Banking Efficiency in Visegrad Countries Before Joining the European Union[‡]

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Abstract

This paper is the first attempt to estimate commercial banks' efficiency in the Visegrad region before joining the EU and also to consider differences in efficiency across the countries. Employing Data Envelopment Analysis, we analyze which of the banking sectors is the most efficient and whether there has been an improvement in banking intermediation efficiency since 1999. Incorporating censored Tobit regression analysis we try to detect whether the cross-country differences should be explained by country specific environmental factors or internal variables such as profitability, size or foreign ownership. Overall, the results suggest that since 1999 there has been, with the exception of Hungary, no improvement in efficiency, and its actual level reaches preferably moderate levels. Efficiency differences among Visegrad banking industries seem to be in the first place determined by country specific factors.

Keywords banking efficiency; Visegrad countries; Data Envelopment Analysis; Tobit model; banking intermediation

JEL classification C14, C34, G21

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1. INTRODUCTION

Since the collapse of communist regimes all the Central and Eastern European Countries (CEEC) have made major strides in establishing functioning market economies and prospects are good that a fairly large group of ten countries will join the EU in May 2004. The task of transforming the financial sector in the CEEC into a stable and efficient system, able to support economic growth, has been one of the most important issues in transition to market-driven economies. The strategic role of financial sector is backed up by a strong consensus in the recent relevant literature that well-functioning financial intermediaries have a significant impact on economic growth[1]. However for example Berglof and Bolton (2002) point out in the case of CEEC that there has so far been little correlation between economic growth and financial sector development and that one cannot attribute the relatively better economic performance of some CEEC to a more developed financial system. But the lack of correlation, let alone causality, between growth and finance in the first decade of transition does not really come unexpected and can be explained by a variety of reasons.

Beyond the crucial significance of financial system still remains the question whether financial sources should come from banks or from capital markets, in other words, whether the bank-based system (B-system) or market-based (M-system) should be established. The theoretical background as well as assessment of pros and cons of both approaches and their applications on CEEC is provided by Polouček *et al.* (2003). Despite initial political and economic preference for M-systems over B-systems, banks have turned out to dominate CEEC financial systems. For instance Wagner and Iakova (2001) report that bank assets account for 85 to 95 percent of overall financial assets in the larger CEEC and banks can be consequently characterized as a core or center point of the financial systems.

Modern banking system should practice three elementary functions. They are payments settlement and record keeping, efficient intermediation between savers and investors, and the provision of the appropriate system wide liquidity using indirect monetary policy instruments. Efficiency of the whole banking sector and fulfillment of all functions are, according to Bonin and Wachtel (2002), contingent on two essential assumptions: (i) financially strong and independent banks with a governance structure that promotes efficient intermediation, (ii) a regulatory system for supervising effectively existing banks and licensing prudently new banks. The initial conditions in transition economies made constructing both pillars a daunting task. The newly created commercial banks were burdened with concentrated loan portfolios, the quality of which was unknown but dubious in a market economy. The transition generated macroeconomic turbulence and made any new bank lending extremely risky. Initially, the banks were wholly state-owned so that the appropriate governance structure was left to be determined in the bank privatization process. The nascent regulatory system was based on new legislation modeled on well developed international standards but insufficient resources, both infrastructure and human capital, impeded its ability to perform tasks effectively.

Surprisingly, there is only few papers studying the ability of banks in the CEEC to provide financial intermediation (e.g. Riess *et al.*, 2002) and they analyze the industry as a whole using aggregated macro data. Therefore, this paper investigates how efficient is the second function of banking sector, i.e. transformation of deposits into investment, in the group

[1] For a critical survey and evaluation of the literature on finance and growth, see Wachtel (2001).

of Visegrad countries (V4).[2] The V4 banking markets are examined between 1999 and 2002 using the non-parametric Data Envelopment Analysis approach (DEA). The aim is to investigate whether there has been an increase in efficiency following the process of convergence with the EU. We also evaluate the determinants of banking efficiency in V4 by using the Tobit regression model approach in order to analyze the influence of various country-specific and environmental factors on bank efficiency.

The paper proceeds as follows. The second section gives a short history of restructuring process in V4 banking sectors. Section 3 discusses methodology and its strengths and provides a review of the recent literature evaluating banking efficiency by DEA. Section 4 describes the data set and deals with the variable selection. Section 5 presents the findings and discussion and the final section is the conclusions.

2. RESTRUCTURING OF BANKING SECTORS IN V4 COUNTRIES

In creating market-driven banking sectors, all V4 countries encountered similar problems, notably a substantial amount of bad loans inherited from the communist past and the accumulation of new non-performing loans in the early years of transition. The latter was due to a combination of factors, in particular an inevitable lack of expertise in commercial banking, continued lending of incumbent banks to enterprises from the communist past with a doubtful future in an open economy, imprudent or fraudulent lending by a rapidly growing number of new banks, and, last but not least, weak banking sector regulation and supervision.

The particular term 'restructuring of banking sector' can be perceived from two basic points of view. The broader definition covers radical and significant changes which affect all banks in the sector and consequently influence the national economy. The changes in ownership structure, implementation of new forms of banking business and new modes of delivering banking services, concentration or changes of the banks' role in the economy belong to the main aspects. The narrower definition of banking sector's restructuring is considered as specific changes of one individual bank or group of banks with similar characteristics. They are mainly tied to the restructuring of credit portfolios and covering the losses from non-performing loans by provisions and reserves. Different approaches have been followed through the years and among countries in terms of restructuring's timing and selection of tools and measures used.[3] However the key elements of restructuring schemes in all V4 countries can be broadly summarized as follows: privatization of large state-owned banks, harmonization of banking legislation with EU standards, improvement of bank management and banking supervision.

Despite such differences, all V4 countries have made over more than ten years of transformation major strides in setting up banking sectors that are guided by market forces. However, V4 banks continue to operate considerably below their potential mainly in provision of funds to the domestic economy. They provide less finance than they could and their profitability does not usually reach levels that ensure the soundness of banking system. In next four sections we present country experiences with the banking sector restructuring.

[2] This group includes the Czech Republic, Hungary, Poland and Slovakia and is called according to the Hungarian town of Visegrad, where the agreement of cooperation were signed by presidents of former Czechoslovakia, Poland and Hungary on 15 February 1991.

[3] Mainly in attitude towards foreign banks, restructuring and recapitalization, as well as management of non-performing loans problems.

2.1 Restructuring in the Czech Republic

In the former Czechoslovakia two-tier banking system started to work in January, 1990.[4] The following period 1990–93 was distinct by opening the banking market and the establishment of many new small banks supplied with domestic capital. The quick growth of banking institutions reflected the fact that the banking sector and banking regulation in Czechoslovakia emerged at the same time, and thus regulation and supervision developed through learning-by-doing process.[5] Establishing of new banks was also pulled by demand factors because of the gap between supply and demand of banking products.

Following the first period of optimism and large credit expansion, the Czech banking system experienced a period of more restrictive license policy of the Czech National Bank, insufficient capital adequacy, non-transparent ownership structure, related lending, asset stripping, huge bad loan problems and banks failures. As a result, domestic banks suffered losses and large state banks had to be bailed out, while small medium-sized domestic banks had to be paid special attention in restructuring and stabilization programs. At the same time, banks under foreign control behaved prudently and were profitable (Hájková *et al.,* 2002).

< Table 1 here >

As it is evident from Table 1, 1995 was the year when the Czech banking sector consisted of the most operating banks. Since then, the total number of 55 has been decreasing because of revocations of poorly performing banks licenses' and the process of mergers and acquisitions. The Czech Republic witnessed two bank failures in 2003 and the actual number of active banks is 36. The group of small banks was affected by the most dramatic development. Stavárek (2002) points out that small banks lacked a more substantial base of primary deposits of its own and were disproportionately engaged in highly risky trades. Small banks became dependent on central bank refinancing and later on the interbank deposit market. As interest rates on this market were high at the start, these banks concentrated in their assets a high proportion of credits and other claims with a presupposed above average profitability, which were, however, burdened by a substantial degree of risk.

Not only small banks but also a group of three large state-owned banks - ČS, IPB, and KB - were most violently hit by the problem of bad loans. At the same time, cost management was very poor and labor productivity low. The weak competition in banking that sustained in the second half of 1990s allowed these banks to maintain large interest margins and did not force them to reduce costs. Provision and reserve requirements that followed the worsening of banks' balance sheets led to huge losses that undermined their capital.

The indicator that probably reveals the extent of the problems in the Czech banking sector most clearly is the ration of classified loans to total bank credit. Table 1 reports that this

[4] In January 1990, the State Bank of Czechoslovakia transferred its commercial banking activities to three newly established banks: Komerční banka (KB), Všeobecná úverová banka (VÚB) and Investiční banka (IPB). Together with Česká spořitelna (ČS) and Slovenská sporiteľňa (SS) (in operation since 1969), these banks dominated the newly developing banking markets. The two other incumbents on the market were Československá obchodní banka (ČSOB) and Živnostenská banka (ŽB), which, however, specialized in international trade financing and large private clients.

[5] Conditions for obtaining banking licenses in the beginning of 1990s were quite soft, requiring a minimum subscribed capital of only CSK 50 million. Later on, the low requirement was gradually increased on CZK 500 million. (CSK stands for Czechoslovak koruna and CZK means Czech koruna).

ratio reached 32 percent in 1999.[6] This, along with a desire to finish bank privatization quickly, was why the government engaged in extensive clean-ups of the banks' loan portfolios. The full extend of the bad loans problem was not recognized for several years. So far, the public costs of the banking sector transformation have been estimated at over CZK 250 billion (14 percent of yearly GDP) at least, but some estimates indicate that the final cost of bank bailouts in the Czech Republic may approach 30 percent of GDP as compared to just over 10 percent for Hungary.[7]

The issue of completing the privatization of the state-controlled banks has been discussed several times by consecutive Czech governments and has been postponed from year to year. As a result, privatization was divided into two independent stages that took place at absolutely different time and the first one had negatively affected results of the second one. Three of the four large commercial banks participated in voucher privatization in which a significant portion of their shares was transferred to individual investors and investment funds in exchange for privatization vouchers.[8] These banks participated on both sides of voucher privatization as they also sponsored the largest investment funds. As a result, Czech banks took ownership stakes in their voucher privatized clients, some of which continued to be loss making, while the state retained a controlling ownership stake in the large banks. Consequently, voucher privatization in the Czech Republic strengthened the relationship between banks and clients and left bank governance held hostage to the legacies of the past.

The second round of privatization occurred from 1998 to 2001 with the sale to foreigners of majority equity interests in four large Czech banks: ČSOB, ČS, KB and IPB. Subsequent to IPB's privatization in 1998 to Nomura Securities, the bank became insolvent, was placed under state receivership, and finally merged with ČSOB in 2000. The state's almost 66 percent stake in ČSOB, the fourth largest bank in the Czech Republic, was sold off in June 1999. ČSOB's sale at a good price to the Belgian Kredietbank (KBC) is an example of a successful privatization resulting in the entry of a reliable and strong investor into the Czech banking sector. In case of ČS, the second largest bank, the government called for preliminary offers from potential investors in May 1999. In September it started exclusive sale talks with Austrian Erste Bank and in March 2000, it signed a contract with that institution about the sale of its 52 percent stake for CZK 19 billion. KB was effectively renationalized when capital injections in 2000 resulted again in majority state ownership. In June 2001, the Czech government sold its interest in KB to Société Générale so that all of the four major Czech banks have now been privatized and have majority foreign owners.

For a long time a characteristic feature of the Czech banking legislation was that appropriate changes in banking laws typically followed problems that had emerged. The supervisory department was established at the former State Bank of Czechoslovakia in 1991, with only eight employees and inadequate legal framework for its operation.[9] The supervision of banks started to become more effective only during 1993 and became fully developed between 1997 and 1998. Since 1998, the major aim has been to stabilize the banking system and harmonize the regulatory framework with EU and international best practices.

[6] The problem was most serious in large banks (with more than 40 percent of their loans being classified at the end of 1999) and small Czech-owned banks (more than 50 % of their loans classified).
[7] More details about banking restructuring's public costs can be found for instance in Polouček *et al.* (2003).
[8] Using voucher method, 37 percent of Česká spořitelna's shares, 53 percent of Komerční banka's shares and 52 percent of Investiční a poštovní banka's shares were sold in 1992.
[9] At that time, the regulation of banks was primarily the responsibility of the federal Ministry of Finance – unlike at present.

2.2 Restructuring in Hungary

Hungary was the first CEEC to embark upon a reform of its banking system. In contrast to many other CEEC, Hungary already had a two-tired banking system when the Berlin Wall came down. The first step was made in 1987 when both central banking and commercial banking functions of National Bank of Hungary were separated and, instead of a monobank system, a two-tired banking system was created with the establishment of three state-owned commercial banks.[10]

< Table 2 here >

Table 2 illustrates that the total number of operating banks has been stable in the Hungarian banking sector. It has been fluctuating around the level of 40 and in 2002, the Hungarian banking sector comprised 41 credit institutions and around 200 small savings and credit cooperatives. Foreign direct investment became a salient feature of the Hungarian banking sector early in the transition process. As a result, at end 2002, foreign shareholders held the majority of shares in 31 credit institutions and foreign-owned or controlled banks accounted for more than 90 percent of banking sector assets. Concentration in the Hungarian banking system is, in contrary to e.g. the Czech sector, moderate and has declined over time.[11]

In 1992 when some state-owned banks were significantly undercapitalized, it was evident that consolidation and restructuring of the banking sector could no longer be postponed. Consolidation began at the end of 1992 and passed through several main stages. At the start of the process it was not known whether consolidation should have the form of a portfolio clean-up or recapitalization and whether the loan portfolios of banks should be shifted away to specialized institutions responsible for work out bad loans or whether the work out should be left to the banks, which after all possessed the best information available on debtors.

Under the 1993 restructuring program, bad loans were swapped for long-term government bonds. Although strengthening banks' balance sheets, portfolios deteriorated again because of continuing difficulties in Hungary's enterprise sector. As a result, many state-owned banks became technically insolvent, triggering further government recapitalization. While government rescue operations officially finished by end 1995, some banks benefited from additional public funds (capital injections and guarantees) to facilitate their privatization. The main objective of Hungary's bank restructuring program was, according to Várhegyi (2002), to make banks attractive to investors, and removing unrecoverable loans from banks' balance sheets and government-financed bank recapitalization were the means of getting banks in shape.

The government considered privatization of the state-owned banks as the final step in strengthening and stabilizing the banking system. The privatization policy consisted of selling controlling shares in state-owned banks to strategic foreign investors as rapidly as possible. In general, strategic investors were selected on the basis of the price and the capital injection

[10] As in most CEEC, there existed in Hungary, in addition to the monobank, two specialized state-owned banks prior to the establishment of the two-tired banking system. These were OTP – National Savings Bank set up to provide banking services for households and MKB – Hungarian Foreign Trade Bank specialized in the financing of foreign trade. Foreign ownership was present with three joint-venture commercial banks. However their market share was small, just about 5 percent in 1990.

[11] The Hungarian banking market has witnessed only two major mergers (ABN Amro with KBC and Bank Austria Creditanstalt with HypoVereinsbank).

promised and most investors acquired majority stakes or were granted an option to attain majority ownership in the future. But there have been two exceptions to this model, namely OTP and Postabank, the two largest retail banks. The owners of OTP are foreign institutional investors, Hungarian institutional and private investors, and bank employees including management. In the case of Postabank, a less conscious government policy produced a diversified but not very transparent ownership structure that led to substantial losses and the need for bailing out the institution. However, by the end of 1997, four of Hungary's five large state-owned banks had been sold to foreign owners.

Bank supervision was rather ineffective in Hungary in the first half of the 1990s. This was due to a lack of professionalism and independence of the supervisory authority. At the beginning of the 1990s, the judicial environment was also rather weak. The 1992 Act on Bankruptcy did not provide adequate protection to creditors and resulted in huge bank losses, triggering a change in the rules regarding voluntary bankruptcy a year later (Várhegyi, 2002). What is more, prior to 1997, separate supervisors were in charge of different financial services while more and more banks were operating as holding companies - offering a wide range of financial services under one roof. This enabled banks to allocate risks within the holding, thereby evading capital requirement regulations. In some cases, such a strategy made it possible for the management to hide the group's capital shortage for many years. To deal with these challenges, the supervisors responsible for banks and investment service providers were combined in 1997. And then, in 2000, a single organization - the Hungarian Financial Supervisory Authority – was established, which also integrated the supervision of insurance and pension funds. As Szapáry (2001) points out, the resulting consolidation of the supervisory activities has crowned a great improvement of financial regulation and now permits a more effective supervision of financial system.

2.3 Restructuring in Poland

At the end of the centralist regime in Poland the distinction between the central bank and commercial banks' functions did not exist; the banks functioned in the monobank structure. In 1988 there were four state-owned banks that played a supplementary role to the National Bank of Poland and specialized in specific banking activities.[12] In the second half of the 1980s three new banks were established, and this was an outcome of a modest reform program pursued by the communist government seeking instruments to stop an economic decline in Poland.[13]

Interestingly enough, the reform of the banking sector started already under the communist regime, i.e. ahead of a market reform which was prepared in the late autumn 1989 by the first non-communist government and commenced in January 1990. In January 1989 two new acts were voted by the Parliament: the Act on Banking and the Act on the National Bank of Poland and opened a way for a two-tier system. As a result, commercial activities of the National Bank of Poland were transferred to nine newly established banks that emerged

[12] These were Powszechna Kasa Oszczednosci (PKO) specializing in retail banking and financing of housing development, Bank Gospodarki Zywnosciowej (BGZ), which was a refinancing bank for a network of cooperative banks (there were about 1600 of such banks in 1988), Bank Polska Kasa Opieki (PEKAO), which collected foreign currency deposits of individuals, and Bank Handlowy (BH), which was financing foreign trade and settling foreign indebtedness of Poland.

[13] Namely Bank for Export Development (BRE), BIG Bank, and Development Bank in Lodz.

from the central bank's local branches. As a result of the reform, there were 18 state-owned commercial banks (four 'old' and fourteen 'new').

From the very beginning the National Bank of Poland had pursued quite a liberal licensing policy that was accompanied with very low equity requirements.[14] The market response was immediate and by the end 1992 there were 54 new domestic banks that had emerged since 1990. In general, they were very small and were often established to service special sectors of the Polish economy such as agriculture, energy sector or sugar industry. Their shareholders hoped to have an easy access to credits and this along with other common weaknesses of young transition banking sector soon turned out to cause problems in this segment of the banking system and in the Polish banking sector as a whole (Balcerowicz and Bratkowski, 2001).

< Table 3 here >

The poor outcome of the liberal entry in the banking sector brought about a dramatic change in the licensing policy of the National Bank of Poland and by 1993 the process of establishment of solely domestic banks ended (see Table 3). Equity requirements had subsequently increased up to the equivalent of ECU 5 million in 1996. In the period from 1992 to late 1994 reputable foreign banks were not interested in establishing business in Poland. This may be easily explained by a poor macroeconomic situation, the country's indebtedness, and an early stage of economic reform at that time. It was only after the agreement with the London Club, that new applications for a banking license were submitted by foreign banks (Kwasniak, 2000).

Financial distress of state-owned banks that became evident in 1991 enforced the government to evaluate the volume of bad loans and liquidity of banks. The Ministry of Finance ordered an external analysis of credit portfolios and the audit showed that credits classified as doubtful or loss ranged from 24 to 68 percent. The chosen way of necessary restructuring can serve as a dangerous example of combining the resolution of bad loans with bank responsibility for enterprise restructuring (Bonin and Wachtel, 2002). The World Bank supported a program of bank-led enterprise restructuring based on the notion that the major bank creditor had sufficient information about its clients either to promote restructuring or to decide on the winding-up of large state-owned enterprises (SOEs). The main instrument used to restructure these loans was debt-equity swaps; the weaker banks chose this option disproportionately. Hence, weak banks with no expertise in restructuring large companies wound up taking ownership stakes in their weak clients. Thus, bank credit was provided regularly to ailing enterprises and no meaningful enterprise restructuring was promoted by banks (Gray and Holle, 1996). Poland's program strengthened, rather than severed the ties between weak banks and their undesirable clients and, thus, provided breathing room for ailing SOEs to postpone painful restructuring. Finally, it needs to be added that apart from seven state commercial banks, also three specialized banks were recapitalized and with much bigger amount.[15]

Although the original scheme of state-owned banks' privatization was approved in March 1991, due to bank's financial situation, political instability and a lot of fears and prejudices against foreign capital, the privatization process had not started until 1993. In

[14] It was only (old) PLN 1.5 billion which represented around USD 268 thousand in 1989 and USD 158 thousand in 1990.
[15] In the years 1993-96 PKO, PEKAO, and BGZ received a capital injection of PLN 3.6 billion.

addition it was often subject to changes and therefore the whole privatization may be divided into three different stages. The first took place from 1993 to 1995 and four banks were privatized via IPO with unsatisfactory results. All banks were sold to strategic investors, however they obtained only minority stakes while the State Treasury retained a vast share in equity. Summing up, by the end 1995 out of nine commercial banks only four were partly privatized.

After replacement of pro-reform government by post-communists the policy focus shifted from privatization to an administrative consolidation of state-owned banks (Balcerowicz and Bratkowski, 2001). Ideologically-driven approach led to a politically motivated bank merger, in which the three weakest of the state commercial banks were merged with a state savings bank PEKAO to form the largest financial group in Poland. While the government was occupied with concepts of consolidation, BH and one of state commercial bank arranged their privatization by their own. Both plans were passed through approval process in 1997. 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.

After parliamentary elections in September 1997, a right-wing government came into power and speeded up the privatization of the remaining state-owned banks. The PEKAO Group was partly sold by IPO in 1998 and 52 percent of shares bought UniCredito with Allianz in 1999. The remaining state-owned commercial Bank Zachodni was sold to Allied Irish Bank and the rest of Ministry of Finance's shares in already privatized banks were sold to dominant shareholders, thanks to which the ownership structure became clear. Finally, the State Treasury resolved the two cases where due to insider privatization the ownership structure was dispersed. Powszechny Bank Kredytowy was taken over by Bank Austria Creditanstalt and BH was bought in 2000 by Citibank.

It is not only a fast pace of privatization but also a high pace of mergers and acquisitions that are characteristic for the post-restructuring period of the Polish banking sector development. In the years 1997 – 2001 23 banks had been taken over or merged and mainly foreign owners were instrumental in promoting post-privatization mergers as a means of expansion. For more details about mergers see e.g. Balcerowicz and Bratkowski (2001). Acceleration of privatization led to a further decrease in state-owned banks' share in the banking sector as it is apparent from Table 3. Although concentration of the banking sector does not reach level as for example in the Czech Republic, it rose recently because it was considerably affected by a wave of aforementioned mergers and acquisitions. See Polouček (2003) for more information about banking sector concentration in V4 countries.

On 1 January 1998 a new Act on Banking and a new Act on the National Bank of Poland came to force. National Bank of Poland introduced a new model of functioning of banking supervision. Serving supervision functions, so far belonging to the NBP, was assigned to a collegiate organ of public administration - the Commission of Banking Supervision. This Commission is supported by the General Inspectorate of Banking Supervision (GINB), which remained within the NBP, yet, it was organizationally separated. The two new banking laws equipped GINB with increased control and supervisory rights over banks. Prudential norms have improved subsequently in recent years, and the regulatory framework conforms to prudential guidelines rendered by the Basel Committee for Banking Supervision, as well as to the EU Council directives and guidelines for the banking sector. The only thing which has remained unresolved is the consolidation of the supervision.

2.4 Restructuring in Slovakia

The Slovak banking sector was developing in early 1990s together with the Czech sector in one common state. Therefore, the same features as a rapid growth of the small banks number or careless lending approach concluded in similar problems such as bad loans, delayed privatization and high public costs as well as in using of similar restructuring measures as in the Czech Republic. The independent Slovak banking sector started to operate on January 1993 with 15 commercial banks held by foreigners of almost 8 percent. There were no foreign bank branches yet on the market at the end 1992. The emerging community of commercial banks grappled with largely the same problems as in other V4 countries – in particular an unstable and still transforming economic environment, lack of skilled human resources, insufficient technical equipment, no software, and others.

< Table 4 here >

As Table 4 reports, at end 1993, the Slovak banking industry comprised 28 banking institutions that may be considered as appropriate for such a market from a quantitative point of view. However, majority of banks suffered from lack of long-term funds[16], high ratio of bad loans in their asset portfolios and insufficient capital adequacy. Slovak banks had to face rampant loans defaults, with their share growing relentlessly. But what made the matters worse was the upsurge on bad loans classified as loss-making. As this situation had an extremely grave impact on savings, pricing policy, banking sector liquidity and the whole economy, the National Property Fund decided to pump over SKK 14 billion in fresh capital into two of the Slovakia's largest banks and some SKK 30 billion worth of their non-performing loans were taken over by a 'hospital bank'. However, these efforts proved futile to free banks from their bad loans worries for good and their bad assets have been continually rising.

The mutual agreement between National Bank of Slovakia and the Ministry of Finance on the first stage of pre-privatization was achieved not sooner than in October 1999. The principal task of the concept focused on VÚB and on the largest Slovakia's bank SS was to ensure a fulfillment of the minimal capital adequacy condition defined by the Basel Committee, and to cut the share of classified assets in the banks' total assets to 25 – 35 percent. These goals were again reached by traditional tools - boosting the banks' capital and spinning off a portion of risky loans from their portfolios. Total costs of the state involvement amounted for SKK 132 billion (Tkáčová, 2001).

Besides voucher privatization launched still in the former Czechoslovakia, the real privatization process did not begin until early 2001. The contract between Slovak government and Austria's Erste Bank Sparkassen about sell off of an 87 percent stake in SS was signed on January 2001.[17] In 2002, VÚB, the second largest Slovak bank, was bought by Italian financial group IntesaBci that obtained 67 percent of shares from the state and 25 percent from EBRD and IFC which had participated on VÚB's capital earlier. In a consequence of privatization, the share of foreign capital in the Slovak banking sector increased to 83 percent.

[16] Despite a mounting share of time deposits in the banking sector, which alleviates some of the liquidity pressures, their maturity structure has long been dominated by short-term deposits.

[17] It means that the same foreign investor became a strategic owner of the Czech and Slovak largest savings bank.

3. METHODOLOGY AND REVIEW OF RELEVANT LITERATURE

Farrell (1957) in his pioneer paper distinguishes two components of the efficiency of a firm: technical efficiency, which reflects the ability of a firm to obtain maximum output from a given set of inputs, and allocative efficiency, which indicates the ability of a firm to use the inputs in optimal proportions, given their respective prices and the production technology. These two measures can be combined to provide a measure of total economic efficiency, or, when cost instead of production is considered, cost efficiency. The optimal or most efficient production, depending on various circumstances such as the scale of the firm in particular, is called efficient frontier. Errors, lags between the choice of the production plan and its implementation, human inertia, distorted communications and uncertainty cause deviations from the efficient frontier, called X-inefficiency (Leibenstein, 1966). Measuring X-inefficiency in financial intermediation in the V4 banking industries is the main subject of this paper.

The two approaches used to assess X-efficiency of an entity, parametric (econometric) and non-parametric (mathematical programming), employ different techniques to envelop a data set with different assumptions for random noise and for the structure of the production technology. In this study we use Data Envelopment Analysis (DEA) as a representative of the non-parametric methods. DEA is a mathematical programming approach for the construction of production frontiers and the measurement of efficiency relative to the constructed frontiers. DEA is based on a concept of efficiency very similar to the microeconomic one; the main difference is that the DEA production frontier is not determined by some specific functional form, but it is generated from the actual data for the evaluated firms. In other words, the DEA frontier is formed as the piecewise linear combination that connects the set of 'best-practice observations' in the data set under analysis. As a consequence, the DEA efficiency score for a specific decision making unit (DMU) is not defined by an absolute standard, but it is defined relative to the other DMUs in the specific data set under consideration (Stavárek, 2002).

In their original paper, Charnes *et al.* (1978) proposed a model that had an input orientation and assumed constant returns to scale (CRS). Thus, this model identifies inefficient units regardless of their scale size. As a result, the use of the CRS specification when some DMUs are not operating at optimal scale will result in measures of technical efficiency which are confounded by scale efficiencies.[18] Later studies have considered alternative sets of assumptions. The assumption of variable returns to scale (VRS) was first introduced by Banker *et al.* (1984). The input-oriented VRS model for the DMU_0 can be written formally as:

$$\min_{\lambda} z_0 = \Theta_0 \tag{1}$$

$$\sum_{j=1}^{n} \lambda_j y_{r_j} \geq y_{r_0}, r = 1,2,...,s \tag{2}$$

$$\Theta_0 x_{i_0} - \sum_{j=1}^{n} \lambda_j x_{i_j} \geq 0, i = 1,2,...,n \tag{3}$$

$$\sum_{j=1}^{n} \lambda_j = 1 \tag{4}$$

$$\lambda_j \geq 0, \quad j = 1,2,\ldots,n \tag{5}$$

[18] The fact that banks face non-constant returns to scale has been documented empirically by, among others, McAllister and McManus (1993), and Wheelock and Wilson (1999).

where

Θ_0	is the technical efficiency of DMU_0 to be estimated
λ_j	is a n-dimensional constant to be estimated
y_{rj}	is the observed amount of output of the r^{th} type for the j^{th} DMU
x_{ij}	is the observed amount of input of the i^{th} type for the j^{th} DMU
r	indicates the different *s* outputs
i	indicates the different *m* inputs
j	indicates the different *n* DMUs.

The VRS efficiency scores are also called pure technical efficiency scores and they are obtained by running the above model for each DMU. The VRS model eliminates the scale part of efficiency from the analysis, and therefore, the CRS efficiency score for each DMU does not exceed the VRS efficiency score.

Cross-country studies using DEA face the problem of heterogeneous environment in analyzed countries. The term 'environment' describes factors that could influence efficiency of a firm, where such factors are not traditional inputs and are not under control of management (Casu and Molyneux, 2000). Such factors can include ownership differences, location characteristics, macroeconomic conditions or government regulation.

Several models have been proposed to incorporate environmental effects into a DEA based evaluation of producer efficiency. These models can be grouped into one-stage models and two stage models. One-stage models use data on outputs, inputs and observable environmental variables all at once, the objective being to control for observable environmental variables in the evaluation of producer performance. However these models are deterministic, and so fail to account for the effect of statistical noise. Their implementation also requires that the direction (if not the magnitude) of each included environmental effect should be known in advance. Two-stage models use data on outputs and inputs in the first stage, and use data on observable environmental variables in the second stage, the objective being to determine the impact of the observable environmental variables on initial evaluations of producer performance. If the second stage is DEA-based, the resulting two-stage model is fully deterministic, and incapable of accounting for the effect of statistical noise on producer performance. However if the second stage is regression-based, this model is capable of attributing some portion of the variation in producer performance to the effect of statistical noise (Fried *et al.*, 2002).[19]

A commonly held view in previous studies is that the use of Tobit model can handle the characteristics of the distribution of efficiency measures and thus provide results that can guide policies to improve performance. DEA efficiency measures obtained in the first stage are the dependent variables in the second stage censored Tobit model in order to allow for the restricted (0, 1] range of DEA efficiency scores. Estimation with an Ordinary Least Squares (OLS) regression of Θ_0 would lead to a biased parameter estimate since OLS assumes a normal and homoscedastic distribution of the disturbance and the dependent variable (Jackson and Fethi, 2000).

[19] The typical two-stage approach was pioneered by Timmer (1971). In this approach a first stage DEA exercise is followed by a second stage regression analysis seeking to explain variation in first stage efficiency scores in terms of a vector of observable environmental variables.

The standard Tobit model can be defined as follows for DMU_0:

$$y_0^* = \beta' x_0 + \varepsilon_0 \tag{6}$$

$$y_0 = y_0^* \quad if \quad y_0^* \succ 0, \ and \tag{7}$$

$$y_0 = 0, otherwise, \tag{8}$$

where $\varepsilon_0 \sim N(0, \sigma^2)$[3], x_0 and β are vectors of explanatory variables and unknown parameters, respectively. The y^*_0 is a latent variable and y_0 is the DEA score.

The likelihood function (L) is maximized to solve β and σ based on observations of explanatory variables and DEA scores.

$$L = \prod_{y_0=0} (1 - F_0) \prod_{y_0^* \succ 0} \frac{1}{(2\Pi\sigma^2)^{1/2}} \times e^{-\left[1/(2\sigma^2)\right](y_0 - \beta_{x_0})^2} \tag{9}$$

where

$$F_0 = \int_{-\infty}^{\beta x_0 / \sigma} \frac{1}{(2\Pi)^{1/2}} e^{-t^2/2} dt \tag{10}$$

The first product is over the observations for which the banks are 100 percent efficient (y=0) and the second product is over the observations for which banks are inefficient (y>0). F_0 is the distribution function of the standard normal evaluated $\beta' x_0/\sigma$.

Efficiency and financial performance of banks and other financial institutions are very frequently discussed topics in economic literature. Sherman and Gold (1985) were one of the first researchers to use the nonparametric approach to evaluate and compare the performances of banks. Berger and Humphrey (1997) surveyed 130 studies that apply frontier efficiency analyses to financial institutions in 21 countries. They report that the majority of these studies are confined to the U.S. banking sector, and call for the need to do further research in this area outside the United States.[20] The method has been also gradually applied for cases in Norway, Spain, U.K., France, Italy, Japan, Singapore, Poland, Croatia, the Czech Republic, Turkey, Kuwait, and several other countries. There is also a set of literature which uses DEA for cross-country comparisons.

The X-efficiency literature on cross-country comparisons of banking institutions has two perspectives. One deals with comparison of foreign-owned banks with domestic-owned banks in the context of a single country. The other concentrates on cross-country comparisons among banking institutions. In the first category, the local business environmental factors are ignored as banks compete in the same market within the country.[21] In the second category of this literature, the papers either did not adjust for country specific local environmental conditions or norms and defined a common efficiency frontier or incorporated the country-specific environmental conditions as was described above. Most of the studies are based on

[20] Only DEA, as a one of non-parametric approaches, has been used to construct banking efficiency frontiers evaluating U.S. data alone in more than 30 published articles.

[21] Studies focused on U.S. market, e.g. Hasan and Hunter (1996), Mahajan *et al.* (1996), DeYoung and Nolle (1996), Chang *et al.* (1998), and Peek *et al.* (1999) usually portrayed foreign-owned banks as relatively less efficient than their domestic counterparts. However, these findings do not correspond with similar comparisons in non-U.S. settings. Vander Vennet (1996) or Hasan and Lozano-Vivas (1998) found no significant differences between the two groups.

banking institutions from EU countries and generally the results did not produce any definite status.[22] However, there is still a lack of cross-country analyses evaluating banking efficiency in CEEC[23]. To fill in the existing gap in financial literature we use two-stage approach in which efficiency of banking intermediation carried out by DEA model allowing VRS is followed by the second stage Tobit regression analysis to detect main determinants of the efficiency.

4. DATA AND SELECTION OF VARIABLES

The analysis is based on data banks representing more than 90 percent of the total banking assets in all V4 countries. As we foresaw arguments concerning the reliability of some of the indicators in an environment where serious false reports and non-compliance could take place we selected the sample period for this study on the end stage of transformation process, particularly from 1999 to 2002, to minimize the extend of the problems. While describing the data, it is necessary to note that composition of the dataset changed slightly over the period analyzed because data from all banks are not available for every year (mainly in 1999) and also mergers reduced the total number of evaluated banks (2002). Therefore the set under estimation contains 59 banks in 1999, 72 banks in 2000, 70 banks in 2001, and 62 banks in 2002.[24] All data were extracted from the banks' official end-of-year unconsolidated balance sheets and financial statements based on international accounting standards. All data reported in local currencies were converted into EUR as a reference currency using official exchange rates.[25] We analyzed only commercial banks (some of them originally performed as savings banks) that are operating as independent legal entities. All foreign branches, building societies, mortgage banks, specialized banks or credit unions were excluded from the estimation set.

In the banking literature, there is a considerable disagreement on the perception of the banking activities' principle and on the explicit definition and measurement of banks' inputs and outputs. A fundamental difficulty arises in the treatment of bank deposits. Long-lasting debate in the literature surrounds the input-output status of deposits. Traditionally, deposits

[22] For instance, Berg *et al.* (1993) found overall average efficiency of 0.58 for Finland, 0.78 for Norway and 0.89 for Sweden; European Commission (1997) found average efficiency levels in the EU of 0.73; Pastor *et al.* (1997a) report average efficiency levels equal to 0.79 and Dietsch and Weill (1998) found average efficiency levels in the EU of 0.64. In a broader context, Pastor *et al.* (1997b) applied DEA to 427 banks from 8 developed countries. They found a mean efficiency value of 0.86, with the highest efficiency value of 0.95 for France and the lowest efficiency value of 0.55 for the U.K. According to Bikker (1999), Spanish banks appeared to be the least efficient ones, followed by banks in France and Italy, whereas banks in Luxembourg were most efficient, followed by banks in Belgium and Switzerland. On average, banks in Germany, the Netherlands and the U.K. took a medium position. Casu and Girardone (2002) concluded that majority of large banks operating in the single EU market obtained efficiency scores about 0.65, while banks from the U.K. appeared as the most efficient whereas Italian and Spanish banks occupied the last positions.

[23] We may mention, among rare examples, Stavárek and Polouček (2003) who analyzed V4 banking sectors together with Finland and Belgium and reported lower intermediation as well as operating efficiency in V4 countries then in two selected EU countries. Other study, Grigorian and Manole (2002), incorporated 17 countries into analysis and found that with the exception of 1997, banks in Central Europe are more efficient in both revenue generating and the ability to provide financial services than banks from Southern and Eastern Europe and from the Commonwealth of Independent States.

[24] The geographical distribution among individual countries is reported in Tables 5a – 5d.

[25] To convert values from local currencies we may use either the official exchange rate or the purchasing power parity rate as computed by the OECD. According to Berg *et al.* (1993) the two approaches seem to yield very similar results.

are regarded as the main ingredients for loan production and the acquisition of other earning assets. On the other hand, high value-added deposit products, like integrated savings and checking accounts, investment trusts and foreign currency deposit accounts tend to highlight the output characteristics of deposits. Indeed, high value-added deposit services are an important source of commissions and fee revenue for specialized commercial banks such as trust and private banks. In the context of these specialized institutions, one cannot afford to ignore the output nature of deposits (Leong *et al.*, 2002). Extending this argument further, one might contend that the classification of deposits should therefore depend on the structure and characteristics of banks in the representative sample and viewed in the regulatory context of the country in question. For example, since the magnitude of high value-added deposits is relatively small compared to time and savings deposits in V4 countries, there may be more reason to regard deposits as inputs in these circumstances.

Three main approaches have been developed to define the input-output relationship in financial institution behavior in the literature. Firstly, the production approach (Sherman and Gold, 1985) views financial institutions as producers of deposit and loan accounts, defining output as the number of such accounts or transactions. This method usually defines inputs as the number of employees and capital expenditures on fixed assets. Second, the intermediation approach (Sealey and Lindley, 1977) stems directly from the traditional role of financial institutions as intermediaries that convert financial assets from surplus units into deficit units. Operating and interest costs are usually the major inputs, whereas interest income, total loans, total deposits and non-interest income form the principal outputs. Third, the asset approach recognizes the primary role of financial institutions as creators of loans. In essence, this stream of thought is a variant of the intermediation approach, but instead defines outputs as the stock of loan and investment assets (Favero and Papi, 1995).

Intermediation approach seems to have dominated empirical research in this area and also we adopt for the definition of inputs and outputs the original approach proposed by Sealey and Lindley (1977) with a small modification. It assumes that the bank collects deposits to transform them, using labor and capital, in loans. We determined the appropriate number of inputs and outputs with a respect on the dataset size and consequently employed three inputs (labor, capital, and deposits), and two outputs (loans and net interest income).[26] We measure labor by the total personnel costs (PC) covering wages and all associated expenses, capital by the book value of fixed assets (FA), and deposits by the sum of demand and time deposits from customers and interbank deposits (TD). Loans are measured by the net value of loans to customers and other financial institutions (TL) and net interest income as the difference between interest incomes and interest expenses (NII). See Tables 5a – 5d for a descriptive statistics of inputs, outputs, and total banks' assets (TA) in 1999 and 2002.

< Tables 5a – 5d here >

To further investigate the determinants of efficiency of financial intermediation in V4 banking sectors we follow aforementioned two-stage approach with a Tobit regression. Using the efficiency scores obtained from the DEA evaluations as the dependent variable, we then estimate the following regression mode already employed by e.g. Casu and Molyneux (2000).

[26] Under the non-parametric approach which will be implemented in our empirical analysis, increasing the number of variables reduces the number of technically inefficient observations. Therefore, in order to minimize this possible drawback of the methodology, we restricted our choice of variables to a three-input, two-output model.

$$\Theta_j = \beta_1 CZE + \beta_2 HUN + \beta_3 POL + \beta_4 SVK + \beta_5 ROAE + \beta_6 EOTA + \beta_7 TA + \beta_8 FO + \varepsilon_j \qquad (11)$$

where

CZE, HUN, POL, SVK	are dummy variables indicating the country of origin of the bank (equal to one if based in the country and equal to zero otherwise)
ROAE	is the return on average equity;
EOTA	is the ratio of equity on total assets;
TA	is the sum of assets;
FO	is dummy variable indicating type of ownership (equals to one if foreign-owned and equals to zero otherwise).[27]

These variables represent aspects of the bank's environment that may influence efficiency, but which are outside the immediate control of company management. There is clearly the potential for disagreement on exactly what kind of variables can meet these criteria. We implemented profitability and capital ratios to test conclusions of the empirical literature (e.g. Casu and Molyneux, 2000, Pastor *et al.*, 1997b, or Jackson and Fethi, 2000) about mutual relations between efficiency, profitability and capital adequacy in the environment of transition economy. We introduce the variable FO to detect whether foreign ownership influences efficiency in a positive way as a widely held understanding says.

5. EMPIRICAL FINDINGS

5.1 Efficiency estimation

Following the methodology described, we evaluated the efficiency of all banks in the estimation set and calculated DEA efficiency scores obtained by running separate programs for the CRS model and for the VRS model.[28] We pooled the cross-country data and used them to define a common best-practice efficiency frontier. This allowed us to focus on determining the relative differences in performances across banking industries. The same approach was previously followed by Berg *et al.* (1993), Pastor *et al.* (1997b), Casu and Molyneux (2000), Dietsch and Weill (2000) or Grigorian and Manole (2002). Table 6a and Table 6b report elementary statistics of efficiency scores obtained relative to the whole sample considering CRS and VRS respectively.

< Table 6a and Table 6b here >

One can point out that VRS efficiency scores are considerably higher than ones of CRS and also that the efficiency frontier using VRS model consisted of more DMUs than the CRS frontier. It is possible to detect an improvement of average efficiency between 1999 and 2001, however followed by a significant drop even below the initial level in the case of VRS approach. Figures 1a – 1h illustrates the frequency distribution of efficiency scores over the period of analysis. The majority of DMUs comprising the sample seem to cluster around the level of efficiency 0.50 and 0.90 considering CRS and VRS respectively. This is absolutely in

[27] If the bank is owned by an institution from any other transition country, it is considered as domestic-owned. This approach was viewed as a good method to restrict foreign ownership only on ownership from developed countries.

[28] We used the EMS software, version 1.3.0, by Holger Scheel for the DEA scores calculation.

accordance with results of other recent studies on European bank efficiency using DEA. See footnotes 22 and 23 for reminding.

< Figures 1a – 1h here >

Also in comparison with findings of Berger and Humprey (1997) the figures show signs of average performance. They surveyed, as mentioned earlier, 130 studies (122 of which were focused on depository financial institutions), applying frontier efficiency analysis (using parametric as well as non-parametric methods) to financial institutions in 21 countries. They drew to the conclusion that the mean value of average efficiencies was 0.79, with a standard deviation of 0.13, and a range of 0.31 to 0.97. Considering only 69 applications of non-parametric techniques, the mean average efficiency was 0.72, with a standard deviation of 0.17. Results of our study are not poles apart.

The Czech banking sector appeared as the most efficient reaching the highest average efficiency scores in both CRS and VRS model. Considering CRS, all banking sectors with the exception of Hungary obtained in 2002 nearly the same efficiency levels like in 1999. The Czech banking industry is more efficient of 1.4 percentage points (p.p.), the Polish of 2.1 p.p. and the Slovak reached in 2002 the average score of 7.8 p.p. lower than in 1999. The Czech banking sector entered the period of analysis with an advance of almost 20 p.p. ahead of the other countries however it was caught up by the Hungary's sector in 2002 that had improved its efficiency of 20 p.p from 0.545 to 0.745. Resembling developments are also evident in the VRS approach's results. One can define the Czech Republic along with Hungary as a leading group with highest average efficiency that reached levels around 0.83. Whereas the Czech final and initial efficiencies did not differ significantly, the analysis has witnessed a dramatic growth of the Hungary's banks efficiency of more than 10 p.p. Poland and Slovakia stood apart with a gap of 12 p.p. and 28 p.p respectively. Figures 2a and 2b summarize the findings graphically.

< Figure 2a and Figure 2b here >

The explanation of generally lower intermediation efficiency in transition countries can be found in a couple of factors. Above all, past bad loans, low credit scores of the majority of potential borrowers, the dormant capacity of lending to households. In 2001, loans to households amounted to 6.5 percent of GDP in the Czech Republic and 6 percent of GDP in Hungary whereas it was 30 percent of GDP in Austria. In addition, much of the investment in transition countries has been realized by foreign investors either with their own financial resources, or with connections to foreign banks and foreign capital. As a result, potential borrowers and clients of the first quality have brushed aside the banks as well as capital markets in transition countries regardless of the method of investment (privatization, merger and acquisition or 'green-field' investment). As a consequence of high interest rates, a considerable number of domestic companies have decided to finance their business activities from abroad, obtaining resources from foreign banks and reducing, in this manner, capital costs. The indebtedness of companies at home as well as abroad had the same levels only in the Czech Republic; with the rest of the V4 countries, the indebtedness abroad was substantially higher.

Besides the analysis of average efficiency scores of all banking sectors, undoubtedly interesting is to expose the composition of efficiency frontiers. One can suppose that the more

efficient banking sector the more banks originating from it are placed at the efficiency frontier. The national structure of the frontier is provided in Tables 7a and 7b.

< Table 7a and Table 7b here >

As it is apparent from figures above, the results obtained show differences between efficiencies allowing VRS and efficiencies based on CRS. Recall that the CRS efficiency score is a product of technical and scale efficiency, and VRS measures purely technical efficiency; thus, the ratio of the efficiency scores

$$S_j = \frac{\Theta_{j,CRS}}{\Theta_{j,VRS}} \tag{12}$$

yields a measure of the relative scale efficiency of bank *j*. If $S_j = 1$, this means that bank *n* is operating at the most efficient scale size. If it is less than one, this means there is scale inefficiency for bank *j*. Thus, $(1\text{-}S_j)$ represents the relative scale inefficiency of a bank. The units that are CRS-efficient will also be scale-efficient, since scale was already factored in the CRS model. Thus, the two are equal. The units that are VRS-efficient, but inefficient in the CRS model, have a scale inefficiency. Since they were technically efficient, all of the inefficiencies picked up by CRS are due to scale. However this ratio does not indicate whether the banks with scale inefficiency are too small or too big. To detect not only the extend of scale inefficiency but also its direction we modified the ratio and replaced the CRS efficiency by non-decreasing returns to scale (NDRS) efficiency and VRS efficiency by the non-increasing returns to scale (NIRS) efficiency score. Thus, the scale inefficiency higher than zero predicates about too big bank and inefficiency lower than zero identifies too small banks from the point of view of the input orientated DEA model. Average scale inefficiencies of all banking sectors are presented in Table 8.

< Table 8 here >

We may summarize that the Czech banks suffer from the lowest scale inefficiency followed by the Slovak banks. However, the Slovakia's banking sector is the only one that composes from too small banks comparing with their counterparts from other V4 countries. Second most important feature is a noticeable reduction of scale inefficiency in Hungary and Poland. The results show that the largest banks were the most efficient using the VRS model. It is quite a common finding for many other studies that smaller banks dominate the frontier in the CRS model, while in the VRS model, frontier banks are on average much larger (e.g. Berg *et al.* (1993) or Vujcic and Jemric (2002) came to the same conclusion).

We are aware of the fact that averaging without any respect to the size of banks causes loss of information, and therefore, we implemented in our analysis a size-adjusted average efficiency (AM) calculated as:

$$AM = \sum_{j=1}^{n} w_j \Theta_j \tag{13}$$

where

AM	is the size-adjusted average efficiency;
w_j	is the weight computed as a share of j^{th} DMU's assets on total assets of all estimated DMUs;
Θ_j	is the observed efficiency for the j^{th} DMU; and
j	indicates the different *n* DMUs.

Development of the size-adjusted average efficiency is portrayed in Figures 3a and 3b.

< Figure 3a and Figure 3b here >

The size-adjusted average efficiency can be used for analysis of the issue of optimal bank size by comparing with 'simple' average efficiency scores. Considering CRS model the adjusted average efficiency is in all counties during the whole period analyze lower than the simple average efficiency. This indicates that the smaller banks perform better than the larger ones. Hence, in the case of common efficiency analysis, we can generalize, that larger banks mainly operate at the wrong scale. Mainly in the Czech Republic and Slovakia the amount of banks' total deposits is not fully utilized and thus, exceeds the total volume of loans and services provided. On the contrary, the scale inefficiency in Poland and, to a lesser extent, Hungary, stems from a great number of medium-sized banks which perform badly due to their high fixed costs in relation to their limited market shares. This finding corresponds to the rather low concentration of Polish and Hungarian banking sectors. Allowing banks to operate with VRS, the overall picture changed dramatically. The size-adjusted efficiency scores surpassed the simple efficiency ones.

5.2 Explaining differences in efficiency

An exploration of inter-company and cross-country differences in efficiency necessitates a two-stage analysis whereby efficiency scores from the first-stage DEA process are regressed against environmental variables. We used DEA scores obtained from the VRS estimation. By definition, these environmental variables are not decision variables which would otherwise figure in the firm's choice of the nature or level of inputs and/or outputs (as these should have already been included in the DEA analysis). Problems can arise if the environmental variables are co-determined or even highly correlated with the DEA inputs or outputs as this can lead to biased estimates in the regression analysis. Since VRS DEA efficiency scores are naturally dependent on the size of the DMU, there will be an inevitable correlation between any second-stage size variable and DEA inputs/outputs. Descriptive statistics of selected environmental variables for all years is provided in Tables 9a – 9d.

< Table 9a - Table 9d here >

This study uses company size as an one of key environmental variables on basis that management cannot easily use size as a decision variable. Since the Pearson correlation coefficient between inputs, outputs and total assets is extremely high (ranging from 0.711 to 0.976), it is preferable to use the natural logarithm of total assets is EUR thousand instead of the sum of total assets. The results of the Tobit regression that are significant at 95 percent level or higher are presented in Table 10.[29]

< Table 10 here >

The yearly results differ in some aspects but these, on the other hand, reflect important development tendencies explaining banking efficiency determinants. Considering profitability we found its positive effects on efficiency of V4 banks during the whole period of analysis. One can observe the growing statistical significance of ROAE, and accepting 95 percent level,

[29] The Tobit regression was computed with EasyReg by Herman J. Bierens.

ROAE appears as statistically significant in 2001 and 2002. These findings indicate that more profitable banks have higher efficiency, which corresponds with findings of some previous studies, e.g. Pastor *et al.* (1997b), Carbo *et al.* (1999), Jackson and Fethi (2000) or to certain extend Stavárek and Polouček (2003). Banks reporting higher profitability ratios are usually seen by clients as preferential and attract therefore the biggest share of deposits as well as the best potential borrowers. Such conditions create a favorable environment for the profitable banks to be more efficient from the point of view of financial intermediation.[30] On the other hand, there is a sign of negative influence of the capital adequacy variable EOTA on banks' efficiency except 1999. However the negative coefficients are not statistically significant at the selected level. The Basel ratio might be a more appropriate indicator of capital adequacy since it distinguishes a risk level of particular assets and thus it better mirrors the intermediation efficiency.

The relationship between bank's size and efficiency is rather mixed. There is an evidence of positive sign in three out of four estimations however the statistically significant relationship is only found to hold in 2000 and 2001. One can consider this kind of results as a verification of U-shaped relationship between size and efficiency, i.e. both small and large banks appear to have higher efficiency scores and the most dangerous or slippery territory belongs to medium-sized banks. Another coefficient with growing significance is FO representing the ownership dummy. During the whole period of estimation the coefficient has a positive sign and in the last two years is statistically significant at 95 percent level. Banks with controlling foreign ownership are likely to be more efficient than their domestically owned counterparts (including state-owned and private domestic). This should come as no surprise because of the ability of foreign owned banks to capitalize on their access to better risk management and operational techniques, which is usually made available through their parent banks abroad. In addition, as foreign ownership is likely to be concentrated, foreign owned banks are less prone to typical corporate governance conflict between (dispersed) owners and the management. The relevance of foreign ownership's positive impact on efficiency of banks in V4 countries confirm outcomes of Grigorian and Manole (2002) who as ones of very few researches carried out cross-country analysis of banking efficiency in European transition countries.

However the most noticeable finding is that the differences between efficiencies across V4 banking sectors stem mainly from country specifics implemented into analysis by country dummies. Their coefficients are the highest and in all estimations statistically significant. These results are absolutely in accordance with Pastor *et al.* (1997b), Casu and Molyneux (2000) and Grigorian and Manole (2002) who also concluded in like manner. It means that in spite of common features' existence the autonomous factors play a crucial role in affecting banking efficiency. One can highlight, among others, aforementioned method of financial sector restructuring, its timing and sequencing along with measures used, and, last but not least, the legal and regulatory framework that vary among V4 countries. Conditions of banking activities such as capital adequacy, single borrower exposure limits, foreign exchange exposure, liquidity limits, rules for reserves and provisions creating and other prudential behavior standards belong among factors significantly influencing banking efficiency. The second group of country specifics consists of factors that generate a potential for efficient financial intermediation. We may distinguish macroeconomic development, level of GDP per capita, restructuring of the enterprise sector, foreign direct investment inflow, tendency to

[30] For more about mutual relationship between banking efficiency and profitability see Stavárek and Polouček (2003).

savings and investments, proportion of customer deposits and interbank deposits, and quality of capital markets.

6. CONCLUSION

Reported results allow us to conclude that even after almost thirteen years after the end of communist period in the history of Central Europe, and in spite of transformation, restructuring, convergence process and harmonization before joining the European Union that took place in all countries, the V4 countries does not represent a homogenous club of identical economies as they are often reckoned for and their banks have not improved their efficiency remarkably since 1999.

According to average efficiency of banking intermediation in 2002, the V4 banking industries can be distinguished as more and less efficient. Generally, the Czech and Hungarian banking sectors were on average evaluated as the most efficient followed, with a non-marginal distance, by the Polish banking industry. The Slovak banking sector stands apart with a substantial gap in efficiency scores. One of the clearest results of the study is a noteworthy increase of the Hungarian sector's average efficiency that may be explained by positive effects of relatively fast and successfully performed restructuring and privatization of the largest banks and banking system as a whole. Efficiency of the leaders does not differ significantly from the results of previous studies focusing mainly on the EU banking markets. However the results were obtained from estimations based on different data and therefore we are far from conclusion that the efficiency of the best performers among V4 countries equals to average efficiency within EU countries. Some attempts to evaluate banks from EU candidate and member countries together (e.g. Stavárek and Polouček, 2003) imply that banking sectors of transition countries are less efficient than their counterparts in EU member countries. Nevertheless, efficiency of Slovakia's banks is undoubtedly deeply below the level considered as a standard in EU as well as in the Czech Republic or Hungary.

Despite privatization, and the dominance of foreign banks, the banking industries in the V4 countries remained underdeveloped in terms of provision of credit to enterprises and households. The depth of financial intermediation was quite low in the V4 countries. However, efficiency is expected to improve with the development of the economy in general, and likewise, the development of small and medium enterprises in particular. Loans to households are also expected to rise as a consequence of growth in household incomes as well as efforts of banks to expand and diversify their activities.

Although there is an evidence of statistically significant factors influencing banks' efficiency in the whole V4 group such as profitability, foreign ownership or to certain extend also size of a bank, the majority of differences should be cleared up by a heterogeneous environment in particular countries. From these results, we may conclude that country specific factors are still, in spite of globalization, integration, harmonization and other similar developments and processes, important determinants in explaining differences in banking efficiency levels in V4 countries.

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Banking sector indicators in the Czech Republic **Table 1**

	1993	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
No. of banks	52	55	55	53	50	45	42	40	38
No. of foreign-owned banks	18	21	23	23	24	25	27	26	26
state-owned banks % of total sector's assets	11.9	17.9	17.6	16.6	17.5	18.6	23.1	28.2	3.8
bad loans % of total loans		36.0	26.6	27.4	27.0	26.7	32.2	23.6	21.5
credit to private sector % of GDP	51.0	50.3	46.7	47.1	54.7	48.8	43.8	41.4	45.1
broad money % of GDP	70.6	73.6	75.3	71.3	73.0	71.2	75.4	77.6	78.9

Source: Czech National Bank, EBRD (2001)

Banking sector indicators in Hungary **Table 2**

	1993	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
No. of banks	40	43	42	42	46	45	44	43	41
No. of foreign-owned banks	15	17	21	25	30	27	27	30	30
state-owned banks % of total sector's assets	74.9	62.8	52.0	16.3	10.8	11.8	9.1	8.6	9.0
bad loans % of total loans	29.6	20.2	12.1	9.0	5.3	6.8	4.4	3.1	3.4
credit to private sector % of GDP	20.7	21.4	18.6	18.7	20.4	20.0	20.8	23.2	23.0
broad money % of GDP	56.8	52.2	48.7	48.6	47.3	45.8	46.2	46.3	46.8

Source: National Bank of Hungary, Hungarian Financial Supervisory Authority, EBRD (2001)

Banking sector indicators in Poland **Table 3**

	1993	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
No. of banks	87	82	81	81	83	83	77	74	71
No. of foreign-owned banks	10	11	18	25	29	31	39	47	49
state-owned banks % of total sector's assets	86.2	80.4	71.7	69.8	51.6	48.0	24.9	24.0	22.1
bad loans % of total loans	36.4	34.0	23.9	14.7	11.5	11.8	14.5	15.9	17.8
credit to private sector % of GDP	12.2	12.0	12.7	15.9	17.1	17.6	18.8	18.8	19.3
broad money % of GDP	35.9	36.7	36.1	37.2	39.6	40.2	43.1	42.0	45.1

Source: National Bank of Poland, EBRD (2001)

Banking sector indicators in Slovakia **Table 4**

	1993	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*
No. of banks	28	29	33	29	29	27	25	23	21
No. of foreign-owned banks	13	14	18	14	13	11	10	13	13
state-owned banks % of total sector's assets	70.7	66.9	61.2	54.2	48.7	50.0	50.7	49.1	22.7
bad loans % of total loans	12.2	30.3	41.3	31.8	33.4	44.3	32.9	26.2	21.8
credit to private sector % of GDP	30.4	23.0	26.3	30.4	42.1	43.9	40.5	37.6	37.7
broad money % of GDP	63.9	64.3	65.4	68.7	66.2	62.1	64.6	58.9	60.1

Source: National Bank of Slovakia, EBRD (2001)

Inputs and outputs descriptive statistics **Tables 5a – 5d**

Czech Republic (1999) - 17 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	2 376 032	923 9237	3 292 968	4 040	9 808 964
PC	27 225	8 542	42 533	537	139 364
FA	84 439	11 833	136 748	745	458 974
TL	1 909 428	743 408	2 576 300	18 506	8 594 644
NII	60 623	21 156	94 345	312	343 427
TA	2 885 523	1 070 088	3 916 222	30 976	11 905 817

Czech Republic (2002) - 16 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	3 116 281	1 063 690	4 578 090	17 864	14 382 424
PC	42 399	13 242	63 521	646	184 371
FA	90 979	14 518	162 747	453	535 529
TL	2 813 827	1 008 199	3 958 209	34 835	11 777 198
NII	102 908	27 208	159 908	1 517	458 795
TA	4 007 395	1 274 512	6 005 072	36 502	19 313 197

Hungary (1999) - 14 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	1 252 080	831 891	1 386 871	210 938	5 961 814
PC	22 717	12 081	23 444	4 089	96 034
FA	37 950	10 596	48 134	4 650	164 485
TL	845 810	686 322	691 808	133 522	2 990 091
NII	63 040	41 700	79 270	5 176	332 181
TA	1 562 969	1 088 602	1 631 984	232 514	6 989 484

Hungary (2002) - 12 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	1 825 718	1 080 201	2 091 652	416 021	8 304 447
PC	35 134	27 663	36 364	6 150	148 752
FA	41 928	15 730	58 223	4 169	205 058
TL	1 459 041	924 249	1 397 106	234 291	5 234 123
NII	99 352	70 165	110 862	12 248	422 211
TA	2 196 203	1 350 010	2 486 586	460 623	9 824 588

Poland (1999) - 17 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	2 040 725	1 593 356	2 589 972	5 849	10 982 585
PC	50 637	48 231	67 873	1 210	294 513
FA	85 797	65 122	117 576	1 480	500 612
TL	1 528 191	1 191 856	1 753 410	10 300	7 371 177
NII	98 452	69 054	114 861	5 425	483 336
TA	2 597 535	1 888 225	3 317 603	51 394	14 208 500

Poland (2002) - 21 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	3 468 497	997 917	5 024 733	30 123	21 855 455
PC	89 770	18 008	173 018	2 834	814 522
FA	122 054	21 973	164 124	1 882	602 452
TL	2 563 010	1 042 101	3 176 295	27 294	12 455 222
NII	154 244	42 677	251 897	265	1 033 164
TA	4 475 068	1 512 722	6 017 068	72 295	24 512 365

Slovakia (1999) - 11 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	707 231	451 780	907 810	67 844	3 457 758
PC	8 483	4 253	12 310	956	46 374
FA	36 270	23 379	51 954	2 066	195 023
TL	478 170	314 498	559 815	55 182	2 165 303
NII	15 353	11 872	11 818	454	44 535
TA	816 916	504 489	998 719	91 938	3 811 757

Slovakia (2002) - 12 banks					
	mean	***med***	***st.dev.***	***min***	***max***
TD	1 201 995	516 340	1 412 853	58 927	4 322 940
PC	13 987	5 784	170 050	988	59 299
FA	45 591	27 535	54 982	875	183 267
TL	636 750	375 419	652 214	35 139	2 181 838
NII	36 220	14 490	54 055	436	158 418
TA	1 437 900	670 962	1 630 091	101 344	4 797 760

Descriptive statistics of efficiency scores – CRS **Table 6a**

	No. DMUs	*No. effic. DMUs*	*mean*	*med*	*st.dev.*	*min*	*max*
1999	59	8	0.6074	0.5839	0.224789	0.1895	1.0000
2000	72	7	0.5888	0.5377	0.219629	0.2588	1.0000
2001	70	9	0.6831	0.6171	0.197626	0.2830	1.0000
2002	62	8	0.6332	0.5868	0.206272	0.1040	1.0000

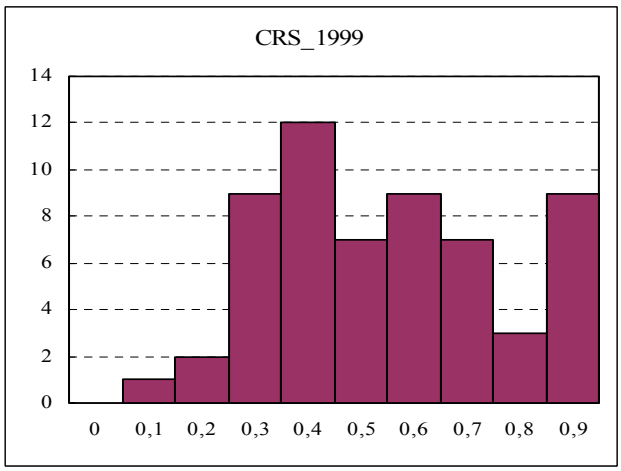
Source: Author's calculation

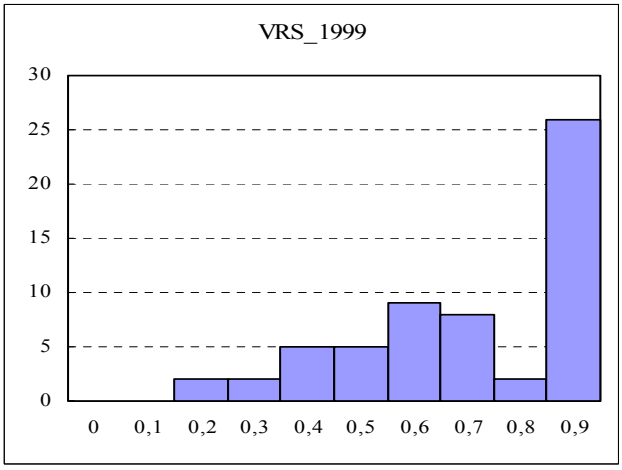
Descriptive statistics of efficiency scores – VRS **Table 6b**

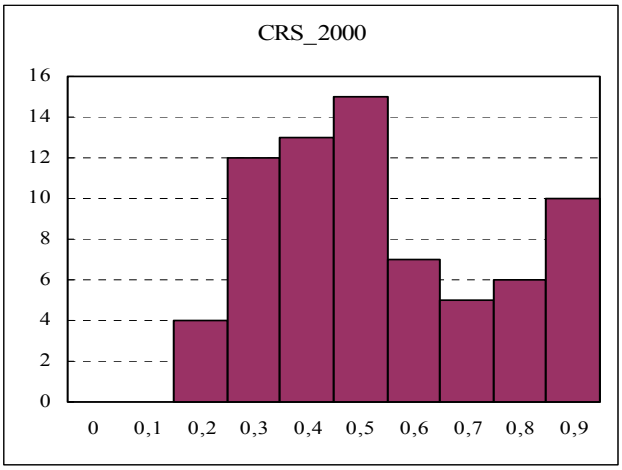
	No. DMUs	*No. effic. DMUs*	*mean*	*med*	*st.dev.*	*min*	*max*
1999	59	21	0.7691	0.7924	0.225985	0.2163	1.0000
2000	72	21	0.7962	0.8578	0.211820	0.2693	1.0000
2001	70	22	0.8045	0.8659	0.191907	0.2869	1.0000
2002	62	12	0.7367	0.7418	0.200694	0.1275	1.0000

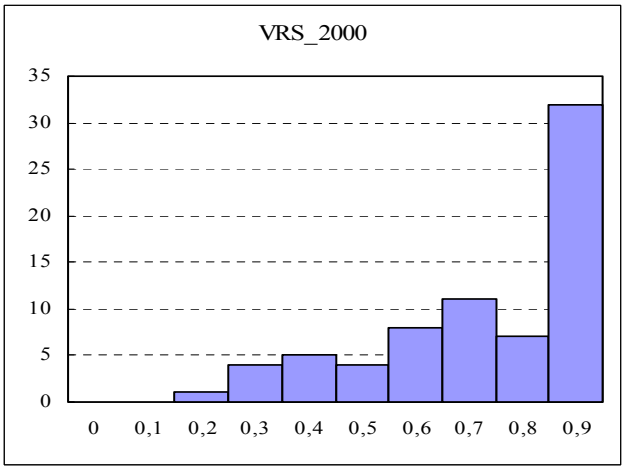
Source: Author's calculation

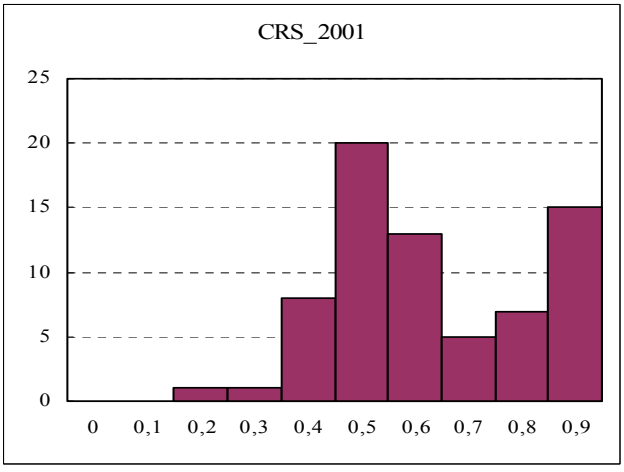
Frequency distribution of efficiency scores **Figures 1a – 1h**

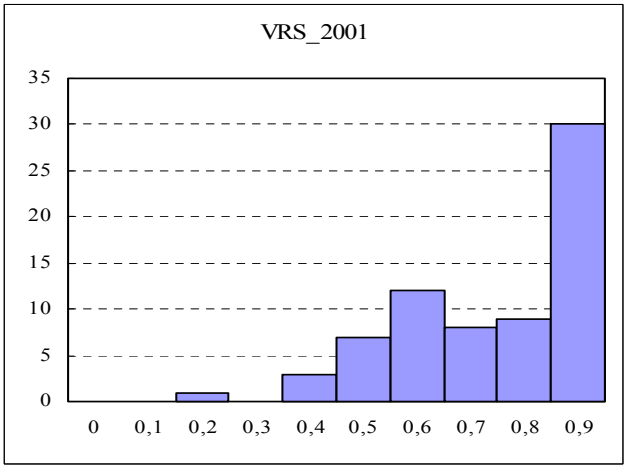


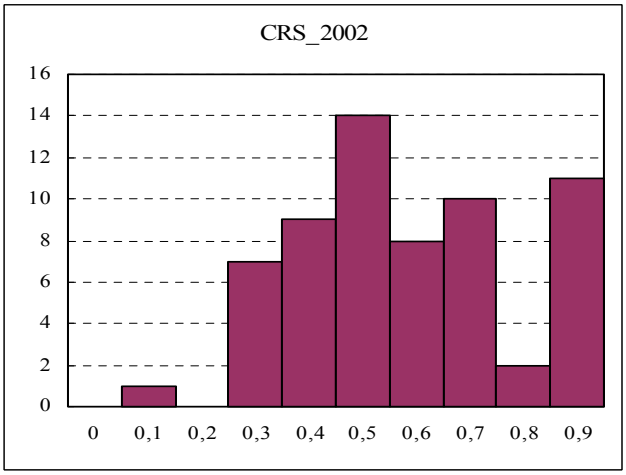


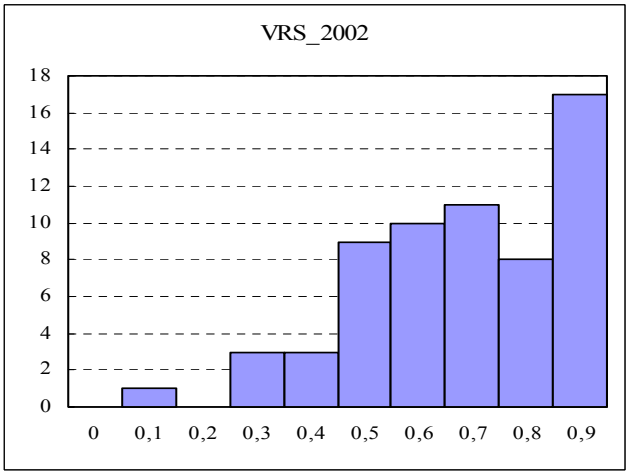












Average efficiency by country – CRS **Figure 2a**

Source: Author's calculation

Average efficiency by country – VRS **Figure 2b**

Source: Author's calculation

Composition of the efficiency frontier – CRS **Table 7a**

	CZE		*HUN*		*POL*		*SVK*	
	no.	***%***	***no.***	***%***	***no.***	***%***	***no.***	***%***
1999	4	50.0	1	12.5	3	37.5	0	0.0
2000	2	28.6	0	0.0	5	72.4	0	0.0
2001	2	22.2	2	22.2	4	44.5	1	11.1
2002	4	50.0	3	37.5	1	12.5	0	0.0

Source: Author's calculation

Composition of the efficiency frontier – VRS **Table 7b**

	CZE		*HUN*		*POL*		*SVK*	
	no.	***%***	***no.***	***%***	***no.***	***%***	***no.***	***%***
1999	10	47.6	3	14.3	8	38.1	0	0.0
2000	6	28.6	4	19.1	10	47.6	1	4.7
2001	6	27.3	5	22.7	10	45.5	1	4.5
2002	5	41.7	4	33.3	3	25.0	0	0.0

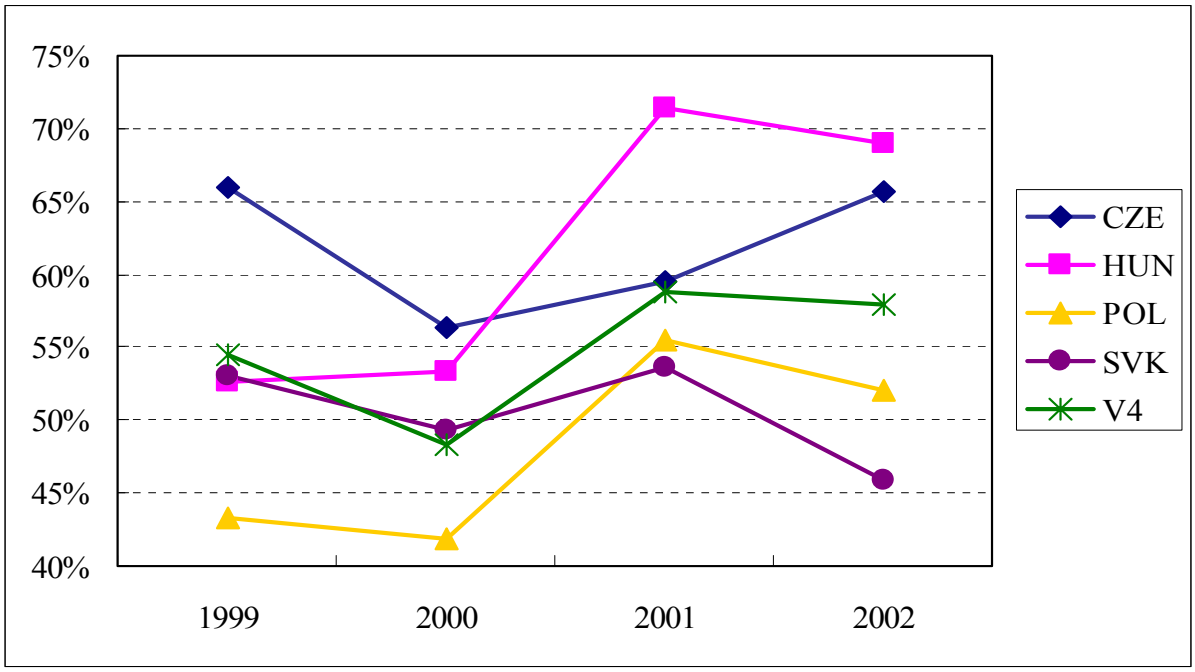
Source: Author's calculation

Scale inefficiency (in percent) **Table 8**

	CZE	***HUN***	***POL***	***SVK***	***V4***
1999	6.26	18.71	27.78	-2.36	13.76
2000	8.26	24.08	27.56	-14.20	15.85
2001	10.49	10.28	18.39	-4.63	11.11
2002	6.75	8.33	16.53	-8.89	7.50

Source: Author's calculation

Size-adjusted average efficiency by country – CRS **Figure 3a**



Source: Author's calculation

Size-adjusted average efficiency by country – VRS **Figure 3b**

Source: Author's calculation

Descriptive statistics of enviromental variables – 1999 **Table 9a**

	mean	*med*	*st.dev.*	*min*	*max*
ROE	0.0026	0.0633	0.3120	-1.2296	0.5799
EOTA	0.1288	0.0791	0.1737	0.0096	0.8318
ln FA	13.6632	13.6945	1.4619	10.3410	16.4964

Source: Author's calculation

Descriptive statistics of enviromental variables – 2000 **Table 9b**

	mean	*med*	*st.dev.*	*min*	*max*
ROE	0.0455	0.0788	0.2485	-0.7789	0.4858
EOTA	0.1009	0.0721	0.1411	0.0126	0.6789
ln FA	13.7127	13.7418	1.4442	10.3984	16.5569

Source: Author's calculation

Descriptive statistics of enviromental variables – 2001 **Table 9c**

	mean	*med*	*st.dev.*	*min*	*max*
ROE	0.0662	0.0865	0.2133	-0.5947	0.4938
EOTA	0.0931	0.0704	0.1297	0.0145	0.6425
ln FA	13.8844	13.7742	1.4252	10.3912	16.5726

Source: Author's calculation

Descriptive statistics of enviromental variables – 2002 **Table 9d**

	mean	*med*	*st.dev.*	*min*	*max*
ROE	0.0864	0.0961	0.1682	-0.4513	0.4382
EOTA	0.0835	0.0643	0.0752	0.0206	0.4431
ln FA	14.0329	13.8842	1.3857	10.5051	16.7763

Source: Author's calculation

Determinants of efficiency – Tobit model estimation **Table 10**

	1999		*2000*		*2001*		*2002*	
	coeff.	***p-value***	***coeff.***	***p-value***	***coeff.***	***p-value***	***coeff.***	***p-value***
intercept	0.84594	0.0000	0.71241	0.0000	0.55436	0.0000	0.91172	0.0000
CZE	0.29893	0.0000	0.31004	0.0000	0.24463	0.0000	0.30035	0.0000
HUN	-0.09730	0.0142	0.14196	0.0000	0.29377	0.0000	0.26882	0.0000
POL	0.19914	0.0000	0.12332	0.0074	0.11162	0.0107	-0.12119	0.0000
SVK	-0.18252	0.0000	-0.15109	0.0000	-0.10994	0.0000	-0.20883	0.0000
ROAE	0.10747	0.1834	0.10554	0.1133	0.12007	0.0471	0.16162	0.0324
EOTA	0.00098	0.7728	-0.00116	0.5967	-0.00788	0.6033	-0.00397	0.6125
ln TA	-0.00645	0.2423	0.01036	0.0424	0.00743	0.0494	0.00976	0.2581
FO	0.07491	0.1714	0.08281	0.1053	0.10348	0.0488	0.14590	0.0311
R^2	0.3732		0.3821		0.3649		0.3894	
log-likelih.	17.2602		17.6544		17.0512		17.7567	

Source: Author's calculation