0.89)
	Model 3: H_3 03-06 (R-sq)	0.88 (0.93)
	H_{null}: $H_1 = H_2$ F-statistic (P Value)	14.73 (0.0000)
	H_{null}: $H_2 = H_3$ F-statistic (P Value)	9.08 (0.0000)
	H_{null}: $Model_1 = Model_2$ F-statistic (P Value)	24.79 (0.0000)
	H_{null}: $Model_2 = Model_3$ F-statistic (P Value)	12.76 (0.0000)
98-06 (balanced)	Model 1: H_1 95-99 (R-sq)	0.85 (0.91)
	Model 2: H_2 00-02 (R-sq)	0.68 (0.92)
	Model 3: H_3 03-06 (R-sq)	0.83 (0.90)
	H_{null}: $H_1 = H_2$ F-statistic (P Value)	20.49 (0.0000)
	H_{null}: $H_2 = H_3$ F-statistic (P Value)	19.35 (0.0000)
	H_{null}: $Model_1 = Model_2$ F-statistic (P Value)	24.83 (0.0000)
	H_{null}: $Model_2 = Model_3$ F-statistic (P Value)	23.85 (0.0000)

this reason, I also provide evidence on the evolution of competition over the sample period. Table 6 shows the competition evolution over the period of the banks included in the sample[13]. The H values vary significantly across different samples as the banks included in each sample vary significantly subject to data availability. All the H statistics are significantly different from 0 and 1 at the 5 percent level with high R-squared values. Recognising that the unbalanced dataset may bias the test result since the number of banks is different in each year, balanced datasets are also used to test for the presence of breaks. F-tests are applied to test the stability of both H values and the whole set of coefficients over the sample period. Results in Table 6 indicate a structural break before and after 1999 as we reject the null hypotheses that $H_1 = H_2$ and $Model_1 = Model_2$ with large F-statistics. After 1999 the degree of competition has overall decreased. It can be explained by the banking crises and

[13]The long-run equilibrium test is also conducted for each model with the dependent variable replaced by pretax-profit as a share of total assets. The test results support that each data sample is actually in the long-run equilibrium. When the price of physical capital is not included to take into account the short-run effect of input prices on revenue, the H values are not very different from those when this input price being included.

restructuring in these countries during the period. Most CEECs abd LACs have experienced systemic banking crises with substantial insolvent loans in their banking systems according to Caprio and Klingebiel (2003). After 1999, many banks in these countries were bankrupt, merged, recapitalised or nationalised. This is also consistent with other studies which examined the changes in competition over time in these countries. For instance, Semih Yildirim and Philipotas (2007b) observe a decline in competition for Brazil, Chile, and Venezuela in the late 1990s. In addition, the test results also suggest an increase in competition with respect to the operating banks in the sample after 2002 as we reject the null hypotheses that $H_2 = H_3$ and $Model_2 = Model_3$ with large F-statistics. This might suggest that the banking sectors in the sample countries were becoming more competitive after being liquidated or restructured. These results of structural breaks confirm **Hypothesis 3. Due to the significant concentration of the banking markets during the period as a result of reforms, competition is likely to have structural breaks rather than increasing steadily.**

The comparison between the changes in competition and the changes in efficiency over time reveals further evidence on knowledge transfer from foreign to domestic banks. As shown in Table 6, bank competition has overall decreased from the period of 1995-1999 to the period of 2000-2002. However, Figure 1 shows that the managerial efficiency gap between foreign and domestic banks was widening during the period of 1995-1999 while narrowing during the period of 2000-2002. The two results show that the narrowing gap between foreign and domestic banks in managerial efficiency can not be explained by competitive pressure. Indeed, consistent with evidence related to the banking reforms and restructuring, competition decreased while the estimated managerial efficiency gap was narrowing. These results therefore provide evidence supporting **Hypothesis 4. With the presence of knowledge transfers, even in the period of low competition, domestic banks may still be catching up with foreign banks in terms of managerial efficiency.** After 2002, the managerial efficiency gap remained narrow (almost closed) while both domestic and foreign banks were experiencing increases in managerial efficiency. After 2002, competition has also been increasing suggesting that competition could have contributed to the increase in bank

efficiency after 2002.

Within the special context mentioned earlier, the decrease in competition after 1999 detected in the empirical tests is consistent with significant consolidation in the banking sectors in the two regions during that period. Meanwhile, bank restructuring responding to the crises might have increased overall efficiency level of domestic banks by recapitalisation or merging and acquisitions, which might also explain the closing gap between efficiency in domestic and foreign banks. While I can not entirely exclude the effect on efficiency arising from bank restructuring after 1999, the controlling of environmental effects via foreign bank selection (which to certain extent indicates the restructuring and reforms in the host countries) and GDP growth and other macroeconomic variables (indicating the crises) should tease out at least some of the effect. After 2002, competition and efficiency increase side by side and the gap between foreign and domestic banks remains narrow (almost closed), suggesting competition contributes to increase in efficiency of both foreign and domestic banks thus maintaining a narrow gap between them. It is worth noting that under increasing competitive pressure (possibly after 2002), positive spillovers can also take place between domestic banks themselves. This is partially suggested by the results that domestic banks are overtaking foreign banks at the end of the sample period (See Figure 1).

To further strengthen the findings regarding **Hypothesis 4.**, I associate managerial efficiency of domestic banks with the extent of foreign bank presence (measured by share of foreign banks' assets) in each country over the sample period. Table 7 shows the correlations. The correlations show that the domestic banks's efficiency scores are more positively correlated to the presence of foreign banks than foreign banks themselves. This suggests that the presence of foreign banks contribute to the enhanced managerial performance of domestic banks.

Table 7: Correlation between Bank Efficiency and the Extent of Foreign Bank Presence

	1st Stage DEA Domestic	3rd Stage DEA Domestic	1st stage DEA Foreign	3rd stage DEA Foreign
Share of foreign banks' assets	0.32	0.36	0.31	0.33
P value	0.0000	0.0000	0.0000	0.0000
No. of obs.	171	171	193	193

A bank is defined as foreign owned if it has more than 50% of equity shares foreign owned.

6. Conclusion

This research investigates whether there is managerial knowledge transfer from foreign to domestic banks in 12 Central Eastern European and 7 Latin American countries over the period from 1995 to 2006 by examining their managerial efficiency scores using both SFA and DEA frontier methods. To obtain managerial efficiency scores, external factors have to be properly controlled for so that efficiency is only attributable to management skills and all banks are compared on a level playing field. In particular, advantages of foreign banks which are not attributable to management expertise also are also to be controlled for. The methodology of adapting Fried et al. (2002)'s 3-stage DEA analysis to the cost efficiency framework by Tone (2002) is used to control for such external (environmental) effects. Moreover, taking into account that there might be increasing competitive pressure with the participation of foreign banks forcing improvement in managerial efficiency of domestic banks even in the absence of any knowledge transfer, competition using Panzar-Rosse approach is also measured and potential structural breaks over the sample period are tested. The main findings show the enhanced performance in the banking sectors combined with the narrowing managerial efficiency gap after 2000 and before 2002 between foreign and domestic banks in the absence of increasing competition. Moreover the improving management performance of domestic banks are strongly associated with the presence of foreign banks. These strongly suggest the possibility of knowledge transfer from foreign to domestic banks. But after 2002, both efficiency and competition increased, suggesting competitive pressure may have contributed to maintaining the narrow gap.

This study therefore shows evidence of positive spillovers either in terms of positive competition effect or knowledge transfers. While I have not been able to provide direct evidence

of knowledge transfers, the empirical evidence is highly suggestive that knowledge transfer somehow takes place to enable domestic banks to catch up with foreign banks, even in the period of higher concentration (associated with lower competition). Indeed, I argue that knowledge transfer serves as a plausible explanation of the survival of domestic banks in the face of fierce competition coming from the strong waves of foreign bank entries. The limitation of this study given the data availability therefore calls for future evidence on knowledge spillovers related to foreign investment in banking sector, especially related to the possible mechanisms through which knowledge spillovers/transfers take place, and the asymmetric impacts (such as greenfield investment vs. joint ventures). The employment of survey evidence may also enrich the information in these respects. For instance, based on the survey data from the Czech Republic and Latvia enterprises, Javorcik (2008) shows the multiple channels through which spillovers can take place. Such information is potentially helpful to shift the focus from generalising about whether or not FDI leads to productivity spillovers to determining under what conditions it can do so, not only in real sectors but also in banking sectors.

Appendix A. The Cost Efficiency Measurement Framework by Tone (2002)

DEA involves the use of linear programming to construct a non-parametric piece-wise linear frontier over the data. Efficiency measures are calculated relative to this frontier. Charnes et al. (1978) first proposed a basic model (CCR) that had an input orientation and assumed constant returns to scale. Subsequent models were proposed afterwards considering alternative sets of assumptions, including variable returns to scale (BCC models), additive models (slack based measurement), allocation models (cost and profit efficiencies) etc. (see Cooper et al., 2007; Battese et al., 2005, for various models and applications.) In this research the allocation model is used to estimate the cost efficiency. The concepts of dealing with "allocative efficiency" [14] can be traced back to Farrell (1957) and Debreu (1951) who originated the ideas underlying DEA. Fare et al. (1985) developed linear programming formulations of these concepts. However, this Farrell-Debreu cost efficiency measurement conceals a shortcoming as indicated by Tone (2002) (also mentioned in Cooper et al. (2007) Chapter 8.3). Suppose that decision making units (DMUs) A and B have the same amount of inputs and outputs, i.e., $x_A = x_B$ and $y_A = y_B$. Assume further that the

[14] Allocative efficiency measures the extent to which a bank is able to use inputs or outputs in optimal proportions given prices and production technology. Technical efficiency is a measure of a bank's distance from the frontier, minimising inputs given outputs or vice versa. Economic efficiency is the sum of technical and allocative efficiency.

unit cost of DMU A is twice that of DMU B for each input, i.e., $w_A = 2w_B$. Since DMUs A and B have the same inputs and outputs, they have the same technical efficiency. The Farrell measure of cost efficiency for DMU A (or DMU B) is also the same since they have cost efficiency: $\gamma_A^* = w_A x_A^* / w_A x_A = 2w_A x_A^* / 2w_A x_A = \gamma_B^*$ where x_A^* is the cost minimising vector of input quantities given the input prices and output levels. They also have the same allocative efficiency since they have the same technical efficiency. However, this can be problematic since DMU A and B have the same cost and allocative efficiencies but the cost of DMU B is half that of DMU A.
Tone (2002) defines a cost-based production possibility set P_c as:

$$P_c = \{(\overline{x}, y) | \overline{x} \geq \overline{X}\lambda, y \leq Y\lambda, I1^{'}\lambda = 1, \lambda \geq 0\} \tag{A.1}$$

where $\overline{X} = (\overline{x}_1, ..., \overline{x}_n)$ are the n inputs with the j-th input of the m DMUs defined as $\overline{x}_j = (w_{1j}x_{1j}, ..., w_{mj}x_{mj})^T$.
Here the matrices $\overline{X}$ and W are assumed to be non-negative. The elements of $\overline{x}_{ij} = (w_{ij}x_{ij})$ for the j-th input of DMU i are denominated in homogeneous units, e.g., dollars, so that adding up the elements of $\overline{x}_{ij}$ has a well defined meaning.
In the traditional model, keeping the unit cost of DMU_0 fixed at w_0, the optimal input mix x^* that produces the output y_0 is found. In Tone (2002)'s model, the optimal input mix $\overline{x}^*$ is searched for to produce y_0 (or more). The optimal mix is described as:

$$\overline{x}_i^* = \sum_{j=1}^{n} w_{ij}x_{ij}\lambda_j^* (i = 1, ..., m) \tag{A.2}$$

Hence, it is assumed that for a given output y_0, the optimal input mix can be found (and realised) independently of the current unit cost w_0 of DMU_0. Using the traditional "Farrell-Debreu" model one can fail to recognise the existence of other cheaper input mixes, as the procedure searches for the optimal input mix given that the unit cost is fixed. Therefore the traditional model is only valid when unit cost is common for all DMUs. In this research, since the unit cost varies from bank to bank Tone (2002)'s cost efficiency measurement scheme is used.
In this study, adopting the intermediation approach, the output variables are total net loans and total other earning assets, and the input variables are interest expenses, personnel expenses and other operating expenses. Some studies use three output measurements, net loan, total other earning assets and off-balance-sheet items. However, due to the data constraints only net loan and total other earning assets are employed as output measurements. Including off-balance sheet items would result in a substantial loss of observations.

Appendix B. Fried et al. (2002)'s 3-stage DEA analysis- Incorporating Environmental Effects and Statistical Noise into DEA

Firstly cost efficiency is estimated using the allocative DEA model (input-oriented) mentioned above. Then the difference between the observed total cost and minimum (target) total cost for the DMU i at time t is calculated (cs_{it}). In the second stage, SFA is applied to regress the cost difference on a set of environmental variables in a single equation as follows:

$$cs_{it} = f(z_{it}; \beta) + v_{it} + u_{it}, i = 1...I, t = 1, ...T \tag{B.1}$$

where the $f(z_{it};\beta)$ is a deterministic feasible cost slack frontier, with the environmental factors z_{it}, parameter vectors β to be estimated and a composite error structure $v_{it}+u_{it}$ for the i-th DMU at time t. Consistent with a stochastic cost frontier formulation, it is assumed that the $v_{it} \sim N(0,\sigma_v^2)$ reflects statistical noise and that the $u_{it} \geq 0$ reflects managerial inefficiency. Assuming that $u_{it} \sim N^+(\mu,\sigma_u^2)$, and that the v_{it} and the u_{it} are distributed independently of each other, and of the z_{it}, the regression is estimated by maximum likelihood techniques. Since the data are cross section units over time, the random effect model proposed by Battese and Coelli (1995) is used. In addition, the cost efficiency term in the above 2nd stage SFA model is also allowed to vary over time.

The impact of the environment on Stage 1 cost difference (cs_i) is captured by the deterministic feasible cost-difference frontiers $f(z_{it};\beta)$. The stochastic feasible frontier is $f(z_{it};\beta)+v_{it}$. Since $\mu \geq 0$, the frontier represents the minimum cost difference that can be achieved in a noisy environment characterised by variables (z_{it},v_{it}) and parameters (β,σ_v^2). Any cost differences in excess of the frontier (optimal cost difference given the environment and noise) are regarded as managerial inefficiency.

In the third stage, the estimated parameters are used to adjust each input so that a DEA analysis can be repeated using the inputs adjusted for the environmental effects. In other words, the objective of the proposed adjustment is to level the playing field before repeating the DEA analysis. The essence of the proposed adjustment exploits the fact that producers operating in relatively unfavorable environments, and producers experiencing relatively unfavourable statistical noise, are disadvantaged in the Stage 1 DEA performance evaluation that does not take these factors into account. To level the playing field, the inputs are adjusted upwards in amounts determined by the extent to which the producers have been advantaged by their relatively favorable operating environments and/or statistical noise. Therefore each input is adjusted in the following way:

$$\overline{x}_{nit}^{A} = \overline{x}_{nit} + [max\{z_{it}\hat{\beta}\} - z_{it}\hat{\beta}] + [max\{\hat{v}_{it}\} - \hat{v}_{it}], (n = 1,...N, i = 1,...I, t = 1,...T) \qquad \text{(B.2)}$$

where $\overline{x}_{nit}^{A}$ is the adjusted n-th input (In Tone (2002)'s cost efficiency model, it is the input cost rather than input quantity.) of the i-th firm at time t. $\overline{x}_{nit}$ is the observed input.

The first adjustment term on the right hand side of the above equation puts all producers into a common operating environment, the least favorable environment observed in the sample. The second adjustment term puts all producers into a common state of noise, the least favourable situation encountered in the sample. Thus producers with relatively favourable operating environments and/or noise have their inputs adjusted upward by a relatively large amount while producers with relatively unfavourable environments and/or noise have their inputs adjusted upward by a relatively small amount. Cooper et al. (2007) provide a slightly different way of adjusting inputs so that inputs are adjusted to an ideal level when there were absences of environmental influences and random shocks. Both procedures are applied and results are very similar. The reported results of the 3rd stage DEA efficiency scores are from using the Cooper et al. (2007) adjustment procedure. While the SFA regression is applied, total cost difference (cs_{it}) is normalised by total cost. The above input adjustment equations are therefore modified accordingly while the inputs are adjusted. All environmental variables are in natural logs since the unit measurements are not the same across variables. In addition, a time trend is included in the 2nd stage SFA equation to control for technology changes over time.

Appendix C. Testing structural breaks in banking competition

For the Revenue test based on the PR approach to measure competition, the following empirical model is used:

$$\ln(REV_{it}) = h_1 \ln(PLabour_{it}) + h_2 \ln(PFunding_{it}) + h_3 \ln(PK_{it}) + \beta Control \tag{C.1}$$

for $t = 1, ..., T$ where T is the number of periods observed, and $i = 1, ..., I$, where I is the total number of banks. The dependent variable (REV) is the ratio of total interest revenue to total assets. The model assumes that banks use three input factors namely, deposits, labor, and physical capital. The variables $PFunding$, $PLabour$ and PK are the unit prices of these inputs or proxies: the ratio of interest expenses to deposits and other short-term funding, the ratio of personnel expenses to total assets[15], and the ratio of other operating expenses to fixed assets. A number of bank specific control variables are included to account for size, risk, and deposit mix differences. They are similar to those used in previous studies. These factors are total assets (TA), financial capital ($EQUITY/TA$), net loans ($LOAN/TA$), and other income ($OTHERINCOME/TA$). The intermediation approach is adopted here.
The above revenue equation is then estimated using fixed effects. The H statistic is equal to the sum of the elasticity of the revenue with respect to the three input prices: $H = h1 + h2 + h3$. It is negative for a neoclassical monopolist, collusive oligopolist, or conjectural-variation short-run oligopolist; equal to unity for a competitive price-taking firm in long-run equilibrium; and between 0 and 1 for a monopolistic competitor.

[15]As data on the number of employees are missing for many banks in the selected countries, following previous banking studies using BankScope data (Semih Yildirim and Philippatos, 2002; Altunbas et al., 2001; Bikker and Haaf, 2002; Weill, 2004), the ratio of personnel expenses over total assets is used as a proxy for unit cost of labour.

Appendix D. Main variables with summary statistics and data sources

Table D.8: Summary Statistics 1-inputs and outputs for DEA and SFA

Country	y1 Mil. U.S.$	y2 Mil. U.S.$	x1 Mil. U.S.$	x2 Mil U.S.$	x3 Mil U.S.$	funding Mil U.S.$	fa Mil U.S.$	ta Mil U.S.$	eq/ta
Argentina	4.33	3.95	0.57	0.28	0.30	7.64	0.37	9.48	0.25
	(11.08)	(7.30)	(1.42)	(0.60)	(0.58)	(15.7)	(0.70)	(19.5)	(0.23)
Brazil	12.91	19.78	3.20	1.02	.0.27	24.5	0.54	38.6	0.19
	(36.23)	(54.07)	(8.22)	(3.14)	(0.81)	(70.6)	(1.59)	(107.2)	(0.15)
Bulgaria	2.58	1.57	0.088	0.056	0.040	3.62	0.13	4.87	0.13
	(2.91)	(2.03)	(0.099)	(0.045)	(0.067)	(3.89)	(0.16)	(5.21)	(0.09)
Colombia	8.43	4.76	0.605	0.35	0.55	12.0	0.58	15.1	0.12
	(10.91)	(51.51)	(0.64)	(0.39)	(0.54)	(13.4)	(0.69)	(17.9)	(0.09)
Croatia	7.82	4.92	0.32	0.17	0.086	10.9	0.35	14.5	0.13
	(13.3)	(8.71)	(0.52)	(0.31)	(0.16)	(18.1)	(0.66)	(24.5)	(0.07)
Czech Rep.	22.86	33.83	1.11	0.63	0.37	48.8	1.05	61.6	0.09
	(33.6)	(48.9)	(1.50)	(0.95)	(0.63)	(71.0)	(1.76)	(24.5)	(0.11)
Estonia	20.6	4.6	0.49	0.31	0.27	22.2	3.85	28.3	0.10
	(35.1)	(7.33)	(0.77)	(0.46)	(0.40)	(37.4)	(0.47)	(47.0)	(0.05)
Hungary	23.9	9.29	1.29	0.56	0.65	29.0	0.87	37.1	0.12
	(29.3)	(12.8)	(1.55)	(0.79)	(1.24)	(35.3)	(1.19)	(47.2)	(0.07)
Latvia	4.72	2.41	0.13	0.085	0.044	6.17	0.14	7.73	0.09
	(8.09)	(2.79)	(0.20)	(0.11)	(0.059)	(7.66)	(0.18)	(10.6)	(0.08)
Lithuania	7.81	2.54	0.17	0.14	0.13	8.64	0.34	11.9	0.10
	(12.1)	(3.20)	(0.23)	(0.15)	(0.12)	(10.7)	(0.35)	(16.4)	(0.06)
Mexico	32.6	18.3	4.73	1.05	0.082	50.6	2.09	62.5	0.19
	(62.4)	(36.2)	(9.38)	(2.1)	(0.17)	(99.1)	(4.91)	(119.9)	(0.16)
Peru	8.22	4.25	0.39	0.32	0.30	12.4	0.54	14.9	0.13
	(11.5)	(6.59)	(0.54)	(0.42)	(0.57)	(18.3)	(0.67)	(21.6)	(0.09)
Poland	11.6	11.2	0.64	0.38	0.27	19.7	0.37	24.7	0.12
	(20.8)	(20.7)	(0.92)	(0.70)	(0.34)	(34.2)	(0.78)	(43.3)	(0.12)
Russian Fed.	1.29	0.77	0.079	0.047	0.059	1.67	0.073	2.46	0.20
	(4.04)	(2.97)	(0.23)	(0.13)	(0.53)	(4.97)	(0.41)	(7.68)	(0.15)
Slovakia	7.25	10.8	0.45	0.23	0.28	16.8	0.52	19.7	0.08
	(7.88)	(13.8)	(0.52)	(0.26)	(0.32)	(18.9)	(0.57)	(22.1)	(0.03)
Slovenia	11.1	7.59	0.58	.28	0.20	14.3	0.46	20.2	0.09
	(15.2)	(9.82)	(0.74)	(0.42)	(0.26)	(17.6)	(0.71)	(27.3)	(0.04)
Ukraine	1.56	0.46	0.13	0.079	0.091	2.10	0.19	2.50	0.14
	(2.29)	(0.61)	(0.18)	(0.13)	(0.15)	(2.93)	(0.34)	(3.34)	(0.07)
Uruguay	2.48	0.84	2.73	0.078	0.20	3.83	0.060	4.18	0.17
	(4.44)	(1.56)	(4.57)	(0.16)	(0.53)	(5.91)	(0.17)	(6.51)	(0.27)

Intermediation approach is adopted for both SFA and DEA analysis such that:
output y1, y2 are deflated loans and other earning assets respectively;
input x1, x2, x3 are deflated interest expenses, personnel expenses and other operating expenses
funding, fa, ta are deflated deposit+other short-term fundings,fixed assets and total assets;
input prices w1, w2, w3 in the SFA analysis are calculated as x1/funding, x2/ta, x3/fa;
eq/ta is the ratio of total equity over total asset;
source: BankScope database

Table D.9: Summary Statistics 2-environmental variables for the 2nd stage SFA, and the analysis of foreign bank selection

Country	GDP Growth (%)	GDP per cap (u.s.$)	Phone Users per 1000	Internet Users per 1000	Population Density per km^2	Real Interest (%)	StockMkt Capitalisation to GDP
Argentina	-0.43	7305.5	421.2	98.1	13.6	13.3	0.54
	(3.73)	(264.1)	(79.2)	(32.0)	(0.19)	(4.99)	(0.13)
Brazil	2.13	3471.9	405.3	76.7	21.1	49.3	0.36
	(0.28)	(40.8)	(88.9)	(39.2)	(0.46)	(5.53)	(0.02)
Bulgaria	4.86	1810.6	776.6	118.3	71.4	4.90	0.05
	(0.36)	(123.3)	(157.6)	(44.4)	(0.51)	(0.55)	(0.007)
Columbia	2.29	2026.1	305.6	48.0	39.05	9.91	0.15
	(1.58)	(40.06)	(81.7)	(23.53)	(0.97)	(2.00)	(0.004)
Croatia	3.95	4531.5	838.4	169.7	79.8	7.62	0.16
	(1.01)	(317.7)	(175.22)	(75.8)	(0.399)	(0.335)	(0.011)
Czech Rep.	3.00	5846.8	1101.2	187.4	132.4	3.92	0.198
	(0.93)	(298.48)	(239.45)	(60.8)	(0.28)	(0.32)	(0.01)
Estonia	6.63	4591.1	979.8	350.6	32.09	2.63	0.29
	(1.22)	(527.03)	(195.1)	(95.2)	(0.20)	(0.83)	(0.04)
Hungary	4.36	5031.9	977.2	179.6	113.3	4.16	0.23
	(0.23)	(335.9)	(200.2)	(65.2)	(0.41)	(0.97)	(0.02)
Latvia	7.59	3986.8	743.7	209.2	37.6	3.85	0.072
	(0.868)	(489.03)	(178.7)	(132.6)	(0.43)	(3.31)	(0.011)
Lithuania	6.59	3893.1	835.9	164.3	55.3	7.50	0.126
	(1.81)	(449.7)	(265.3)	(85.2)	(0.450)	(2.11)	(0.012)
Mexico	2.93	5816.6	311.3	65.1	51.6	4.81	0.249
	(0.73)	(67.7)	(68.8)	(24.7)	(0.59)	(1.95)	(0.020)
Peru	3.32	2119.3	161.2	83.7	20.9	15.9	0.23
	(1.52)	(73.4)	(41.4)	(33.3)	(0.50)	(4.64)	(0.002)
Poland	3.29	4710.5	712.8	184.1	125.4	8.41	0.156
	(0.51)	(229.3)	(176.97)	(63.12)	(0.557)	(2.76)	(0.020)
Russian Fed.	6.54	2170.3	660.7	96.7	8.81	-4.11	0.31
	(0.61)	(161.9)	(177.9)	(31.7)	(0.04)	(1.30)	(0.03)
Slovakia	4.19	4138.0	798.9	224.4	111.9	6.05	0.054
	(0.965)	(273.7)	(172.0)	(110.4)	(0.05)	(2.11)	(0.003)
Slovenia	3.61	1029.4	1148.4	341.7	98.9	5.97	0.15
	(0.29)	(524.2)	(167.5)	(108.3)	(0.18)	(0.842)	(0.035)
Ukraine	5.33	677.4	256.7	13.6	84.4	19.3	0.05
	(1.71)	(39.40)	(27.52)	(6.88)	(0.67)	(3.20)	(0.003)
Uruguay	-1.03	5806.3	430.5	125.7	19.3	43.9	0.012
	(3.01)	(223.4)	(37.6)	(22.7)	(0.21)	(8.05)	(0.004)

Source: World Bank Development Indicators Dataset

Table D.10: Summary Statistics 3-revenue and inputs variables for H statistics (95-06)

Country	Interest Revenue to Total Assets	PFunding	PLabour	PCapial	Other Operating Income to Total Assets	Net loan to Total Assets	Equity to Total Assets
Argentina	0.087	0.063	0.038	0.873	0.014	0.449	0.116
	(0.0246)	(0.0200)	(0.0206)	(0.3930)	(0.0206)	(0.1564)	(0.0682)
Brazil	0.245	0.285	0.034	1.054	0.022	0.317	0.215
	(0.1286)	(0.2873)	(0.0253)	(4.6088)	(0.0389)	(0.2079)	(0.1956)
Chile	0.089	0.783	0.018	1.752	0.001	0.536	0.283
	(0.0301)	(0.0282)	(0.0064)	(2.1805)	(0.0021)	(0.2563)	(0.2553)
Colombia	0.147	0.132	0.042	1.422	0.012	0.588	0.139
	(0.0536)	(0.0859)	(0.0150)	(0.6350)	(0.0147)	(0.1261)	(0.0742)
Croatia	0.095	0.179	0.017	0.622	0.013	0.467	0.116
	(0.1028)	(0.3067)	(0.0066)	(1.3566)	(0.0329)	(0.1065)	(0.0455)
Czech Rep.	0.073	0.064	0.009	0.376	0.004	0.383	0.09
	(0.0328)	(0.0325)	(0.0037)	(0.3711)	(0.0045)	(0.1538)	(0.1072)
Estonia	0.065	0.034	0.017	0.561	0.008	0.643	0.106
	(0.0132)	(0.0076)	(0.0039)	(0.2298)	(0.012)	(0.1212)	(0.0224)
Hungary	0.096	0.082	0.016	1.168	0.009	0.512	0.112
	(0.0298)	(0.0310)	(0.0068)	(1.0747)	(0.0076)	(0.1609)	(0.0680)
Latvia	0.059	0.032	0.017	0.220	0.010	0.214	0.113
	(0.0265)	(0.0144)	(0.0103)	(0.1393)	(0.0120)	(0.1328)	(0.0537)
Lithuania	0.087	0.051	0.033	0.358	0.005	0.642	0.062
	(0.0429)	(0.0239)	(0.0072)	(0.0386)	(0.0031)	(0.1149)	(0.0152)
Macedonia	0.129	0.107	0.023	0.514	0.014	0.512	0.213
(FYROM)	(0.0671)	(0.0749)	(0.0022)	(0.1679)	(0.0122)	(0.1908)	(0.1091)
Moldova	0.115	0.075	0.031	0.364	0.003	0.477	0.143
	(0.0254)	(0.0213)	(0.0043)	(0.0753)	(0.0011)	(0.0469)	(0.2111)
Poland	0.126	0.104	0.028	1.218	0.006	0.450	0.143
	(0.0453)	(0.0413)	(0.0071)	(0.4666)	(0.0068)	(0.1454)	(0.0338)
Russian Fed.	0.096	0.056	0.020	0.454	0.008	0.231	0.256
	(0.0860)	(0.0285)	(0.0117)	(0.2109)	(0.0065)	(0.1575)	(0.1882)
Serbia	0.088	0.076	0.011	0.475	0.0062	0.454	0.07
	(0.0259)	(0.0223)	(0.0024)	(0.2471)	(0.0044)	(0.1805)	(0.0807)
Slovakia	0.088	0.076	0.011	0.475	0.006	0.453	0.069
	(0.0259)	(0.0223)	(0.0024)	(0.2471)	(0.0044)	(0.1804)	(0.0807)
Slovenia	0.086	0.068	0.016	1.049	0.002	0.525	0.107
	(0.0274)	(0.0295)	(0.0058)	(1.3299)	(0.0064)	(0.1027)	(0.0445)
Ukraine	0.193	0.188	0.029	1.531	0.016	0.537	0.092
	(0.0956)	(0.1451)	(0.0161)	(0.7632)	(0.0129)	(0.1493)	(0.0524)
Uruguay	0.490	0.411	0.023	0.701	0.017	0.818	0.083
	(0.3544)	(0.3013)	(0.0068)	(0.4752)	(0.0091)	(0.1042)	(0.0375)

Source: BankScope database

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