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Privatization Matters: Bank Efficiency in Transition Countries

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Abstract

To investigate the impact of bank privatization in transition countries, we take the largest banks in six relatively advanced countries, namely, Bulgaria, the Czech Republic, Croatia, Hungary, Poland and Romania. Income and balance sheet characteristics are compared across four bank ownership types. Efficiency measures are computed from stochastic frontiers and used in ownership and privatization regressions having dummy variables for bank type. Our empirical results support the hypotheses that foreign-owned banks are most efficient and government-owned banks are least efficient. In addition, the importance of attracting a strategic foreign owner in the privatization process is confirmed. However, counter to the conjecture that foreign banks cream skim, we find that domestic banks have a local advantage in pursuing fee-for-service business. Finally, we show that both the method and the timing of privatization matter to efficiency; specifically, voucher privatization does not lead to increased efficiency and early-privatized banks are more efficient than later-privatized banks even though we find no evidence of a selection effect.

JEL Classifications: P30, P34, and P52

1. Introduction

Banking sectors in the transition economies of Central and Southeastern Europe were restructured dramatically the 1990s. Beginning with a financial organization that, in most cases, was designed to support the central planning apparatus, new governments moved to create modern commercial banking sectors immediately. The first rudimentary step was to divest commercial and retail activities from the portfolios of national banks and to set up new joint-stock banks with universal licenses that were fully state-owned initially. Bank privatization was an essential part of the financial reform agendas in these countries. Although much descriptive work exists on these financial sector reforms and bank privatizations, e.g., Bonin, Mizsei, Székely, and Wachtel (1998), no systematic empirical work was possible until sufficient time had elapsed to make the construction of a meaningful dataset possible. The basic issue to investigate is whether or not privatization improves bank performance. Although the theoretical literature indicates that private firms should outperform government-owned firms, empirical evidence is needed to confirm this theoretical hypothesis for banks in transition countries.

The empirical literature provides evidence of the influence of ownership on the performance of individual banks and on the effectiveness of the banking sector. In a cross-country study, La Porta, Lopez-De-Silanes, and Shleifer (2002) find that the performance of government-owned banks is inferior to that of private banks. Claessens, Demirgüc-Kunt and Huizinga (2001) investigate performance differences between domestic and foreign banks in eighty countries, both developed and developing, over an eight-year period from 1988 to 1995. These authors find that foreign bank entry was followed by a reduction in both the profitability and the overhead expenses of domestic

banks and that foreign banks in developing countries perform better than do domestic banks. For Latin American countries, Crystal, Dages, and Goldberg (2001) argue that foreign bank entry is associated with improved production of financial services and more banking competition; in addition, they claim that it facilitates the early waves of privatization of government-owned domestic banks. Hence, this empirical literature provides evidence that ownership matters; in particular, government ownership of banks is less efficient than private ownership and foreign bank entry has a salutary effect on banking sectors.

Much of the empirical literature on banking in transition countries addresses the impact of foreign bank entry on banking efficiency. Hasan and Marton (2003), Drakos (2003), and Fries and Taci (2003) demonstrate that the entry of more efficient foreign banks creates an environment that forces the entire banking system to become more efficient, both directly and indirectly, in transition countries. Buch (2000) compares interest rate spreads in the three fast-track transition countries, Hungary, Poland and the Czech Republic, from 1995 to 1999. She finds evidence confirming the hypothesis that foreign banks create a more competitive market environment in transition economies, but only after they have attained sufficient aggregate market share. A few studies examine the effects of ownership on individual bank efficiency. For Poland, Nikiel and Opiela (2002) find that foreign banks servicing foreign and business customers are more cost-efficient but less profit-efficient than other banks in Poland. Bonin, Hasan, and Wachtel (2003) examine the performance of banks in eleven transition countries and show that majority foreign ownership is associated with improved bank efficiency. However, these

authors cannot investigate privatization directly because their data do not distinguish among different types of foreign bank ownership.

Studies focusing specifically on the effects of bank privatization are less numerous. Verbrugge, Megginson and Owens (2000) document marginal performance improvements and increases in equity among privatized banks in OECD countries. For Argentina, Clark and Cull (1999, 2000) study the privatization process and show that the success of the provincial bank privatization depended on the effectiveness of the buyers. These authors find evidence that credit allocation and efficiency are higher in privatized banks. The transformation of the Argentine banking system occurred mainly through domestic mergers and acquisitions so that foreign banks played only a relatively minor role. In the transition countries, the prevalence of foreign strategic owners in formerly state-owned but subsequently privatized banks makes it crucial to distinguish these banks from foreign greenfield banks when analyzing bank privatization.

In this paper, we focus on six relatively advanced transition countries, namely, Bulgaria, the Czech Republic, Croatia, Hungary, Poland and Romania. We chose not to include banks in very small transition economies, e.g., the Baltic countries and Slovenia, and those in less advanced transition economies that have only recently restructured the banking system, e.g., the former Soviet Union, Albania and the other Balkan states. In the next section, we present a brief description of the privatization experiences in these six countries to establish that the strategies and the timing of privatizations are sufficiently different to allow us to use these experiences as the basis for an empirical analysis of privatization. Section 3 describes our dataset and presents the results of testing for differences in means across bank types for several measures of bank

performance and for several bank characteristics. Section 4 characterizes briefly our methodology of deriving profit and cost efficiency measures from stochastic frontier estimates that allow for country and year effects directly in a pooled data set. In this section, we relate the bank efficiency scores, as well as a measure of financial performance, to the type of ownership and the method of privatization in second-stage regressions. Section 5 concludes with a brief summary focusing on policy implications.

2. Bank Privatization in Six Transition Economies

Pre-transition banking sectors were designed to meet the needs of a centrally planned economy (CPE). Intermediation between savers and borrowers was internalized within the state banking apparatus basically through a system of directed credits to state-owned enterprises for both investment needs and budget allocations for the working capital necessary to meet the output plan. In most CPEs, large specialty banks performed specific functions. A state savings bank, with an extensive branch network, collected virtually all household deposits. A foreign trade bank handled all transactions involving foreign currency. An agricultural bank provided short-term financing to the agricultural sector. A construction bank funded long-term capital projects and infrastructure development. Hence, banking activities were both subservient to the plan and segmented along functional lines in CPEs.

In the transition economies (TEs), the first step in banking sector reform involved creating a two-tier system with commercial banking activities carved out of the old central bank. At the beginning of the decade, the new banking sectors in the former CPEs consisted of the newly created commercial banks and the specialty banks, both types

having universal banking licenses, along with a few foreign greenfield banks and often many relatively undercapitalized *de novo* domestic private banks that were born under lax entry requirements. Specialty banks had virtual monopolies in their core activities, e.g., the savings bank was often the only entity with an extensive enough branch network throughout the country to collect primary deposits. Typically, three or four large banks dominated the emerging banking sector in a TE. Both the newly created commercial entities and the specialty banks were state-owned initially. Hence, structural segmentation, a proliferation of weak small domestic private banks, and state-ownership of the large banks were the major features of banking sectors in TEs at the beginning of the 1990s.

These legacies affected the banking sectors in all of the countries in our sample with the exception of Croatia, which was part of Yugoslavia. From the 1950s, commercial banks in Croatia as well as the other republics were not state-owned but were owned collectively according to the Yugoslavian system of self-management. Virtually all foreign exchange deposits collected by the republic-level banks were remitted to the National Bank of Yugoslavia in Belgrade in exchange for credits in dinars. Upon succession in June 1991, the Yugoslavian government froze the foreign exchange deposits of Croatian banks. Hence, Croatian banks faced a currency mismatch between assets and liabilities creating large holes in their balance sheets after succession. At the end of 1995, four Croatian banks were selected for government rehabilitation because of the poor quality of their loan portfolios. Involvement in this program resulted in these banks being nationalized so that four large state-owned banks were created in Croatia in the middle of the 1990s.

The three more advanced TEs, i.e., Czech Republic, Hungary, and Poland, embarked on significantly different bank privatizations programs during the first half of the 1990s. Even before the political change, the Hungarian government had been receptive to foreign bank activity as it allowed three foreign banks to operate in the country from 1985. By the end of 1994, the Hungarian foreign trade bank had been purchased by a foreign owner and foreign investors held about 20% of total banking assets in Hungary. In the Czech Republic, three of the largest four banks participated in the first wave of voucher privatization in 1992. Investment funds, the largest of which were created by these banks, were an integral part of the Czech voucher privatization program. Hence, this initial divestiture of state holdings resulted in interlocking ownership with the state retaining large controlling stakes of voucher-privatized Czech banks. At the end of 1994, although foreign investors held about 6% of banking assets in the Czech Republic, none of the large banks had any foreign ownership. With some inducement from the G7 donor countries and international financial institutions, Polish authorities set a three-year timetable at the beginning of 1993 for privatizing the nine medium-sized, regional, state-owned banks that were created from the commercial portfolio of the national bank. However, by the end of 1994, only two of these banks had been privatized and only two more would be privatized before 1997. Foreign ownership of banking assets remained insignificant in Poland at about 2% in the mid-1990s.

Macroeconomic instability and financial sector distress made bank privatization infeasible in Bulgaria and Romania during the first half of the 1990s. By 1995, neither Bulgaria nor Romania had privatized any banks and foreign ownership of banking assets was negligible at less than 1% in both countries. In Croatia, only one small foreign bank

was operating in 1995 and there was hardly any foreign ownership of banking assets. Of the six countries, only Hungary and to a lesser extent Poland had committed to selling banks to foreign investors by the end of the first half of the 1990s. However, by the end the decade, five of the six countries were embarked on, or had completed, privatizations that would put at least 75% of their banking assets under foreign control by 2002.

The second half of the 1990s witnessed a flurry of bank privatizations in these countries. Appendix A lists the banks in our sample from each country ranked according to market share at the end of the decade. Information on each bank's status throughout the 1990s is provided and, when relevant, the bank's privatization is dated. Bank privatization proceeded relatively swiftly in Hungary; by mid-1997, eight of the top ten banks were majority foreign-owned. After a few initial bank privatizations, the Polish government became sidetracked by a bank consolidation initiative that was intended to fend off foreign competition. Nonetheless, a combination of mergers and privatizations involving foreign partners left foreigner investors holding more than 75% of Polish banking assets by 2000. Although the Czech government was late to recognize the importance of attracting strategic foreign investors for its large voucher-privatized banks, all major banks were sold to foreign owners by mid-2001.

Both of the southeastern TEs, i.e., Bulgaria and Romania, began bank privatization only in the late 1990s. After instituting a currency board and stabilizing the macroeconomic environment, the Bulgarian government privatized its first bank to a consortium of investors in 1997. By the end of 2000, eight of the ten largest banks in Bulgaria were foreign owned. Romania is a laggard in bank privatization compared to the other former CPEs. In 2000, foreign investors owned less than half of Romanian banking

assets and two of the three largest banks remained state-owned as late as 2003. Beginning in 1995 with virtually no holdings in Croatia, foreigner investors had acquired about 84% of banking assets by 2000 and, by 2002, all of the ten largest banks in the country were majority foreign owned.

In summary, Hungary was the first country to shed the legacies of the CPE by privatizing all but one of its major banks by mid-1997. In Poland, after some delay in the privatization timetable, only the zloty savings bank and the umbrella agricultural bank remain state-controlled. Initially, the Czech Republic placed three big banks in the voucher privatization program but, despite a late start, foreign investors gained control of all large Czech banks by mid-2001. The banking sectors in Bulgaria, Romania, and Croatia were financially distressed in the first half of the 1990s, albeit for different reasons, so that bank privatization could not begin until the late 1990s. Once started, sales of banks to foreign investors were rapid in Bulgaria and Croatia. Romania is the only one of the six transition countries in this study to retain significant government ownership in its banking sector through 2003 with only one of its three largest banks privatized.

3.   The Data and Bank Characteristics by Type

The dataset consists of the largest banks by asset size in the six selected countries. As is shown in Appendix A, the smallest bank in the sample has a market share ranging between 2% in the Czech Republic and 4% in Poland. Taken together, the large banks in

our sample hold more than 75% of the banking assets in their respective countries.[1]

Restricting the sample to large banks yields a more homogeneous set of observations than

is often found in other studies of banking in transition countries. Homogeneity is

important for investigating the effects of privatization on individual banks because

privatized state-owned banks are usually among the largest banks in their respective

countries. Moreover, our sample contains a sufficient number of large banks of various

types to make comparisons meaningful.

Balance sheet and income data are taken from Thompson's BankScope and

Bureau van Dijk. Data for each bank was examined to insure that all available relevant

information was used. Thus, we took care to avoid duplicating data for the same bank

when alternative accounting standards or different levels of consolidation are reported in

BankScope. The total number of bank observations is 451; a bank observation is datum

for an individual bank in a particular year. We have information for 67 different banks

from 1994 to 2002, although data are not available for every year for every bank.[2] Most

of the observations are for 1995 to 2001 as Table 1 indicates. In terms of country

coverage, Romania has the fewest observations accounting for 9.1% of the total while

Poland has the most at 25.5%.[3]

To facilitate our investigation of privatization, we divide the observations into

four mutually exclusive bank types, namely foreign greenfield, domestic *de novo*, state

owned, and privatized. As reported in Table 1, foreign greenfield banks constitute almost

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[1] There are not exactly ten banks for several countries because of data limitations. Moreover, by the end of
the 1990s, some of the large banks in several of the countries are the result of mergers and acquisitions;
whenever possible, we included the precursor organizations in our dataset.
[2] No data were available for three foreign banks listed in Appendix A because their balance sheets were
consolidated with their parent banks.
[3] The large proportion of bank observations from Poland reflects the mergers and acquisitions that took
place in that country in the late 1990s; when data are available we include observations for the major
predecessor banks.

a quarter of all bank observations, which indicates the importance of foreign penetration

into the banking sectors of these six transition countries. Domestic *de novo* banks make

up the smallest category because only a few of the domestic entrants in the early 1990s

grew to become one of the ten largest banks in its country by the end of the decade.

About 10% of the total, or about 38% of the observations in the state-owned category, are

banks that were not privatized during our sample period.[4] The majority of the

observations in the state-owned category represent the pre-privatization histories of banks

that were privatized within the sample time period. Adding the post-privatization

experiences of both these banks and those banks that were privatized throughout the

sample period to these pre-privatization histories encompasses almost half of all bank

observations in our sample.[5]

Privatization is concentrated in the post-1997 period as Table 1 indicates. The

three years prior to 1997 account for less than 20% of the observations for privatized

banks.[6] In contrast, about 79% of all privatized observations come from the years

between 1997 and 2001.[7] Table 1 contains additional information about the privatization

process. The column labeled strategic owner indicates that a strategic foreign investor

has a majority-controlling stake in a privatized bank or, in a few cases, in a domestic *de*

novo bank. By definition, foreign greenfield banks are controlled by a strategic foreign

owner but these banks are not included in this column. Almost one fourth of all the bank

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[4] Six large banks, two in Bulgaria (DSK and Biochim), two in Poland (PKO and BGZ), and two in
Romania (BCR and CEC), account for these observations as Appendix A indicates.
[5] Eight banks in the data set were privatized throughout the time period. These are the three voucher-
privatized Czech banks (KB, CS, and IPB), two banks in Hungary (MKB and General Banking Trust), and
three banks in Poland (BRE, BSK, and WBK). For these banks, we have no pre-privatization histories.
[6] In addition to the eight banks already identified, two banks in Hungary (OTP in 1995 and BB in 1996)
and two banks in Poland (BPH in 1995 and BG in 1996) are privatized prior to 1997.
[7] Only limited data were available for 2002 when the data set was constructed; there are 9 observations of
which 4 are for privatized banks.

observations are foreign greenfield operations and almost the same fraction is domestic

banks with a strategic foreign investor.   In about 74% of all privatized observations, the

bank has a strategic foreign owner. Across countries, the percentage of privatized

observations having a strategic foreign owner ranges from 43% in the Czech Republic,

mainly due to voucher privatization, and 50% in Romania, due to its late start on bank

privatization, to 72% in Hungary and more than 80% in Bulgaria, Croatia, and Poland.

To investigate whether bank privatization matters, we report the means for

various performance measures and characteristics by bank type in Table 2. With the

exception of assets, all means are adjusted to remove country and year fixed effects.[8]

The means are shown for each of the four ownership categories and for the whole sample.

In addition, the last two columns show the means for the pre-privatization histories and

the post-privatization experiences of the banks privatized in our sample period. Table 3

contains signed t-statistics for tests comparing the means between privatized banks and

each other bank type as well as between post-privatization histories and pre-privatization

experiences. A positive (negative) sign on a t-statistic indicates that privatized banks

have a higher (lower) mean for that measure than do banks in the comparison category.

Statistical significance at the 5% or better level is represented by a bold t-statistic in

Table 3.

Taking bank characteristics first, privatized banks are the largest of the four

classes and foreign greenfield banks are the smallest at about half the average size of

domestic *de novo* banks. To some extent, the difference in the mean asset size of state-

owned and privatized banks reflects the timing of privatization. The first and last

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[8] The adjustment is made by regressing the particular bank characteristic on dummy variables for countries
and years. The adjusted value is the regression residual plus the overall mean; hence, it has the country and
year effects removed.

columns of Table 3 present the effects of the bank privatization process. Prior to privatization, banks are recapitalized and their balance sheets are cleaned of some bad loans. Reflecting this preparation, the equity ratio increases significantly and becomes comparable that of foreign greenfield banks in privatized banks. However, privatization is not associated with a significant decrease in loan loss provisioning or liquid asset holding. Relative to foreign greenfield banks, privatized banks have higher liquid asset and loan loss provision ratios.   The high liquid asset ratio of privatized banks reflects the legacy of state ownership on their balance sheets even though their equity ratios become comparable to those of foreign greenfield banks.

Regarding performance measures, the most popular one used in the financial literature is return on assets (ROA). From Tables 2 and 3, ROA is significantly higher in privatized banks than in either state-owned or domestic *de novo* banks and lower, but not significantly so, than in foreign greenfield banks. After privatization, ROA increases dramatically from less than one-half of one percent to over one and a half percent. To investigate the profitability of privatized banks further, we take net interest margin to represent a profit rate on lending and the commission-to-income ratio to represent the profitability of fee-for-service activities. Net interest margin is higher in privatized banks than in domestic *de novo* private banks but it is not significantly different between privatized banks and either state-owned or foreign greenfield banks nor does it increase significantly after privatization. Somewhat surprisingly, privatized banks have the highest commission income ratio and one significantly greater than that of foreign greenfield banks; this ratio also increases significantly after privatization. The presence of a

strategic foreign owner in most privatized banks may explain the increased focus on fee-for-service business after privatization.

On the cost side, privatized banks have lower cost ratios than state-owned banks but higher ratios than foreign greenfield banks; although the cost ratio drops by about 20% after privatization, this decrease is not statistically significant at the 5% level. To probe cost management further, we consider the non-interest expenditure ratio. Privatized banks are outperformed again by foreign greenfield banks but there are no significant differences with other types. After privatization, this ratio increases although not significantly perhaps indicating the need to incur expenses to modernize and upgrade technology.

Turning to the intermediation measures, privatized banks have significantly lower loan-to-asset ratios and significantly higher deposit-to-assets ratios than foreign greenfield banks. No other differences are statistically significant. Hence, privatized banks retain their comparative advantage in collecting primary deposits.[9] However, despite having a smaller domestic deposit base, foreign greenfield banks are more aggressive than privatized banks in lending to domestic firms. Overall, our results indicate that privatization improves the financial and business situation of banks in these transition countries, making them comparable to foreign greenfield banks in some respects, but it has no statistically discernible impact on intermediation. Financially speaking, privatization matters in terms of increased profitability, more fee-for-service income, and, to a lesser extent, improved cost management.

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[9] The measure of deposits does not differentiate between primary, i.e., household deposits, and commercial deposits. Since commercial deposits are strongly positively correlated with business loans, we infer that privatized banks are still the major collectors of primary deposits in these countries.

4.   Efficiency Estimates and Regression Results

Although the accounting data are informative, we focus on efficiency measures to investigate the impact of ownership and privatization on bank performance. Berger, DeYoung, Genay and Udell (2000) review the literature on applying stochastic frontier analysis (SFA) to estimate bank efficiency. Bonin, Hasan, and Wachtel (2003) use this approach to examine the efficiency of banks in transition economies. In this paper, we use similar frontier specifications so that we provide only a brief summary of the salient features.

The model estimated for cost efficiency is given by:

$$Y_{it} = f(X_{it}, P_{it}, Z_{it}) + v_{it} + u_{it,}$$

where Y represents total costs that are a function of various outputs, X, the price of inputs, P, and fixed effects for years and countries, Z. As is common in the efficiency literature, we use a translog specification for the function with standard symmetry and homogeneity assumptions. The random disturbance term has two components; v_{it} represents measurement error and other uncontrollable factors, while u_{it} represents technical and allocative inefficiency. The frontier approach maintains that managerial or controllable inefficiencies, i.e., u_{it}, increase costs above the frontier or best-practice levels that are subject to random fluctuations, i.e., v_{it}. We use a similar specification for the profit function except that Y is total profits and the disturbance becomes v_{it} - u_{it} because managerial inefficiency reduces profits below the frontier or best practice level.

The v_{it} terms are assumed to be identically distributed as normal variates with zero mean and variance equal to σ_v^2. The u_{it} terms are nonnegative random variables distributed normally but truncated below zero. We assume that the u_{it} terms are

distributed independently but not identically. Hence, for the i–th bank in year t, technical inefficiency, u_{it}, is assumed to follow a half normal distribution with a non-constant variance, i.e., $N(\mu, \sigma^2_{u\,it})$. Because structural conditions in the banking sector and general macroeconomic conditions may generate differences in banking efficiency from country to country and over time, we include both country effects and time effects in the estimation of the frontier. Specifically, the year and country effects appear in the cost and profit functions directly and as determinants of the variance, i.e., $\sigma^2_{u\,it} = Z_{it}\,\delta$.

Total costs are the sum of interest and non-interest costs. The output variables are total deposits, total loans, total liquid assets and investments other than loans and liquid assets. The input prices are the price of capital, measured by the ratio of non-interest expenses to total fixed assets, and the price of funds, measured by the ratio of interest expenses to total deposits. Total profit is measured by net profit earned by the bank. The output variables and costs or profits are normalized by total loans and the input variable is the ratio of the price of capital to the price of funds. Thus, the specification assumes homogeneity with respect to prices and constant returns to scale. Following the literature, we add a constant amount to profit for all banks to avoid having negative net profits for any bank observation so that we may take logarithms of all profit function variables. We also estimated frontiers with alternative measures of cost and profit. The cost frontier for non-interest expenditure is virtually identical to the total cost frontier and is not discussed. The profit function using commission income is included in the ownership regressions below. The stochastic frontiers are estimated with the LIMDEP Version 8 developed by William Greene.[10]

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[10] Econometric Software, Inc. (www.limdep.com).

Summary statistics for estimates of the stochastic frontiers are given in Appendix

B. These statistics are the ratio of the standard deviation of the inefficiency component

of the disturbance to the random component (σ_u / σ_v), the standard deviation of the

composite disturbance (σ), and the proportion of the variance in the overall disturbance

that is due to inefficiency, $\lambda = \sigma_u^2 / \sigma^2$. As Appendix B indicates, most of the variation in

the disturbance from best practice is due to technical inefficiency rather than random

error. Since the cost and profit frontiers are translog functions, efficiency is defined as

e^{-u}, where u is the estimated inefficiency. Hence, efficiency is always positive and it is

equal to one for the best-practice or zero-inefficient bank. Individual bank efficiency is

measured relative to best practice; the means and standard deviations of cost and profit

efficiency are reported in Appendix B.

To investigate the impact of privatization on bank efficiency, we take the

efficiency scores for each bank observation as the dependent variable in second-stage

regressions having dummy variables for bank type as explanatory variables. The

regression coefficients are shown in Table 4; the omitted ownership category is domestic

de novo private banks. All of the regressions include dummy variables to account for

country and year fixed effects, although the coefficients of these variables are not

reported. Because bank privatizations in these six countries usually involve selling a

state-owned bank to a strategic foreign owner, we include a dummy variable to test for

the incremental impact of strategic foreign ownership. [11] The dependent variables for the

four regressions in Table 4 are cost and profit efficiency, an alternative measure of profit

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[11] In 74% of all privatized-bank observations, a strategic foreign owner is present. If the observations for
the Czech voucher-privatized banks are excluded, this percentage is even higher.

efficiency, i.e., commission income efficiency, and a performance measure, i.e., ROA, for comparison.

Taking ROA first, ownership type explains very little of the overall variation in this financial performance measure.[12] Foreign greenfield banks (C1) and privatized banks (C4) have significantly higher ROAs than domestic private banks, by 2% and 1.6% on average respectively, but the presence of a strategic foreign owner (S) has no additional impact on ROA. In the final two rows of Table 4, we include the p-values for tests of differences between privatized banks (C4) and state-owned banks (C3) and between privatized banks having a strategic foreign owner (C4 + S) and state-owned banks. In both cases, privatized banks have significantly higher ROAs than their state-owned counterparts. This analysis confirms our earlier means tests indicating that privatized banks have higher earnings than state-owned banks in these transition countries.

Turning to the efficiency regressions, we find that these regressions explain a substantial percentage of the variation in efficiency.[13] Foreign greenfield banks are significantly more cost and profit efficient and state-owned banks are significantly less cost and profit efficient than domestic private banks. Although privatized banks are significantly less profit efficient than domestic private banks, the presence of a foreign owner improves the profit efficiency of a bank significantly. No significant differences are found between privatized banks and domestic private banks regarding cost efficiency. Other comparisons relevant to the impact of privatization are shown by the hypothesis

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[12] Much of the explained variation is due to country and year fixed effects that are not reported in the table. Regressions using other performance measures, which we do not report, exhibit even weaker explanatory power.
[13] The coefficient of variation for ROA is 2.9 while it is 0.5 or less for the three efficiency measures.

tests in the final two rows of the table. Specifically, all privatized banks and privatized banks having a strategic foreign owner are significantly more cost efficient than state-owned banks. When all privatized banks are considered, no significant difference in profit efficiency relative to state-owned banks is found. However, the presence of a strategic foreign owner yields significantly higher profit efficiency. Hence, attracting a strategic foreign owner in the privatization process improves both profit and cost efficiency.

The regression using an efficiency measure based on commission income confirms our earlier means tests. Foreign greenfield banks are significantly less efficient than domestic private banks in fee-for-service activities even though the literature suggests that these banks were involved in targeting this profitable business in the transition economies. Moreover, all privatized banks are significantly more efficient at attracting fee-for-service business than are state-owned banks, although the coefficient measuring the incremental impact of a strategic foreign owner is not significant. Taken together, our results suggest that domestic private banks, either *de novo* or privatized, have a local comparative advantage in generating fee-for-service income and that banks focus more on, and become more efficient at, this activity after privatization.

In summary, the ownership regressions indicate that, compared with other bank types, foreign greenfield banks are the most efficient, except in generating fee-for-service business, and that state-owned banks are the least efficient. In addition, we find evidence that having a strategic foreign owner matters to bank efficiency after privatization. To investigate directly the impact of privatization, we divide the state-owned category into two groups: banks that are always state-owned in our sample (C30) and observations

representing the state-owned pre-privatization histories of banks that are privatized within the sample period (C31). In addition, we divide the privatized category into three groups: banks that are always privatized in our sample excluding voucher privatized banks (C40), denoted early-privatized banks, observations representing the post-privatization experiences of banks that are privatized during the sample time period (C41), denoted later-privatized banks, and observations representing the voucher experiences of the three Czech banks (C42), denoted voucher-privatized banks.[14]

The impact of privatization on cost and profit efficiency is shown in the regressions in Table 5; country and year dummies are included but their coefficients are not reported. The coefficients for foreign greenfield banks change very little in magnitude from Table 4; they remain positive and highly significant as expected. State-owned banks that were not privatized during the sample period (C30) remain significantly less efficient than domestic private banks by both measures. Although later-privatized banks are also less cost efficient than domestic private banks during their state-owned years, the statistical significance of this difference is lower than it is for banks that remain state-owned throughout the sample period. No other coefficients are significant in the cost efficiency regression; in particular, having a strategic foreign owner does not lead to an increase in cost efficiency for privatized banks.

The p-values for additional hypothesis tests provide some evidence that the timing of privatization matters to cost efficiency. First, early-privatized banks (C40) are significantly more cost efficient than banks that remain state-owned throughout the sample (C30). Second, early-privatized banks (C40) are significantly more cost efficient

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[14] In our sample, we have four observations that pertain to years in which the Czech banks were privatized to strategic foreign investors. These observations are included in C41 not C42 so that C42 contains only the voucher experiences of these three banks.

relative to the pre-privatization histories of banks that are privatized in the sample (C31).

In addition, a comparison of later-privatized banks (C41) with their state-owned pre-

histories (C31) does not yield significant improvements in cost efficiency even when the

incremental effect of a strategic owner is added (C41 + S). Finally, early-privatized

banks (C40) are significantly more cost efficient than later-privatized banks (C41),

indicating that the timing of privatization is important. Our results suggest that achieving

the full impact of privatization on cost efficiency may take some time.[15]

These timing results are confirmed in the profit regression; in addition, the

importance of the method of privatization is shown. First, voucher privatization does not

compare with private ownership; voucher-privatized banks are significantly less profit

efficient than domestic private banks. Second, voucher privatization does not lead to any

improvement in profit efficiency; the comparison of voucher-privatized banks (C42) with

the state-owned pre-privatization histories of privatized banks (C31) indicates no

significant difference. Third, the comparison of voucher-privatized banks with early-

privatized banks (C40) indicates that voucher-privatized banks are significantly less

profit efficient than their counterparts that are privatized by other methods. Finally, later-

privatized banks that attract a strategic foreign owner (C41 + S) are significantly more

profit-efficient than voucher-privatized banks. Hence, we find no evidence of any

significant improvement in efficiency attributable to voucher privatization.[16]

Finally, the positive impact on profit efficiency of having a strategic foreign

owner, which we find in the ownership regression, is confirmed in the privatization

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[15] We tested for selection effects in the privatization process between banks that remain state-owned
throughout the sample (C30) and the pre-privatization histories of later-privatized banks (C31). No
significant differences between these coefficients are found in either the cost or the profit regression.
[16] Similar comparisons of voucher-privatized banks with other bank types yield no significant differences in
the cost efficiency regression.

regression. The coefficient measuring the incremental effect of a strategic foreign owner is positive and significant at the 5% level in the profit regression. Moreover, the importance of attracting a strategic foreign owner is evident from the comparison between post-privatization experiences and pre-privatization histories. Comparing all later-privatized banks (C41) to their pre-privatization histories (C31) yields no significant difference in profit efficiency. However, when the incremental effect of a strategic foreign owner is included (C41 + S), the difference is significant at about the 6% level. Hence, we find evidence that attracting a strategic foreign owner in the privatization process increases a bank's profit efficiency.

In conclusion, the differences in the hypothesis tests using cost and profit efficiency measures suggest that, although banks sold to foreign owners are not more cost-efficient immediately after privatization, they do manage revenues more efficiently. The means test in Table 3 and the ownership regression in Table 4 indicate that banks pursue more fee-for-service business and do so more successfully after privatization. Taken together, these results suggest that privatized banks with strategic foreign owners redirect their attention to this profitable business. However, generating commission income requires an upgrading of both technology and human capital, which may have adverse effects on the cost side of the ledger for privatized banks and explain the insignificant findings for cost efficiency. Moreover, the robust result that early-privatized banks are more efficient than later-privatized banks suggests that more time may be needed to achieve the full benefits of bank privatization in transition countries. Finally, our findings indicate that voucher privatization does not lead to any increase in bank efficiency while attracting a strategic foreign investor results in higher profit

efficiency. Hence, we conclude that both the method and the timing of privatization matter to bank efficiency.

5. Conclusion

Our empirical analysis confirms the propositions in the literature that government ownership of banks is inefficient and that the entry of foreign banks, which are the most efficient of all bank types, improves the performance of banking sectors in transition countries. The strategy of privatizing large state-owned banks by selling them to strategic foreign investors after recapitalization and cleaning the balance sheets, espoused by the policy literature for small, open transition countries, is supported by our empirical findings. In terms of equity and earnings, privatized banks resemble foreign greenfield banks although they have higher loan loss provisions and more liquid portfolios. In contrast to the conjecture in the literature that foreign banks engage in cream skimming, we find that domestic banks, both privatized and *de novo*, are more successful in pursuing fee-for-service business than are foreign banks. Although privatized banks retain their inherited ability to collect primary deposits, they make fewer loans relative to assets than do foreign banks and focus more on commission income after privatization. Disappointingly, we find no evidence that these newly privatized banks are contributing to improving the effectiveness of financial intermediation in their respective countries.

Our empirical evidence indicates that the timing of privatization affects bank efficiency. Early-privatized banks are more efficient than later-privatized banks. In addition, compared to their pre-privatization histories, later-privatized banks are not more efficient. Although this might indicate that the better banks were privatized first, we find

no statistically significance evidence that the state-owned banks remaining to be privatized are less efficient than were the privatized banks when they were state owned. Because we find no evidence of a selection effect, we attribute the above efficiency differences to a lag in achieving the full benefits of privatization. We do find that banks having a strategic foreign owner are more profit, but not cost, efficient after privatization. Taking into account the change in business strategy of focusing more on commission income after privatization, we infer that privatized banks incur increased cost to upgrade their technology and human capital to compete successfully for this profitable fee-for-service business but that this investment affects adversely current cost efficiency.

The method of privatization also matters. We find no evidence of any improvements from voucher privatization; for example, early-privatized banks are significantly more profit efficient than voucher-privatized banks during a comparable time period. We find evidence to support the prescribed policy of attracting a strategic foreign owner in the privatization process. Later-privatized banks are not more efficient until the impact of a strategic foreign owner is considered. In addition, banks having a strategic foreign owner are more profit efficient after privatization but such comparisons for all later-privatized banks do not yield this result. Finally, as a cautionary note for further research, our empirical results indicate that financial performance measures are not sufficient to detect the impact of bank privatization in transition countries.

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Table 1

Distribution of Observations across Bank Types

	Foreign Greenfield (1)	Domestic *De novo* (2)	State Owned (3)	Privatized (4)	**TOTAL**	Strategic Owner
Bulgaria	15 *(22.1)*	0 *(0)*	37 *(54.4)*	16 *(23.5)*	**68** **(15%)**	*19%*
Czech Rep	22 *(33.8)*	9 *(13.8)*	6 *(9.2)*	28 *(43.1)*	**65** **(14.4%)**	*18%*
Croatia	22 *(28.2)*	38 *(48.7)*	11 *(14.1)*	7 *(9.0)*	**78** **(17.3%)**	*14%*
Hungary	28 *(33.3)*	4 *(4.8)*	13 *(15.5)*	39 *(46.4)*	**84** **(18.6%)**	*33%*
Poland	8 *(7.0)*	16 *(13.9)*	46 *(40.0)*	45 *(39.1)*	**115** **(25.5%)**	*31%*
Romania	15 *(36.6)*	8 *(19.5)*	12 *(29.3)*	6 *(14.6)*	**41** **(9.1%)**	*7%*
TOTAL	**110** **24.4%**	**75** **16.6%**	**125** **27.7%**	**141** **31.3%**	**451** **100.0%**	*23%*

Notes

(i)   Entries are numbers of bank observations.
(ii)   The *percentage distribution by bank type* within each country is in parentheses.
(iii)   The column labeled **TOTAL** shows the number of observations in each country and the percentage distribution.
(iv)   The row labeled **TOTAL** shows the number of observations by bank type and the percentage distribution.
(v)   For strategic owner, the number shown is the percentage of all bank observations in the row.

	1994	1995	1996	1997	1998	1999	2000	2001	2002
Number	47	55	55	54	59	59	59	54	9
Number Privatized and %	6 13%	9 16%	11 20%	16 30%	19 32%	24 41%	27 46%	25 46%	4 44%

Table 2

Bank Performance and Characteristics by Bank Type

	Foreign Greenfield	Domestic *De Novo*	State Owned	Privatized	TOTAL	Banks Privatized in Sample*	
						Pre	Post
Return on Assets	0.0224	0.0051	0.0042	0.0176	0.0133	0.0047	0.0158
Commission income ratio	0.014	0.0164	0.0130	0.0186	0.0155	0.0145	0.0204
Net interest margin ratio	0.0417	0.0375	0.0424	0.0439	0.0422	0.0388	0.0449
Cost ratio	0.1005	0.1434	0.1862	0.1302	0.1402	0.1631	0.1331
Non interest expenditure ratio	0.0446	0.0713	0.0754	0.0649	0.0652	0.0619	0.0686
Loan ratio	0.4801	0.3945	0.3734	0.3797	0.4038	0.3745	0.3526
Deposit ratio	0.7542	0.7583	0.7850	0.7769	0.7690	0.7738	0.7754
Liquid asset ratio	0.4378	0.4340	0.4932	0.4924	0.4707	0.4924	0.5185
Equity ratio	0.1171	0.1009	0.0729	0.1122	0.1041	0.0855	0.1187
Loan loss provision ratio	0.0083	0.0171	0.0177	0.0133	0.0142	0.0135	0.0103
Assets (000$) Not adjusted	813,024	1,606,922	3,036,874	4,742,269	2,798,652	2,501,847	4,073,382

Notes

(i)   The total sample size is 451, although not all data are available for every variable.
(ii)   All variables, except return on assets and assets, are ratios to total assets.
(iii)   Each entry, except assets, is adjusted to remove the fixed country and year effects.

* These columns include observations for banks that were privatized in our sample only; there are 78 pre-privatization histories and 83 post-privatization bank experiences. However, observations for the second privatizations of the Czech voucher privatized banks are not included.

Table 3

Significance of Differences in Bank Performance and Characteristics

	Privatized banks less:			Post less pre-privatization
	State owned	Domestic *De Novo*	Foreign Greenfield	
Return on Assets	**2.58**	**2.92**	-1.47	**2.12**
Commission income ratio	**5.18**	1.68	**4.29**	**3.73**
Net interest margin ratio	0.39	**2.95**	1.12	1.57
Cost ratio	**-3.68**	-1.48	**4.76**	-1.75
Non interest expenditure ratio	-1.06	-0.86	**4.97**	0.63
Loan ratio	0.38	-0.84	**-5.59**	-1.05
Deposit ratio	-0.81	1.41	**1.97**	0.11
Liquid asset ratio	-0.04	**2.76**	**2.93**	1.09
Equity ratio	**5.17**	**2.14**	-0.25	**3.37**
Loan loss provision ratio	-0.73	-0.78	**2.59**	-0.50
Assets (Not adjusted)	**3.25**	**7.26**	**9.81**	**2.65**

Notes (in addition to those to Table 2)

(i)   The entries are signed t-statistics for the significance of the difference specified.
(ii) **Bold** entries are significant at approximately the 5% level or better.

Table 4

Ownership regressions

		Cost efficiency	Profit efficiency	Commission income efficiency	Return on assets
Constant		0.762*	0.265*	0.835*	-0.004
		(.026)	(0.039)	(0.024)	(0.008)
Foreign Greenfield	C1	0.070*	0.170*	-0.051*	0.020*
		(0.019)	(0.029)	(0.018)	(0.006)
State owned	C3	-0.061*	-0.153*	-0.038#	0.000
		(0.020)	(0.029)	(0.018)	(0.006)
Privatized	C4	-0.006	-0.172*	0.038	0.016*
		(0.022)	(0.032)	(0.020)	(0.007)
Strategic owner	S	0.016	0.123*	-0.035	0.000
		(0.021)	(0.032)	(0.020)	(0.007)
Adjusted R^2		.709	.441	.712	.075
HYPOTHESIS TESTS					
Privatized vs. State owned	H_0: C4 = C3	.0081	.5691	.0001	.0135
Privatized with strategic owner vs. state owned	H_0: C4+S =C3	.0024	.0002	.0234	.0086

Notes

(i)   The omitted category is domestic private banks.
(ii)   The sample size is 435.
(iii)   All regressions include fixed effects for years and countries, although these coefficients are not reported.
(iv)   Standard errors are in parentheses.
(v)   For regression coefficients, the symbol * indicates significance at the 1% level and the symbol # indicates significance at the 5% level.
(vi)   For hypothesis tests, entries are the significance levels for χ^2 tests for rejection of the null hypotheses indicated.

Table 5

Privatization Regressions

		Cost efficiency	Profit efficiency
Constant		0.762* (0.027)	0.292* (0.041)
Foreign Greenfield	C1	0.067* (0.019)	0.163* (0.029)
Always state owned	C30	-0.076* (0.024)	-0.139* (0.035)
State owned prior to privatization in sample	C31	-0.049# (0.021)	-0.160* (0.032)
Always privatized	C40	0.048 (0.030)	-0.034 (0.045)
Privatized in sample	C41	-0.022 (0.024)	-0.178* (0.036)
Voucher privatization	C42	-0.013 (0.036)	-0.244* (0.053)
Strategic owner	S	0.004 (0.023)	0.085# (0.034)
Adjusted R^2		.713	.461
HYPOTHESIS TESTS			
Privatized early or late	H_0: C40 = C41	.0036	.0001
Strategic owner matters	H_0: S = 0	.8786	.0141
Voucher differs	H_0: C40 = C42	.1649	.0012
	H_0: C31 = C42	.3105	.1156
	H_0: C41 = C42	.8095	.2497
	H_0: C41+S = C42	.8753	.0063
	H_0: C40+S = C42	.1110	.0000
Privatization matters	H_0: C30 = C40	.0001	.0256
	H_0: C31 = C41	.2753	.6246
	H_0: C30 = C40+S	.0000	.0000
	H_0: C31 = C41+S	.1974	.0623
	H_0: C40 = C31	.0016	.0060

Notes: See the notes to Table 4.

Appendix A

Ownership and Market Share of Large Banks in Six Transition Economies

	Asset Share	Ownership	Strategic owner
Bulgaria	**(2000)**		
Bulbank	25.4	Privatized 10/ 00	10/00
United Bulgarian Bank (UBB)	12.4	Privatized 5/97	7/00
Derzhavna Spestovna Kassa (DSK)	12.1	Privatized	5/03
Biochim Bank	5.3	Privatized	10/02
Bulgarian Post Bank	5.2	Privatized	11/98
SG Express Bank	4.5	Privatized	11/99
BNP-Dresdnerbank	3.5	Foreign Greenfield	
Hebrosbank	3.4	Privatized	3/00
First Investment Bank	3.3	Foreign Greenfield	
ING –Sofia	2.7	Foreign Greenfield	
Total	*77.8*		
Croatia	**(2000)**		
Zagrebacka Banka	28.9	Domestic Private Shares sold 12/99	3/02
Privredna Banka Zagreb	18.3	Domestic private; Nationalized 1996; Privatized 12/99	12/99
Splitska Banka	7.1	Domestic private; Nationalized 1996; Privatized 5/00	5/00
Rijecka Banka	7.0	Domestic private; Nationalized 1996; Privatized 4/00	4/00
Raiffeisen Bank	4.5	Foreign Greenfield	
Hypo-Alde-Adria-Bank	3.4	Foreign Greenfield	
Dubrovacka Banka	2.9	State owned, acquired by Dalmatinska 2/02	
Erste&Steiermaerkische Bank	2.7	Foreign Greenfield	
Varazdinska Banka	2.6	Domestic private; Acquired by Zagrabacka Banka 6/00	
Dalmatinska Banka	2.3	Domestic private	10/00
Total	*79.7*		

Czech Republic	**(June 2001)**		
Ceskoslovenska Obchodni Banka (CSOB)	21.4	Privatized 6/99 Merged with IPB 6/00	6/99
Investicni a Postovni Banka (IPB)	(part of CSOB)	Voucher privatization 12/92	3/98
Komercni Banka	18.4	Voucher privatization 12/92	6/01
Ceska Sporitelna (CS)	15.7	Voucher privatization 12/92	2/00
Konsolidacni banka * (Not a commercial bank)	9.0	State owned bank for bad debts during bank restructuring.	
GE Capital (Agrobanka)	2.9	Private domestic; Nationalized 1996; Privatized 1998	1998
Commerzbank*	2.7	Foreign Greenfield	
Bank Austria / Credit Anstalt (BACA)	2.6	Foreign Greenfield	
Citibank	2.6	Foreign Greenfield	
HypoVeriensbank	2.3	Foreign Greenfield	
Deutsche Bank*	2.1	Foreign Greenfield	
Zivnostenska Bank	2.0	Domestic private	2/03
ABN AMRO*	2.0	Foreign Greenfield	
Total (with Konsolidacni bank excluded from banking sector)	*80.0*		
Hungary	**(1999)**		
National Savings and Commercial Bank (OTP)	25.1	Privatized 7/95	
Hungarian Foreign Trade Bank (MKB)	9.6	Privatized 7/94	1996
Central-European International Bank (CIB)	8.0	Private domestic	1998
Kereskedelmi es Hitelbank (K&H)	7.7	Privatized 7/97 Merged with ABN Amro 7/01	7/01
ABN Amro / Magyar Hitel Bank	5.8	Privatized 12/96 Merged with K&H 7/01	12/96
Postabank	4.7	Private domestic; Nationalized 1998	
Budapest Bank (BB)	4.1	Privatized 12/95	12/95
Bank Austria – Creditanstalt Hungary	4.1	Foreign Greenfield	
Raiffeisen Bank	3.7	Foreign Greenfield	
General Banking Trust	3.5	Privatized 1990	1996
Total	*76.3*		

Poland	(1999)		
Powszechny Kasa Oszczednosci-Bank Panstwowy (PKO BP)	17.6	State owned	
Bank Polska Kasa Opieki S.A. Group (PeKaO SA)	17.5	Privatized 6/98	6/99
Bank Przemyslowo-Handlowy+Powszechny Bank Kredytowy (BPH+PBK)	9.5	BPH privatized 1/95 PBK privatized 10/97 Merger 12/01	BPH 11/99 PBK 10/97
Bank Handlowy+Citibank	8.0	Privatized 6/97 Merged with Citibank 2/00	2/00
Bank Inicjatyw Gospdarczch+Bank Gdanski (BIG + BG)	6.3	BIG Domestic private BG privatized 12/95 Merger 9/98	1/01
Bank Slaski+ING-Barings (ING)	5.5	Privatised 9/93 Merged with ING 4/01	7/96
Wielkopolski Bank Kredytowy+ Bank Zachodni (WBK + BZ)	5.4	WBK privatized 3/93 BZ privatized 1999 Merger 12/00	WBK 4/97 BZ 1999
Bank Gospordarki Zywnosciowej (BGZ)	5.1	State owned	
Kredyt Bank	4.3	Private domestic	1999
Bank Rozwoju Eksportu (BRE)	4.2	Privatized 6/92	10/00
Total	*83.4*		

Romania	(March 2002)		
Banca Comercială Română (BCR)	31.2	State owned	
Banca Română pentru Dezvoltare – Société Générale	15.7	Privatized 3/99	3/99
Casa de Economii şi Consemnaţiuni	8.6	State owned	
ABN Amro Bank	5.5	Foreign Greenfield	
ING Bank Bucharest Branch *	5.1	Foreign Greenfield	
Banc Post	4.1	Privatized 4/99	
Raiffeisen –Banca Agricolă	3.5	Privatized 7/01	7/01
Banca Comercială „Ion Ţiriac"	3.1	Private domestic	
Citibank	3.1	Foreign Greenfield	
ALPHA Bank	2.7	Foreign Greenfield	
Total	*82.6*		

Notes

(i)   The symbol * indicates that the bank is not included in sample. For these foreign greeenfield banks, no data are reported in BankScope because the bank's balance sheet is consolidated with its parent. Konsolidacni Banka is excluded because it is not a commercial bank.

(ii)   The PeKaO Group in Poland includes three of the original nine commercial banks hived off from the portfolio of the Central Bank. These are Pomorski Bank Kredytowy (PBKS) in Szczecin, Bank Depozytowo-Kredytowy (BDK) in Lublin, and Powszechny Bank Gospardarczy (PBG) in Lodz.

(iii)   Although not effectuated in 1999, the mergers of some Polish banks, i.e., BPH+PBK, Bank Handlowy+Citibank, Bank Slaski+ING, and WBK+BZ, are considered to be merged in the table so that we add the assets of the partners in 1999 to obtain the newly merged entity's market share.

Sources: Annual reports of the National Bank of Croatia, the National Bank of Bulgaria, the National Bank of Hungary and the National Bank of Romania as well as annual reports of individual banks. In addition, data are also taken from Ceska Bankovni Asociace (Czech Republic) and *Hungarian Banking Association*, 2000. Data for Poland are taken from Najlepsze Banki, 2000 and *Gazeta Bankowa*, June 10, 2000, p.31.

Appendix B

Summary of Stochastic Frontier Estimates

	Cost efficiency	Profit efficiency	Commission income efficiency
	(1)	(2)	(3)
Log Likelihood	-129.3	-531.1	-271.2
σ_u / σ_v	2.93	4.59	1.73
σ	0.689	1.576	0.708
λ	.90	.95	.75
Mean efficiency	0.786	0.445	0.758
Standard deviation	0.219	0.237	0.207

Notes

(i) See the text for an explanation of the frontier specification.
(ii) Frontiers were estimated with the 431 bank observations that contain all the data needed for the estimation. Missing information reduced our sample size by only 20 observations from the sample used in the means tests.
(iii) σ_u and σ_v are the standard deviations of the composite of the inefficiency and random components of the disturbance, respectively.
(iv) σ is the standard deviation of the overall disturbance, i.e., (u+v) for the cost function and (u-v) for the profit function.
(v) $\lambda = \sigma_u^2 / \sigma^2$ is the proportion of the variance in the overall disturbance that is due to inefficiency.