Economics of Transition
Volume 14(4) 2006, 579–610

Market entry, privatization and bank performance in transition[1]

Steven Fries*, Damien Neven**, Paul Seabright*** and Anita Taci****

*European Bank for Reconstruction and Development, One Exchange Square, London EC2A 2JN, UK. E-mail: friess@ebrd.com

**Graduate Institute of International Studies, University of Geneva, and CEPR

***Université de Toulouse I and CEPR

****European Bank for Reconstruction and Development

Abstract

This paper examines how market entry and privatization have affected the margins and marginal costs of banks in the post-communist transition. We estimate bank revenue and cost functions, allowing the estimated parameters to change over time. In the first sub-period (1995–98), we find that privatized banks earned higher margins than other banks, while foreign start-ups had lower marginal costs. In the third sub-period (2002–2004), foreign banks remained low marginal cost service providers, while privatized domestic banks had the widest margins. Subtracting marginal costs from margins to calculate mark-ups, an indication of demand for services, shows that initially privatized banks had the largest mark-ups. However, by the third sub-period, differences among private banks diminished. In comparison to private banks, state banks persistently under-performed in controlling costs and attracting demand. Our evidence therefore indicates that foreign bank entry promoted lower costs and that privatization and market entry encouraged more demand for services.

JEL classifications: G2, L1, L8, P2.
Keywords: Banking, imperfect competition, cost functions, transition.

[1] We thank Nadia Aleshina for valuable research assistance and Erik Berglöf, Wendy Carlin, Christa Hainz, Shelagh Heffernan, Mark Schaffer and Claudia Senik-Leygonie for helpful comments and suggestions. The funding of the Japan–Europe Cooperation Fund is gratefully acknowledged. Views presented are those of the authors and not necessarily of the EBRD.

Published by Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main St, Malden, MA 02148, USA

1. Introduction

This paper investigates how market entry and privatization have affected the performance of banks in the transition from a command to a market economy. Since its start in 1989, the post-communist transition has fundamentally transformed Eastern European banking systems and the changes have been so radical and multi-faceted that it is not easy to distinguish the different possible channels of change. Under the command economy, state authorities directed credit allocation with scant regard for capacity to repay, using state banks to channel funds to state (or socially) owned enterprises for inputs and investments authorized under planning. To direct resources in this way, banks specialized by economic sector (or foreign trade), rather than diversified across them. State savings banks specialized in collecting deposits from households, although most saving was forced and done by the state. At the same time, without a profit incentive, state banks were not encouraged to compete for loans and deposits or to control costs. Because of this structure of socialist banking, banks had to fundamentally restructure their outputs and inputs with the start of transition.

Governments and central banks in Eastern Europe have implemented several types of policy to transform socialist banking systems into market-oriented ones (see, for example, Anderson, Berglöf and Mizsei, 1996; EBRD, 1998; and Berglöf and Bolton, 2002). Banking systems were liberalized by freeing interest rates and decentralized by transferring commercial banking activities from the central bank to state banks. State banks were restructured and privatized and new private banks, both domestic and foreign, were allowed to enter the markets. Moreover, to support arms-length lending relationships between banks and their borrowers and to foster confidence of depositors in banks, legal frameworks were overhauled (including the strengthening of creditor rights) and systems of prudential regulation and supervision were initiated. In broad terms, the main policy instruments to promote the transformation of banking were therefore interest rate liberalization, bank restructuring and privatization, market entry of new banks and fundamental institutional change.

To understand this process of change further, we examine the associations between market entry and privatization on the one hand and bank performance on the other. To do so, we model and investigate empirically the structure of margins on loans and deposits and the costs of providing these services. Given the starting point of transition, attracting demand for loans and deposits and controlling costs are central to the process of developing market-oriented banks. This requires competition among banks, as well as the incentive of profitability and the constraint of effective prudential regulation and market exit.

In this paper, we develop a unique model of monopolistic competition in banking and use it to investigate the equilibrium structure of margins earned on loans and deposits.[2] This model enables us to identify the associations between the

[2] We use a standard trans-log specification for the cost function.

market entry and privatization of banks and their margins. Variables on the origin and ownership of banks are used as proxy measures for the incentive and capacity of banks to attract demand for their loans and deposits and to control costs. The model also allows us to test directly for the intensity of competition associated with the number of banks in a market and indirectly for product differentiation among banks.

This approach builds on the extensive empirical studies of competition in banking in industrialized economies beginning with Shaffer (1982).[3] Studies by Gelos and Roldós (2004), Yildirim and Philippatos (2006b) and Drakos and Konstantinou (2005) extend this literature to developing countries and transition economies. The studies of competition in banking find that systems are often characterized by imperfect competition. In a worldwide study of the factors that influence the extent of competition in banking, Claessens and Laeven (2004) show that banking systems with greater foreign entry and fewer activity restrictions tend to be more competitive, while Dermigüç-Kunt *et al*. (2004) find that banking systems in countries with better legal protection of property rights have lower net interest margins.

Theoretical analyses of banking in transition economies, moreover, emphasize the important link between competition and institutional development in banking. In a model of collateralized lending by oligopolistic banks, Hainz (2003) shows that, if creditor rights are weakly protected, banks have more market power, other factors being equal, and are able to extract more rents from their borrowers, thereby holding back the scale of intermediation. A key feature of the model is that a better institutional framework strengthens competitive pressures among banks.

In addition to the analysis of bank revenues, we estimate a standard trans-log cost function. The estimated parameters of the cost function together with the underlying data on costs, deposits and loans enable us to calculate the marginal costs of deposit taking and lending by bank origin and ownership. This provides a basis for examining variations in margins and marginal costs across bank types and over time.

To implement empirically our model of monopolistic competition in banking and to investigate the structure of bank costs, we use a large panel dataset of banks in 15 mostly Eastern European countries (Bulgaria, Croatia, the Czech Republic, Estonia, FYR Macedonia, Hungary, Kazakhstan, Latvia, Lithuania, Poland, Romania, Russia, the Slovak Republic, Slovenia and Ukraine) and covering the years 1995–2004. Fries and Taci (2005) developed the dataset, which is unique in its coverage of time-varying bank ownership in transition economies. Their related study examines the relative cost efficiency of banks by estimating efficient cost

[3] This literature includes several recent studies by Bikker and Groeneveld (2000), De Bandt and Davis (2000) and Bikker and Haaf (2002). The references in these papers provide a more extensive guide to this literature.

frontiers for banks in transition economies and investigating the correlates of bank inefficiencies.

The empirical estimations of our monopolistic competition model of bank revenues and of the cost function allow for structural changes between three sub-periods that divide the entire sample period approximately into thirds. They yield a number of interesting results regarding the performance of banks by their origin and ownership. In the first sub-period, the average margins on loans and deposits earned by privatized banks are significantly higher than those of newly established banks or state-owned banks. By the later sub-period, the margins of domestic private banks are significantly above those of foreign or state-owned banks. This pattern in margins suggests that privatized banks initially had either an advantage in attracting demand for their loans and deposits (for example, because of service improvements and established reputations) or a cost disadvantage in providing loans and deposits.

Evidence from the estimated cost equation indicates that newly established foreign banks had significantly lower marginal costs than other types of banks in the first sub-period. By the third sub-period, both new foreign banks and privatized banks with foreign owners had lower costs. At the same time, domestic banks had marginal costs that were similar to those of state-owned banks. This suggests that foreign banks brought with them technology and skills that were not available to domestic institutions.

Calculating the difference between revenue margins and marginal costs to obtain mark-ups shows that in the first sub-period privatized banks had the largest mark-ups, an indication of their capacity to attract more demand for their service than new entrants and state banks. By the third sub-period, differences in mark-ups among private banks diminished, but remained above that of state banks. This indicates that privatization and market entry are associated with a greater capacity to attract demand for services.

2. Literature on competition, profitability and costs of banks in transition

The existing empirical literature on transition banking that is closely related to this study consists of three strands. The first examines the extent of competition in these banking markets. The second strand studies the relative profit and cost efficiency of banks within transition economies. The third considers factors that influence net interest margins in transition banking. Importantly, our paper extends this existing literature by combining the analysis of margins and marginal costs to examine how both supply of and demand for banking services change during the transition.

In the first strand, Gelos and Roldós (2004), Yildirim and Philippatos (2006b) and Drakos and Konstantinou (2005) use the methodology of Panzar and Rosse (1987) to assess the competitive conditions in transition banking. The Panzar–Rosse

H-statistic measures the percentage change in a bank's equilibrium revenues associated with a 1 percent change in all the bank's input prices. This statistic can be used to infer the competitive structure of the industry in which the bank operates. An H-statistic value of one is associated with perfect competition and a value of zero or less with monopoly or perfect collusion. Values in the range between zero and one characterize cases of monopolistic competition.

The Gelos and Roldós study covers three transition economies (the Czech Republic, Hungary and Poland, as well as five Latin American countries) and the period 1994 to 1999. For the transition economies, the estimated values of the H-statistic lie between the values of one (perfect competition) and zero (monopoly), although, in the case of Hungary, the H-statistic is sufficiently close to one that the hypothesis of perfect competition cannot be rejected. Moreover, this study finds that the competitive conditions remain broadly stable between two sub-periods, 1994 to 1996 and 1997 to 1999.

The studies of Yildirim and Philippatos and of Drakos and Konstantinou cover most of the transition economies covered in this paper. Their respective sample periods are also broadly similar. Both find that most banking markets in Eastern Europe are characterized by monopolistic competition. However, for FYR Macedonia and the Slovak Republic, Yildirim and Philippatos cannot reject the hypothesis that banks act as if they were monopolies or perfectly collusive oligopolies. Drakos and Konstantinou cannot reject this hypothesis in the case of Estonia and Latvia. Unlike Gelos and Roldós, Yildirim and Philippatos also find that the extent of competition in transition banking has increased over time.

Studies of the relative profit and cost efficiency of banks in transition economies include Grigorian and Manole (2002), Yildirim and Philippatos (2006a), Bonin, Hasan and Wachtel (2005) and Fries and Taci (2005). Again, they cover most of the countries covered by this study, although their sample periods are shorter. The efficiency measures and estimation methodologies used in these studies vary. The studies of Fries and Taci and of Grigorian and Manole examine cost efficiency using the stochastic frontier approach and data envelopment analysis, respectively. Yildirim and Philippatos and Bonin, Hasan and Wachtel use the stochastic frontier approach to analyse both cost and profit efficiency. Yildirim and Philippatos also employ the distribution free approach.

These studies find significant variation across countries in bank efficiency and Fries and Taci, Grigorian and Manole, and Yildirim and Philippatos seek to explain this variation by examining country-level variables as correlates of bank efficiency or costs. Grigorian and Manole observe that bank cost efficiency is significantly and positively associated with GDP per capita and weakly and positively associated with a measure of progress in institutional reform. Fries and Taci find no association between cost efficiency and GDP per capita, but a significant non-linear association between progress in institutional reform and costs (costs declining early in the process of banking reform and then increasing). Regarding the association with measures of market competition, the findings are mixed. The studies of Fries

and Taci and of Yildirim and Philippatos find that greater competition in a banking market is associated with greater cost efficiency. In contrast, Grigorian and Manole observe that higher banking market concentration is associated with greater cost efficiency.

The association between ownership and efficiency is broadly consistent across the four studies. All find that banks with majority foreign ownership are more cost efficient than those with majority domestic ownership. However, Yildirim and Philippatos and Bonin, Hasan and Wachtel observe that majority foreign ownership of banks is not associated with greater profit efficiency. In addition, Fries and Taci find that private banks newly established after the start of transition (newly established banks) are more cost efficient than state-owned banks and privatized banks with majority domestic ownership, but less efficient that privatized banks with majority foreign ownership. However, Grigorian and Manole observe no difference in the cost efficiency of newly established banks and that of old banks (privatized and state-owned).

In the third strand of existing empirical research on transition banking, Drakos (2003) examines the net interest margins of banks in 11 post-communist countries over the period 1993 to 1999. This study finds that net interest margins decrease significantly over time and that bank ownership has a significant effect. In particular, Drakos observes that state-owned banks set significantly lower net interest margins that do other banks.

3. A model of monopolistic competition in banking

In this section, we derive a model of banking market equilibrium under monopolistic competition that is used to examine the structure of revenues earned by banks and their costs. A bank is regarded as a multi-product firm that manages both its assets and liabilities, including lending and deposit taking. A bank can also invest in non-loan assets and issue securities. At the same time, a bank faces the balance sheet constraint that total assets must be equal to total liabilities plus equity capital. To satisfy the balance sheet constraint, it has the opportunity of borrowing or lending in the interbank market.

The profit of a bank therefore includes the returns obtained from its lending activities and non-loan assets, the interest paid out on its deposits, and the interest earned from or paid out on its net position in the interbank market, as well as the operating cost of undertaking its activities. Let D_{ijt}, L_{ijt} and N_{ijt} denote deposits, loans and net non-loan financial assets of bank i in country j at time t, excluding its gross interbank positions. R_{jt} is the interbank rate in country j at time t, while r^d_{ijt}, r^l_{ijt} and r^n_{ijt} are, respectively, the rates of interest paid on deposits and the rates of interest earned on loans and non-loan assets. The expression $C(D_{ijt}, L_{ijt}, N_{ijt}, W_{ijt})$ refers to operating costs, where W_{ijt} is a set of factor prices. E_{ijt} is the equity capital of bank i.

The profit of a bank, Π_{ijt} can accordingly be written as

$$\Pi_{ijt} = r^l_{ijt}L_{ijt} + r^n_{ijt}N_{ijt} - r^d_{ijt}D_{ijt} - R_{jt} \cdot (L_{ijt} + N_{ijt} - D_{ijt} - E_{ijt}) - C(D_{ijt}, L_{ijt}, N_{ijt}, W_{ijt}), \quad (1)$$

where the expression $(L_{ijt} + N_{ijt} - D_{ijt} - E_{ijt})$ represents the net debtor position of the bank in the interbank market. With a view to empirical estimation, the profit function of a bank can be rewritten as

$$\Pi_{ijt} = (r^l_{ijt} - R_{jt})L_{ijt} + (r^n_{ijt} - R_{jt})N_{ijt} + (R_{jt} - r^d_{ijt})D_{ijt} + R_{jt}E_i - C(D_{ijt}, L_{ijt}, N_{ijt}, W_{ijt}). \quad (2)$$

In order to examine how a bank earns its profits, we consider separately the revenues and costs of the bank. Given Equation (2), the revenues of a bank, REV_{ijt}, are simply

$$REV_{ijt} = (r^l_{ijt} - R_{jt})L_{ijt} + (r^n_{ijt} - R_{jt})N_{ijt} + (R_{jt} - r^d_{ijt})D_{ijt} + R_{tt}E_{ijt}. \quad (3)$$

Because revenues, loans, non-loan assets, deposits and equity are observable, this equation can be estimated directly. If this were done for our sample of banks, the coefficients on the loan, non-loan financial asset and deposit variables would be estimates of the average margins that the banks have earned on these activities. The coefficient for bank equity would be an estimate of the interbank rate.

We now assume that each bank sets the rates for its loans and deposits to determine the respective margins, but that the returns on non-loan financial assets and the interbank rate are exogenous to each bank. This assumption reflects the empirical evidence that banking markets in most countries, including the post-communist countries in Eastern Europe, are characterized by monopolistic competition (see Gelos and Roldós, 2004; Yildirim and Philippatos, 2006b; and Drakos and Konstantinou, 2005). Accordingly, we allow for the loan and deposit margins charged by each bank and the amount of its loans and deposits to be determined jointly by the interaction between a bank's supply curve and the demand that it faces. In other words, we focus on lending and deposit taking as the activities in which banks can potentially exercise market power. Banks are assumed to be price takers in the market for non-loan assets, such as government securities, and in the interbank market.

The estimated coefficients for loans and deposits in the revenue equation can therefore be seen as equilibrium margins and variation in these equilibrium margins across banks and countries and over time can be further explored. In particular, the effects of exogenous variables on equilibrium margins can be identified by specifying an equilibrium margin function. In what follows, we specify a model of monopolistic competition among banks, derive equilibrium margins as a function

of the underlying parameters of the model and examine the comparative static properties of the equilibrium margins.

It is important to emphasize that this estimation allows for neither the direct identification of market power nor the estimation of supply functions. This would require the estimation of a structural model where demand and supply functions are jointly estimated, using observed margins and quantities (see Bresnahan, 1989, for an exposition of this approach and Neven and Röller, 1999, for applications to banking). This cannot be done in this paper because we do not have data on loan and deposit margins. Nevertheless, the structure of the equilibrium margins may give some indirect insight into how competition and bank ownership influence the transition in banking.[4]

Consider now the loan market (the analysis can be applied in the same way to the deposit market). Assume that a bank takes the interbank rate and the rate on non-loan assets as given and that its loan policy is independent of its strategy with respect to deposits. This will be the case if the cost function is separable in loans and deposits. Assume that bank's marginal operating costs with respect to loans are constant (a linear marginal cost could also be accommodated). The profit of the bank in the loan market is then given by

$$\Pi_{ijt} = (M^l_{ijt} - c^l_{ijt})L_{ijt}, \tag{4}$$

where $M_{ijt} \equiv r^l_{ijt} - R_{jt}$ is the bank's margin in the loan market and c^l_{ijt} is the marginal cost of making a loan.[5] Assume further that each bank faces an inverse demand function of the type

$$M^l_{ijt} = a^l_{ijt} - L_{ijt} - \lambda^l_{jt}L_{-ijc}, \tag{5}$$

where L_{-ijt} denotes the total volume of loans sold by all other banks in the same country and time period and where $0 < \lambda^l_{jt} < 1$.

This demand specification is adapted from Shubik and Levitan (1980) and allows for product differentiation. A bank may be able to differentiate its loans in such a way that the demand curve is shifted out and the intercept a^l_{ijt} increases. The specification also allows for reduced substitution between a bank's loans and those of its competitors in the market (that is, λ^l_{jt} falls). Such reduced substitution can be associated with product differentiation (for example, through advertising) or market segmentation (for example, because of geographical distance among competitors). The characteristics of each bank's loans that determine such differentiation cannot be observed directly.

[4] This approach is therefore semi-structural and similar in this respect to Panzar and Rosse (1987).

[5] The model can accommodate marginal costs that are in general a linear function of the amount of loans.

Faced with this demand specification, each bank will maximize profit by solving the following first-order condition

$$a^l_{ijt} - 2L_{ijt} - \lambda^l_{jt}L_{-ijt} - c^l_{ijt} = 0. \tag{6}$$

Summing up the first-order conditions for all banks in country j at time t yields

$$(a^l_{jt} - c^l_{jt}) - 2L_{jt} - \lambda^l_{jt}(n_{jt} - 1)L_{jt} = 0, \tag{7}$$

where $(a^l_{jt} - c^l_{jt}) \equiv \sum_i (a^l_{ijt} - c^l_{ijt})$, L_{jt} is total loans provided by the banking system in country j at time t and n_{jt} is the number of banks in the country at that time. The volume of total loans in equilibrium is therefore given by

$$L^*_{jt} = \frac{a^l_{jt} - c^l_{jt}}{2 + \lambda^l_{jt}(n_{jt} - 1)}. \tag{8}$$

Combining Equation (8) with the first-order condition for each bank yields as the equilibrium amount of loans made by bank i in country j at time t

$$L_{ijt} = \frac{(a^l_{ijt} - c^l_{ijt})}{2 - \lambda^l_{jt}} - \frac{\lambda^l_{jt}(a^l_{jt} - c^l_{jt})}{(2 - \lambda^l_{jt})[2 + \lambda^l_{jt}(n_{jt} - 1)]}. \tag{9}$$

From Equations (5) and (9) a bank's equilibrium loan margin can therefore be expressed as

$$M^l_{ijt} = a^l_{ijt} - \frac{(1 - \lambda^l_{jt})(a^l_{ijt} - c^l_{ijt})}{(2 - \lambda^l_{jt})} - \frac{\lambda^l_{jt}(a^l_{jt} - c^l_{jt})}{(2 - \lambda^l_{jt})[2 + \lambda^l_{jt}(n_{jt} - 1)]}. \tag{10}$$

The comparative static properties of the model with respect to the fundamental parameters, a^l_{ijt}, c^l_{ijt} and n_{jt}, are straightforward to calculate. For the equilibrium loan margins it is possible to show that $\partial M^l_{ijt}/\partial a^l_{ijt} > 0$, $\partial M^l_{ijt}/\partial c^l_{ijt} > 0$ and $\partial M^l_{ijt}/\partial n_{jt} < 0$. In other words, a bank's equilibrium loan margin increases with its ability to increase the demand for its loans and with its inability to control the marginal costs of loans and decreases with the number of competitors in the market. It can also be shown that a bank's profits in a market equilibrium are increasing in its ability to shift out its demand curve and to control its costs; that is, $\partial \prod^l_{ijt}/\partial a^l_{ijt} > 0$ and $\partial \prod^l_{ijt}/\partial c^l_{ijt} < 0$. A profit-maximizing bank, for example, one that is privately owned, would therefore seek to control its marginal cost and reduce its margins in order to boost its market share and profits. Such a bank would also aim to expand demand for its loans and its market share. However, a state-owned bank may have no such set of incentives.

The equilibrium loan margin can also be expressed as a function of the equilibrium loan market share, L_{ijt}/L^*_{jt}, which is observable but depends on the underlying model parameters. In this expression, it is straightforward to show that,

provided $\lambda^l_{jt} < 1$, the loan margin is an increasing function of the market share. Moreover, the strength of the association between loan market share and margin increases as the value of λ^l_{jt} decreases. A positive correlation between loan margin and market shares is therefore an indirect test that the loans provided by banks are imperfect substitutes. It is not possible to estimate λ^l_{jt} directly with the available data because the strength of the correlation depends also on other parameters that are neither observable nor capable of being separately estimated.

In the empirical implementation of the revenue model, we use observable variables that may be correlated with the underlying structural parameters of the model, because the parameters, a^l_{ijt}, c^l_{ijt} and λ^l_{jt}, cannot be observed directly. In particular, we use the origin and ownership of banks as a variable that may be correlated with the incentive and capability of banks to increase the demand for their loans and to control their costs, that is a^l_{ijt} and c^l_{ijt}. The number of banks in a country j at time t relative to the country's population, N_{jt}, is used as a measure of market competition. In addition, we include the market share of a bank in the loan market to test indirectly that $\lambda^l_{jt} < 1$. We control for other country level factors using fixed effects for countries and time, including their interaction.

For costs, we use a standard trans-log specification. In particular, the cost function takes the form:

$$\ln C_{ijt} = \alpha_0 + \sum_s^t \beta_s \ln Q_{s,ijt} + \sum_m^n \chi_m \ln W_{m,ijt} + \frac{1}{2}\sum_s^t \sum_t^s \beta_{s,t} \ln Q_{s,ijt} \ln Q_{t,ijt} + \frac{1}{2}\sum_m^n \sum_n^m \chi_{m,n} \ln W_{m,ijt} \ln W_{n,ijt} + \sum_s^t \sum_m^n \delta_{s,m} \ln Q_{s,ijt} \ln W_m, \quad (12)$$

where $Q_{s,ijt}$ are output quantities (that is, the amounts of loans, non-loan financial assets and deposits) and $W_{u,ijt}$ are input prices (wages and the cost of physical capital). In estimating Equation (12), we impose constraints on symmetry, $\beta_{s,t} = \beta_{t,s}$ and $\chi_{m,n} = \chi_{n,m}$, and, homogeneity in input prices, $\sum_m^n \chi_m = 1$.

In the empirical implementation of the cost function, we allow for estimated parameters to vary with bank ownership to make possible comparisons with the estimated revenue function, in which the equilibrium loan and deposit margins vary with this observable characteristic of banks. This specification for the cost function enables us to compare the marginal costs of loans and deposits across different types of banks, one of the factors that may contribute to the variation in equilibrium margins. Again, we control for country level factors using fixed effects for countries and time, including their interaction.

4. Empirical implementation

In the empirical implementation of the revenue equation, we express revenues in the general form of Equation (3) and assume that banks engage in monopolistic competition for loans and deposits. The returns earned on non-loan assets and

the interbank interest rates are assumed to be exogenous to individual banks. The equation for bank revenues therefore takes the form

$$REV_{ijt} = M^{l}_{ijt}(.)L_{ikt} + M^{d}_{ijt}(.)D_{ikt} + \rho N_{ijt} + \sigma E_{ijt} + \varepsilon_{ijt}, \quad (13)$$

where ρ and σ are the average return that banks can earn on non-loan financial assets and the average interbank rate, respectively.

We write individual equilibrium loan and deposit margins as a function of the observable characteristics of banks that may be correlated with the underlying parameters of the model and with measures of the intensity of competition in the banking market. Specifically, the equilibrium loan margin of bank i in country j at time t is

$$M^{l}_{ijt} = \sum_{p}^{q} \phi^{l}_{p} own_{p,ijt} + \varphi^{l}_{s} S^{l}_{ijt} + \gamma^{l}_{f} N_{jt} + \varepsilon^{l}_{ijt}\phi, \quad (14)$$

where own_p is a vector of time-varying origin and ownership dummy variables (privatized with majority foreign ownership, privatized with majority domestic ownership, newly established bank with majority domestic ownership, newly established bank with majority foreign ownership, and majority state-owned), S^{l}_{ijt} is the loan market share of bank i in country j at time t, and N_{jt} is the total number of banks. The error term is assumed to have the usual properties.

This specification allows us to examine whether the comparative static properties of the equilibrium margins in monopolistic competition model are consistent with the data. The anticipated association between the origin and ownership of banks and their margins depends on both the variation in marginal costs across bank types and that of the capacity of banks to increase demand for their services. For example, newly established banks may have both lower marginal costs and less capacity to increase demand for their services than old banks. On the cost side, newly established banks would have benefited from not having to restructure existing banking organizations, while on the revenue side they may have faced the disadvantage of not having established reputations in the market. We would, in addition, anticipate that margins are negatively correlated with the measure of market competition and positively associated with market shares.

The same specification can be used for the equilibrium margins in the deposit market by simply substituting the superscript d for l. However, because the costs of deposit taking and lending are not separable and because the amounts of loans and deposits by banks are highly correlated, we examine the comparative static properties of the model using a single-scale variable equal to the combined value of loans and deposit rather than estimate separately the structure of margins for both loans and deposits. In the estimation, the origin and ownership dummy variables, number of banks (scaled by population) and market share (weighted average of the loan and deposit market shares) are interacted with the single-scale variable. The estimated coefficients on these variables show how the average

margin on loans plus deposits varies across banks with different observable characteristics and with the measure of the intensity of competition in the banking market. The coefficients on the non-loan assets and the equity variables are estimates of the average rates of return and the risk-free interest rate, respectively.

Given that we introduce disturbances on the margin equation, the overall error term takes the form

$$\varepsilon_{ijt}^{l+d}(L_{ijt} + D_{ijt}) + \varepsilon_{ijt}. \tag{15}$$

To account for the induced heteroscedasticity of the errors, we estimate Equation (14) using generalized least squares, and because of the presence of an error term in the coefficients on loans plus deposits, we instrument the scale variable using its own lagged value, the bank origin and ownership variables, the banking market share variable and the country and time fixed effects. We also instrument the average loan and deposit market share variable because it is endogenous. A Durbin–Wu–Hausman test indicates that it is appropriate to instrument these variables in the estimations reported in the following discussion.[6]

To estimate the revenue equation, we use the Baltagi (1981) error-components two-stage least squares estimator (EC2SLS) (see Baltagi, 1995, Chapter 7). Country and time fixed effects are used to control for other country level factors. We also allow for bank-specific random effects in the estimations reported in the following discussion. A Hausman test clearly rejects a bank fixed-effects specification in favour of the EC2SLS estimation with random effects.

In the empirical implementation of the trans-log cost function, we allow the estimated parameters of the cost function to vary with the origin and ownership of banks, but omit most of the higher order terms in the final trans-log specification. In preliminary estimations most of these terms were not statistically significant. Consistent with the estimation of the revenue equation, we use as the output variables the values of deposits and loans, as well as the value of non-loan financial assets. Ideally, we would also include two input prices, one for labour and the other for physical capital. However, it is not possible to estimate these input prices with our dataset because it does not include comprehensive data on numbers of employees or branches. We therefore follow Hasan and Marton (2003) and use the ratio of total non-interest expenses to total assets as the best available proxy measures for the average cost of non-financial inputs to banks. As with the revenue equation, we use country and time fixed effects to control for other country level factors. The error term is assumed to have the usual properties.

We estimate the revenue and cost equations while allowing for bank specific effects and using both fixed- and random-effects specifications. As with the revenue

[6] We do not instrument the number of banks per unit of population, because it comfortably passes the Durbin–Wu–Hausman test.

Table 1. Frequency distribution of data by bank origin and ownership

	1995–1998	1999–2001	2002–2004
Total number of observations	963	807	1,629
Total number of banks	289	287	477
Percentage of observations by bank origin and ownership			
Newly established, domestic	31.5	31.1	40.5
Newly established, foreign	24.4	25.8	24.9
Privatized, domestic	18.2	9.4	6.7
Privatized, foreign	4.6	21.7	19.2
State-owned	21.4	12.0	8.7

***Note*:** The second sub-period excludes Russian banks.

equation, we report only the random-effects specification because a Hausman test rejects the fixed effects model in favour of this specification.

5. Data sources and variable descriptions

The primary source of data on the banks' balance sheets, income statements and ownership is the *BankScope* database produced by the Bureau van Dijk, which includes data on over 10,000 banks worldwide. The *BankScope* data are supplemented with the data and information from annual reports of the banks and from EBRD staff research on bank ownership. The central banks and the national statistical agencies of the countries provided aggregate data on their banking systems, including the total loans and deposits and the total number of banks in the banking systems.

In our sample, we include all banks in the *BankScope* database for which at least two years of data are available in each of the sub-samples. Table 1 describes the composition of the samples in each sub-period. In addition, where banks report according to both local accounting standards and international accounting standards, we select data in international accounting standard rather than national accounting standards for banks. These banks account for 58 percent of the sample. All bank accounting data are in nominal terms in US dollars converted at current exchange rates.

The composition of banks in our sample also varies over the sample period of 1995–2004. There are 115 banks for which data are available for the entire sample, while there are 362 banks that enter the sample after 1995 and/or exit from the sample before 2004. The additions to the sample are not necessarily new market

entrants, but could be successful banks that are added to the *BankScope* database over time. Exits from the sample are due primarily to either bank failures or mergers with other banks. Our method of selecting banks from the *BankScope* database introduces selection bias in the data, as does the selection by *BankScope* of banks to include in the dataset, which are primarily the larger and financially sounder banks in the region. The estimation results are therefore representative not of the entire population of banks in transition economies, but rather of the relatively successful top tier of banks in the region.

To identify whether there is selection bias arising from the entry and exit of banks from our sample in each sub-period, we follow Verbeek and Nijman (1992) and use a simple variable addition test that is designed to detect the presence of selection bias in an unbalanced panel. One added variable is the number of years the bank is included in the sample (we call this the 'years' dummy). The second is a dummy variable if the bank is absent from at least one year of the sample period (we call this the 'absent' dummy). The third is a dummy variable which takes a value of one for a bank-year observation if that bank was absent from the sample in the previous year (we call this the 'entrant' dummy, because it identifies a bank in the year of its entry).[7]

If any of these variables is significant, it provides an indication that the pattern of missing observations in the panel is affecting the regression results. However, neither of the first two dummy variables was significant in any of the regressions we report below. Only the entrant dummy was significant and this only in the first period in the revenue equation and in the first and second periods in the cost equation.

This test, however, does not provide for the consistent estimation of the parameters if there is evidence of selection bias. For this we interact any significant dummy variable with the explanatory variable the consistency of whose parameter estimate we wish to test, as we describe when presenting the results in the following discussion. We interpret an insignificant coefficient on the interaction term (which is what we find in nearly all cases) as evidence that the estimation of the parameter in question has not been biased by any non-randomness in the selection of banks into or out of the sample during the sub-period in question.[8] Because of the limited evidence of sample selection bias within each sub-period, a more computationally demanding technique to correct for selection bias, such as that of Wooldridge (1995), is not warranted.

The data on total revenues and operating costs of banks come from the income statement and balance sheets of the sample banks, as reported in the *BankScope* database. Total bank revenues include net interest income plus non-interest

[7] The last two are not identical to the dummy variables used by Verbeek and Nijman (1992) but are equal to one minus the latter, which makes for a more intuitive interpretation of their coefficients without changing the statistical properties of the test.

[8] While there is significant entry and exit of banks from the dataset for the entire sample period (1995–2004), the panel datasets are largely balanced within each sub-period except for the first one (1995–1998).

income. Costs include general operating expenses, but not interest expenses. Bank dividend payments are excluded from the measure of total cost.

We use four items from the balance sheets of banks included in the *BankScope* database. Customer loans and customer deposits include all loans made to and deposits received from non-bank entities. Net non-loan financial assets are the securities held by a bank net of market liabilities. Bank equity includes total paid-in capital plus retained earnings.

Bank origin and ownership are divided into five separate types. Private banks with no state-owned antecedents are referred to as newly established banks and they are distinguished by whether their majority owners are domestic or foreign entities. Private banks that were formerly state-owned or part of a state-owned bank are referred to as privatized banks. They too are distinguished by whether their majority owners are domestic or foreign entities. The fifth bank ownership type is state owned. Data on the origin and ownership is from EBRD staff research and varies over time for each bank.

Regarding measures of competition and market structure, the central banks of the countries covered by the study provided data on the number of banks and the total amounts of loans and deposits in the banking systems. These data on total amounts of loans and deposits, together with the bank-level data, were used in calculating the loan and deposit market shares of individual banks. In the cost equation, we also include the equity-to-asset ratio as a proxy measure for other unobservable characteristics of banks that relate to their ability to control costs. A higher equity ratio, for example, may be positively correlated with the capabilities of bank managers to control costs.

Table 2 summarizes the dataset used in the analysis. It reports sample means for the dependent and explanatory variables for each of the five bank origin and ownership categories used in the estimations. The table also provides average ratios to total assets for revenues, operating costs and profits before taxes. These data indicate that privatized banks and state banks tend to be larger than newly established banks with greater market shares. They also show that foreign banks tend to have lower revenues and operating costs relative to total assets than do domestic banks. State banks on average are the least profitable banks.

6. Results

Revenue equation

Table 3 reports the results of the estimations of the revenue equation for the three sub-periods, 1995–1998, 1999–2001 and 2002–2004.[9] Our preliminary investigations

[9] While the dataset includes observations from 1994, this year is dropped from the sample period for the estimations because lagged explanatory variable values are included in the regressions as instrumental variables.

Table 2. Descriptive statistics of the dataset – averages by bank origin and ownership (1995–1998)

Variable	Total Sample	Newly established, domestic	Newly established, foreign	Privatized, domestic	Privatized, foreign	State-owned
Bank balance sheets (in US$ millions)						
Total assets	840.1	176.9	397.8	1099.0	1424.2	2024.7
Total customer loans	351.1	79.9	167.4	461.1	614.4	834.5
Total non-loan financial assets less interbank deposits and non-deposit liabilities	237.1	43.7	75.3	299.5	414.8	628.1
Total deposits from non-bank entities	423.2	111	190	618	857	913
Total equity	71.1	24.9	38.8	96.8	136.4	144.4
Bank income statements (in US$ millions)						
Total revenues (net interest income + non-interest income)	54.3	15.2	19.6	86.3	97.4	117.0
Total operating costs	47.2	12.7	17.2	71.9	70.4	108.8
Market structure						
Number of banks per million of population	8.1	9.4	6.4	9.3	4.7	7.2
Average loan market share (in percent)	2.8	1.0	1.8	4.1	3.9	5.4
Average deposit market share (in percent)	5.8	2.0	3.6	7.7	7.4	12.3
Performance ratios (in percent)						
Net profit before taxes to total assets	1.4	2.2	1.0	1.1	1.9	0.9
Revenues to total assets	6.5	8.6	4.9	7.9	6.8	5.8
Operating costs to total assets	5.6	7.2	4.3	6.5	4.9	5.4

***Note*:** Sample means are for bank-year observations.

Table 2. (cont) Descriptive statistics of the dataset – averages by bank origin and ownership (1999–2001)

Variable	Total Sample	Newly established, domestic	Newly established, foreign	Privatized, domestic	Privatized, foreign	State-owned
Bank balance sheets (in US$ millions)						
Total assets	869.2	444.5	725.2	1,183.0	1,236.4	945.5
Total customer loans	399.1	195.4	336.0	507.2	589.5	445.6
Total non-loan financial assets less interbank deposits and non-deposit liabilities	249.2	124.8	191.5	428.8	309.1	350.5
Total deposits from non-bank entities	623.7	305.8	471.0	876.9	926.6	678.3
Total equity	77.8	43.8	66.2	97.7	99.2	104.9
Bank income statements (in US$ millions)						
Total revenues (net interest income + non-interest income)	89.1	45.8	65.9	127.9	128.1	111.1
Total operating costs	46.0	26.2	33.3	69.5	69.6	23.0
Market structure						
Number of banks per million of population	5.5	6.2	4.2	7.5	5.0	5.9
Average loan market share (in percent)	4.6	2.8	2.6	5.8	7.1	8.4
Average deposit market share (in percent)	5.0	3.0	2.5	7.5	7.4	9.2
Performance ratios (in percent)						
Net profit before taxes to total assets	1.3	1.1	1.3	1.2	1.0	2.2
Revenues to total assets	10.3	10.3	9.1	10.8	10.4	11.8
Operating costs to total assets	5.3	5.9	4.6	5.9	5.6	2.4

***Note*:** Excludes Russian banks. Sample means are for bank-year observations.

Table 2. (cont) Descriptive statistics of the dataset – averages by bank origin and ownership (2002–2004)

Variable	Total Sample	Newly established, domestic	Newly established, foreign	Privatized, domestic	Privatized, foreign	State-owned
Bank balance sheets (in US$ millions)						
Total assets	1,392.3	472.5	758.3	1,223.4	3,240.1	2,920.9
Total customer loans	730.4	258.3	415.1	684.8	1,635.8	1,588.7
Total non-loan financial assets less interbank deposits and non-deposit liabilities	169.1	–3.4	34.1	177.1	462.0	752.3
Total deposits from non-bank entities	926.0	248.2	403.0	877.4	2,251.8	2,667.0
Total equity	138.8	59.1	73.5	136.2	295.5	297.7
Bank income statements (in US$ millions)						
Total revenues (net interest income + non-interest income)	85.4	31.8	41.7	100.5	174.1	213.8
Total operating costs	59.0	22.0	26.9	67.3	120.4	154.1
Market structure						
Number of banks per million of population	6.3	7.4	5.1	7.3	4.9	7.0
Average loan market share (in percent)	3.3	1.3	1.8	3.3	9.3	3.5
Average deposit market share (in percent)	3.6	1.2	1.5	4.1	9.7	5.7
Performance ratios (in percent)						
Net profit before taxes to total assets	1.8	2.0	1.9	2.7	1.5	1.9
Revenues to total assets	6.1	6.7	5.5	8.2	5.4	7.3
Operating costs to total assets	4.2	4.6	3.5	5.5	3.7	5.3

***Note*:** Sample means are for bank-year observations.

Table 3. Panel estimations of bank revenue Functions using an error components two-stage least squares estimator with bank random effects

Sample period	1995–1998				1999–2001		2002–2004	
Dependent variable	Total revenues		Total revenues – eroded equity		Total revenues	Total revenues – eroded equity	Total revenues	Total revenues – eroded equity
Explanatory variables								
Loans	0.0360***	0.0372***	0.0306**	0.0320**	0.0282**	0.0194	–0.0131***	–0.0350***
	(0.0130)	(0.0129)	(0.0138)	(0.0136)	(0.0130)	(0.0157)	(0.0044)	(0.0049)
Deposits	0.0068	0.0043	–0.004	0.0007	0.0433***	0.0609***	0.0278***	0.0475***
	(0.0143)	(0.0142)	(0.0152)	(0.0150)	(0.0114)	(0.0142)	(0.0037)	(0.0040)
Interacted with loans plus deposits								
Newly established,	–0.0067	–0.0066	–0.0097	–0.0096	–0.0040	0.0095***	0.0071**	0.0105***
domestic	(0.0099)	(0.0098)	(0.0105)	(0.0104)	(0.0037)	(0.0045)	(0.0029)	(0.0032)
Newly established,	–0.0238*	–0.0236*	–0.0230*	–0.0227*	–0.0184***	–0.0094***	–0.0018	0.0081***
foreign	(0.0119)	(0.0118)	(0.0126)	(0.0125)	(0.0032)	(0.0044)	(0.0027)	(0.0030)
Privatized, domestic	0.0131***	0.0134***	0.0137***	0.0140***	0.0199***	0.0275***	0.0187***	0.0282***
	(0.0040)	(0.0040)	(0.0042)	(0.0042)	(0.0031)	(0.0034)	(0.0019)	(0.0021)
Privatized, foreign	0.0078	0.0081	0.0121**	0.0125**	0.0052**	0.0051**	–0.0078***	0.0038***
	(0.0056)	(0.0056)	(0.0060)	(0.0059)	(0.0023)	(0.0021)	(0.0012)	(0.0015)
Number of banks per	–0.0004	–0.0003	–0.0006	–0.0005	–0.0022***	–0.0012**	0.0008***	0.0002
million of population	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0005)	(0.0003)	(0.0003)
Share of loan and deposit	0.0013***	0.0013***	0.0014***	0.0015***	0.0056***	0.0289***	–0.0047	0.0063*
market	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0084)	(0.0041)	(0.0035)	(0.0038)

Table 3. (cont) Panel estimations of bank revenue Functions using an error components two-stage least squares estimator with bank random effects

Sample period	1995–1998				1999–2001		2002–2004	
Dependent variable	Total revenues		Total revenues – eroded equity		Total revenues	Total revenues – eroded equity	Total revenues	Total revenues – eroded equity
IAS (yes = 1)	–0.0117**	–0.0119**	–0.0098	–0.0101	–0.0177***	–0.0289***	0.0013	–0.0089***
	(0.0042)	(0.0042)	(0.0045)	(0.0045)	(0.0038)	(0.0041)	(0.0016)	(0.0017)
Non-loan financial assets	0.0082	0.0063	–0.0147	0.0125	0.0656***	0.0391***	0.0299***	0.0194***
	(0.0197)	0.0189	(0.0203)	(0.0200)	(0.0130)	(0.0177)	(0.0050)	(0.0057)
Equity	0.3127***	0.3148***	0.2386***	0.2408***	0.4317***	0.2749***	0.4790***	0.2906***
	(0.0318)	(0.0314)	(0.0336)	(0.0332)	(0.0281)	(0.0307)	(0.0143)	(0.0159)
Entrant dummy (not present in previous year's sample)		81.92*** (22.22)		90.16*** (23.51)	Insignificant	Insignificant	Insignificant	Insignificant
Variables affected by interaction with entrant dummy		Non-loan assets (+)		Non-loan assets (+)				
No. of observations	628	628	628	628	760	760	1119	1119
No. of groups	245	245	245	245	274	274	424	424
R^2	0.70	0.71	0.62	0.63	0.96	0.94	0.97	0.94

***Note*:** Second sub-period excludes Russian banks. Standard errors are in parentheses. The ***, ** and * indicate significance at the 1 percent, 5 percent and 10 percent confidence levels, respectively. Coefficients on the country and time fixed effects are not reported.

of bank margins indicated that they vary significantly over time. Partitioning the sample in this way divides the overall sample into three roughly equal sub-periods in terms of number of years which they cover. This allows us to see how any effects of competition and bank origin and ownership change over time. Our preliminary analysis also revealed that the inclusion of Russian banks in the middle sub-period introduced a very high degree of noise into that sample, which reflects the impact and aftermath of the August 1998 financial crisis in that country.[10] In the middle sub-period we therefore omit Russian banks.

In addition, we report two versions of the revenue equation. In one specification the dependent variable is total revenue and in the other it is total revenue less an adjustment for the effect of inflation on bank capital. This adjustment subtracts from bank revenue the real value of bank capital at the mid-point of each year that has been eroded by inflation over that year. The reason for making this adjustment is that in inflationary environments banks tend to increase their margins in order to maintain the real value of bank capital. Therefore, the estimated coefficient on bank capital may reflect both the interbank interest rate and the effect of inflation on the real value of bank capital. In the estimations without this adjustment to revenues, the estimated coefficient on bank capital is significantly above its theoretically predicted value.

Because of the possible bias associated with the entry and exit of banks from the sample, we also report the estimations of the revenue equation with and without the entrant dummy in the first sub-period. Neither of the other two dummies designed to test for the presence of selection bias was significant in any of the sub-periods. The estimations indicate that there is a significant selection effect only in the earliest sub-period, an effect that consisted of a different behaviour on the part of new banks in their first year of operation. There is no evidence of a significant selection effect in the revenue equation in the latter periods. We discuss below the implications of this selection bias for our specific parameter estimates after presenting the estimates in detail.

The estimations yield a number of interesting results regarding the effects of competition and bank ownership. The estimated coefficients on the value of loans and deposits are the average margins earned by state-owned banks above a set of constants that control for country and time fixed effects. The estimated coefficients on the other explanatory variables indicate how their margins change from this

[10] Russia is the only country covered by this study that experienced a banking crisis within the sample period of sufficient size to affect a large number of banks that would have been included in our sample using our selection criteria. The sensitivity of the estimation results to the potential inclusion of 102 Russian banks (compared to 274 non-Russian banks) is indicated in subsequent footnotes. In this regard it is important to note that, because of the differential impact of the crisis on Russian banks, the country dummy cannot control adequately for the effects of the crisis. This differential impact arose in part from the fact that state banks but not private banks benefited from an explicit or implicit deposit guarantee at the time of the crisis.

base value. In the estimations with revenues adjusted for the erosion of bank capital by inflation as the dependent variable, we obtain similar parameter estimates, although the estimated margins for the last two sub-samples are slightly lower at about 1 percent for deposits and 2 percent for loans.

The comparative static properties of the model are investigated using the combined value of loans and deposits rather than these variables separately because they are highly colinear. In the first sub-period (1995–1998) and with unadjusted revenue as the dependent variable, the average margin earned on loans is about 3.5 percent, while that on deposits is not significantly different from zero. Other factors being equal, the average margin on the combined value of loans and deposits of newly established domestic banks is not significantly different from those of state banks. However, the average margins of privatized banks with majority domestic and foreign ownership are about 1 to 1.4 percentage points above those of state banks. This difference is statistically significant for privatized banks with majority foreign ownership only when the total revenues are adjusted for the effects of inflation. There is in addition statistically weak evidence that newly established foreign banks had margins about 2 percentage points below that of state banks.

If bank origin and ownership are associated with the incentive and capability of a bank to increase the demand for its loans and deposits and to control its costs, this pattern of margins in the earlier sub-period suggests that privatized banks increased their margins relative to those of state-owned banks either because they were able to increase the demand for their loans and deposits or because their costs rose. Similarly, newly established foreign-owned banks may have been able to reduce their margins below those of state banks because they were either able to control their costs or unable to increase demand for their loans and deposits. We defer our comparison of margins and marginal costs until after our discussion of the cost equation estimations.

In the second sub-period (1999–2001, excluding Russian banks), and the estimation that does not adjust revenues for inflation, the average margin earned by state-owned banks on loans is 2.8 percent, while that on deposits is 4.3 percent.[11] When revenues are adjusted for the effects of inflation, the average margin earned by state banks on loans is 1.9 percent and that on deposits is 6.1 percent. The margins earned by all private banks except newly established foreign banks are significantly above those of state-owned banks.[12]

[11] When Russian banks are included in the sample the estimated average margins earned by state-owned banks on loans does not change significantly; however, the average margins earned by state-owned banks on deposits increases significantly reflecting the funding advantage state banks derived from their explicit or implicit deposit guarantee.

[12] When Russian banks are included in the estimation, the margins earned by all private banks are lower than those earned by state-owned banks. This again reflects the fact that private banks did not benefit from the deposit guarantees and therefore had to offer higher deposit margins in order to attract deposits after the crisis.

Other things being equal, the margins earned by newly established domestic banks on their loans plus deposits range from nil to 1.0 percentage point. At the same time, the margins of banks privatized to domestic owners are about 2 percentage points higher, while those of banks privatized to foreign owners are about 0.5 of a percentage point higher. In contrast, newly established foreign banks had margins below those of state-owned banks, with the estimates ranging from –1.0 percentage point to –1.8 percentage points.

In the third sub-period (2002–2004) and in the estimation that does not adjust revenues for inflation, the average margin earned by state-owned banks on loans is –1.3 percent, while that on deposits is 2.8 percent. When revenues are adjusted for inflation, the average margin earned on loans is –3.5 percent and that on deposits is 4.8 percent.

Other things being equal, domestic banks tended to earn higher margins than state-owned banks in the third sub-period (2002–2004). Newly established domestic banks had margins that were on average about 1 percentage point higher than that of state-owned banks, while privatized banks with majority domestic ownership had margins that were 1.9 to 2.8 percentage points higher, depending on the estimation. In contrast, foreign-owned banks, both newly established and privatized, had margins that were closer to those of state-owned banks. In the estimation without adjusting revenues for inflation, newly established foreign banks earned margins that were on average the same as state-owned banks, while privatized banks with majority foreign ownership had margins that were on average 0.8 of a percentage point below that of state-owned banks. In the estimation that corrects for the effect of inflation on bank equity, foreign banks had somewhat higher margins, but below those of domestic banks. In the context of our monopolistic competition model of banking, the higher margins of domestic banks arise either from greater demand for their services or higher costs.

Regarding the effects of competitive pressure as measured by the number of banks in relation to population in a country, there is no consistent evidence of competitive pressures associated with the number of banks per million of population. However, the estimated parameter on the weighted average market share of loans and deposits is positive and significant in most estimations. In the first sub-period, an increase in market share of one percentage point at the sample mean is associated with a 1.3 to 1.5 basis point increase in the margin earned on loans and deposits. However, by the third sub-period, a one percentage point increase in market shares is not associated with a higher margin. This is consistent with the loans and deposits of different banks being imperfect substitutes, a basic assumption of our model of monopolistic competition in banking, and with the previous empirical findings on banking market structures in transition economies that market structures are imperfectly competitive and that competitive pressures increased over time.

The average margin on non-loan financial assets in the earlier sub-period is not significantly different from zero, while those in the second and third sub-periods

are in the range of 2 to 7 percent.[13] With the possible exception of the earlier sub-sample, which includes periods of macroeconomic instability in most of the countries included in the sample, these are plausible estimate values.

In the estimations that use unadjusted revenues, the coefficient on bank equity for the first sub-period is about 31 percent, in the second sub-period is 43 percent and in the third is 48 percent. In theory, these coefficients are estimates of the interbank rate, but are somewhat high compared to the actual rates. In the estimations that adjust revenues for inflation, the coefficient on bank equity in the first sub-period is 24 percent, while those for the second and third sub-periods are 27 percent and 29 percent. Again, these estimated coefficients are high relative to their predicted values. This may be because bank equity is correlated with other unobservable factors that contribute to higher bank margins, such as the quality of bank management.

The estimated revenue equations also include a dummy variable that indicates whether a bank reported according to international accounting standards. This variable is statistically significant and negatively signed in several of the regressions, implying that these banks tend to report lower earnings than do those banks that report using local accounting standards.

Given the significance of the entrant dummy in the first sub-period, which indicates the presence of some selection bias associated with the unbalanced nature of the panel, what can we say about the robustness of these various parameter estimates? To investigate further, we interacted the entrant dummy one by one with each of the explanatory variables in the revenue equation for the period 1995–98 (if we had interacted it with more than one explanatory variable at a time the instrumenting equation would not have been identified). It was insignificant in all cases but one, namely the interaction with non-loan financial assets, where it took a significant coefficient equal to around 5 percentage points, while not changing the insignificant coefficient on the un-interacted variable. This indicates that new entrants have had significant positive returns on their non-loan financial assets, even in the earlier period, while confirming the insignificance of such returns for the remainder of the sample.

The tests for robustness of the parameter estimates in the face of sample selection are encouraging. Few of the parameter estimates are affected, and those few are affected in intuitive and reasonable ways that do not alter the overall picture of the evolution of the banking sector over this period.

Cost equation

Table 4 reports the estimation results for the trans-log cost equation for the same three sub-periods. As with the revenue equation, this partitioning of the dataset allows us to see how the costs of providing banking services changes over time.

[13] When Russian banks are included in the sample, the average margin on non-loan financial assets is significantly negative. This result reflects losses on government securities incurred by Russian banks after the sovereign default on domestic debt.

Table 4. Panel estimations of bank trans-log cost functions using a GLS estimator with bank random effects

Sample period	1995–1998		1999–2001		2002–2004
Dependent variable	Ln (operating costs)				
Explanatory variables					
Ln (loans + deposits)	0.7995***	0.8041***	0.6101***	0.5940***	0.6332***
	(0.1051)	(0.1050)	(0.0692)	(0.0696)	(0.0476)
Ln (loans + deposits) ^ 2	0.0021	0.0018	0.036***	0.0388***	0.0410***
	(0.0086)	(0.0086)	(0.0119)	(0.0120)	(0.0079)
Ln (operating costs/total assets)	0.3681***	0.3563***	1.3556***	1.3849***	0.9657***
	(0.0643)	(0.0644)	(0.1262)	(1.1261)	(0.1373)
Ln (operating costs/total assets) ^ 2	0.1715***	0.1772***	0.2036***	0.2137***	0.0370*
	(0.0303)	(0.0304)	(0.0407)	(0.0408)	(0.0200)
Ln (non-loan financial assets)	0.0331	0.0306	0.1075***	0.1046***	0.0529***
	(0.0265)	(0.0264)	(0.0265)	(0.0264)	(0.0113)
Equity to total assets ratio	–0.0019	–0.0019	–0.1170	–0.1244	0.3072**
	(0.0018)	(0.0018)	(0.2152)	(0.2144)	(0.1520)
Newly established, domestic	–0.2649***	–0.2752***	–0.0833	–0.0852	–0.0298
	(0.0783)	(0.0784)	(0.0668)	(0.0662)	(0.0576)
Newly established, foreign	–0.3767***	–0.3830***	–0.0051	0.0266	0.0303
	(0.0812)	(0.0812)	(0.0685)	(0.0617)	(0.0618)
Privatized, domestic	–0.2767***	–0.2749***	0.0340	0.0311	0.0083
	(0.0775)	(0.0774)	(0.0815)	(0.0810)	(0.0693)
Privatized, foreign	–0.0209	–0.0182	0.0263	0.0266	–0.0377
	(0.1127)	(0.1112)	(0.0621)	(0.0617)	(0.0632)

Table 4. (cont) Panel estimations of bank trans-log cost functions using a GLS estimator with bank random effects

Sample period	1995–1998		1999–2001		2002–2004
Dependent variable	Ln (operating costs)				
IAS (yes = 1)	0.1736***	0.1879***	0.0816	0.0777	0.0997**
	(0.0684)	(0.0688)	(0.0671)	(0.0664)	(0.0427)
Share of loan and deposit market	0.0099**	0.0101**	0.0070**	0.6912**	0.2353
	(0.0046)	(0.0046)	(0.0033)	(0.3292)	(0.2765)
Number of banks per million of population	0.0491	0.0439	–0.1973	0.7538	–0.4084
	(0.1150)	(0.1145)	(0.5782)	(0.8114)	(0.5831)
Entrant dummy (not present in the sample in the previous year)		0.4185**		–0.1204*	Insignificant
		(0.1936)		(0.0718)	
Variables affected by interaction with the entrant dummy		None		Operating costs/ total assets (–); (Operating costs/ total assets)^2 (+)	
No. of observations	623	623	746	746	1056
No. of groups	244	244	272	272	412
R^2	0.90	0.90	0.94	0.94	0.95

***Note*:** Second sub-period excludes Russia. Standard errors are in parentheses; ***, ** and * indicates significance at the 1, 5 and 10 percent confidence levels. Country and time fixed-effect coefficients are not reported.

The reported form of the estimated trans-log cost function includes the first- and second-order terms of the value of loans and deposits. But because the values of loans and deposits are highly collinear, we estimate a cost function in which their values are combined into a single scale variable. The explanatory variables also include the value of non-loan financial assets, the ratio of operating costs to total assets as a proxy for the average price of non-financial inputs, the ratio of bank equity to total assets and dummy variables for bank origin and ownership. An initial specification of the trans-log cost function included all of the higher order terms and those that allowed for interactions with bank origin and ownership but were eliminated because they were statistically insignificant. We also report estimations of the cost equation with and without the entrant dummy variable in the first and second sub-periods. It was insignificant in the third sub-period. Neither of the other two dummy variables to test for the presence of selection bias were significant in any of the sub-periods.

The estimation provides a number of interesting results regarding the association between bank origin and ownership and cost efficiency. In the first sub-period, most types of private banks were on average more cost efficient than state-owned banks. This effect can be seen from the fact that the dummy variables for bank origin and ownership are significantly negative for three of the four types of private banks in the earlier sub-period, newly established banks and privatized banks with majority domestic ownership. The effect is largest for newly established foreign banks. In the second sub-period and third sub-periods, the differences in average costs among banks are no longer statistically significant.

For the purpose of comparison with the variation in average margins on loans plus deposits estimated from the bank revenue equation, the marginal costs can be calculated from the estimated coefficients of the cost equation (that is, the estimated cost elasticities) and from the average costs and the average values of loans and deposits for the different types of banks. In the first sub-period and the specification of costs that combines the value of loans and deposits,[14] the marginal cost evaluated at the sample mean of a newly established foreign bank in providing a unit of loans plus deposits is 3.1 percent and that of a privatized bank with majority foreign ownership is 4.0 percent. The marginal costs evaluated at the sample means for domestic banks are somewhat higher, 5.7 percent for newly established banks and 5.0 percent for privatized banks. The marginal costs evaluated at the sample means of state-owned banks is 5.6 percent. The marginal costs of newly established foreign banks are significantly lower than those of state-owned banks. The differences in marginal costs among other banks are not statistically significant.

[14] We calculate the marginal costs by bank origin and ownership based on the cost function using the combined value of loans and deposits because multicollinearity leads to high standard errors of the estimated parameters of the cost function when their values are entered separately. The estimated marginal costs by bank origin and ownership are approximately the same in these two specifications; however, the standard errors of the estimates are much lower when the combined scale variable is used.

In the second sub-period, the differentiation among banks in terms of their marginal costs evaluated at the sample means diminishes and is no longer statistically significant. The marginal costs of newly established foreign banks rose to 4.0 percent, but remained below that of other banks. The marginal costs of other banks were 5.0 percent for privatized banks with majority foreign ownership, 5.4 percent for privatized banks with majority domestic ownership, 5.2 percent for newly established private banks and 4.7 percent for state-owned banks.

The third sub-period saw significant differences in the estimated marginal costs of banks re-emerge. The marginal costs of newly established foreign banks fell back to 3.2 percent, while that for banks privatized to foreign owners declined to 3.8 percent and that for newly established domestic banks to 4.8 percent. In contrast, the estimated marginal cost for privatized banks with domestic owners and state-owned banks remained relatively high at 5.2 and 5.1 percent, respectively. The differences in marginal costs between newly established foreign banks and domestic banks are statistically significant, but the differences in marginal costs among other banks are not statistically significant. Therefore, over time, newly established foreign-owned banks have been the relatively low marginal cost providers of deposit taking and lending services. This cost advantage may have arisen from foreign banks having access to better technologies and skills and to superior organizational systems and processes.

The estimated cost equations also provide evidence on the elasticity of operating costs with respect to input prices. The estimated coefficients on the proxy measure of average non-financial input costs are positive and statistically significant in all sub-periods. Moreover, the value of these coefficients tends to increase over time, which means that total operating costs have become more responsive to input prices. The cost equation also includes the value of non-loan financial assets and the ratio of equity to total assets. Like the value of loans and deposits, the value of non-loan financial assets is positively and significantly correlated with operating costs. The estimated elasticity of operating costs with respect to non-loan financial assets is significantly less than that with respect to loans and deposits. The ratio of equity to total assets is included as a proxy for differences in risk preferences among banks that may give rise to variations in operating costs.[15] However, it is not statistically significant.

The market entrant dummy variable, our test for the presence of sample selection bias, was significant in the first sub-period and weakly so in the second. To investigate further, we interacted this dummy variable one-by-one with the explanatory variables to see if the results were sensitive to this pattern of missing observations. In the first sub-period, there were no significant interaction effects. However, in the second sub-period, the interaction effects were significant with the average price of non-financial inputs costs (negative) and this term squared (positive). This result

[15] See, for example, Berger and Mester (1997).

indicates that banks in their first year in the dataset tended to have lower costs for a given level of overheads, but that their costs were more sensitive to increases in overheads.

Margins, marginal costs and mark-ups

From our analysis of margins and marginal costs, it is possible to calculate the average mark-up of margins above marginal costs for each type of bank and each sub-period. This is a measure of the extent to which different bank types are able to attract demand for their deposit taking and lending services. Table 5 reports these calculations, using state banks as the baseline against which the effects of market entry and privatization can be assessed. These calculations show that in the first sub-period, the privatized banks, both domestic and foreign-owned, appear to have been able to attract greater demand for their services than were newly established or state-owned banks. Relative to the benchmark of state banks, their mark-ups were 2.0 percentage points (domestic) and 2.8 percentage points (foreign) higher than the benchmark. In the second sub-period, privatized banks with majority domestic ownership were again able to set wide margins relative to the other private bank and state banks. However, in the third sub-period, the differences among private banks diminished and their mark-up increased significantly above that of state banks.

One consistent result for all three sub-periods was the relative inability of state-owned banks to boost their mark-ups, an indication that they may have been less able to attract demand for their services than were their competitors. There is also evidence that, for those private banks that remain in the market, differences among them diminish over time. In particular, the early advantage of privatized banks in attracting demand does not endure.

7. Conclusion

Our paper examines factors that affect the margins and costs of banks in the post-communist transition. The analysis of bank revenues is based on a unique equilibrium model of monopolistic competition in banking. Our analysis of costs uses a standard trans-log specification. Given the starting point of transition, attracting demand for loans and deposits and controlling costs are central to the process of change in these banking systems. This can require competition among banks, as well as the incentives from private ownership and the constraints of effective prudential regulation and market exit.

The analysis of bank revenues and costs yields several key findings. First, the average margins on loans and deposits earned by banks grouped by their origin and ownership indicate that in the first sub-period, privatized banks had significantly higher margins than newly established banks or state banks. However, by

Table 5. Margins, marginal costs and mark-ups on loans plus deposits (Percentage points differences of the sample averages for each private bank type and the benchmark of state banks)

	1995–1998			1999–2001			2002–2004		
	Margins	Marginal cost	Mark up	Margins	Marginal cost	Mark up	Margins	Marginal cost	Mark up
Newly established, domestic	–0.1	0.1	–0.2	1.0	0.5	0.5	1.1	–0.3	1.4
Newly established, foreign	2.3	–2.5	0.2	–1.0	–0.7	0.3	0.8	–1.9	2.7
Privatized, domestic	1.4	–0.6	2.0	2.8	0.7	2.0	2.8	0.1	2.7
Privatized, foreign	1.2	–1.6	2.8	0.5	0.3	0.2	0.4	–1.3	1.7

***Note*:** Based on estimations in Table 3, using revenue minus eroded equity as the dependent variable, and Table 4.

the third sub-period, the difference in margins of private domestic banks diminished, but privatized banks with domestic owners retained the widest margins. In terms of our model of monopolistic competition, this finding indicates that these privatized banks had either a greater capacity to attract demand for their services (due possibly to service improvements and established reputations) or higher marginal costs.

Evidence from the estimated cost equation indicates that newly established foreign banks initially had significantly lower marginal costs than state-owned banks, but that the differences in marginal costs among the other types of banks are not significant. By the third sub-period, the foreign-owned banks, both newly established and privatized, had relatively lower marginal costs. This finding suggests that foreign banks may have benefited from access to superior technology and skills that have not been as readily available to domestic banks. An outstanding issue is whether the domestic banks will be able to reduce eventually the cost advantage of foreign banks.

Combining the evidence on margins and marginal costs to calculate mark-ups indicates that initially the privatization of state-owned banks was associated with greater demand for lending and deposit taking services relative to that of market entrants and state banks. However, this advantage did not endure. By the third sub-period, differences in mark-ups among private banks diminished, but remained greater than those of state banks. This finding suggests that both privatization and market entry have contributed to attracting greater demand for banking services and that competition and market selection have reduced differences among private banks that remain in the market.

References

Anderson, R. W., Berglöf, E. and Mizsei, K. (1996). *Banking Sector Development in Central and Eastern Europe: Forum Report of the Economic Policy Initiative*, London: Centre for Economic Policy Research.

Baltagi, B. H. (1981). 'Simultaneous equations with error components', *Journal of Econometrics*, 17, pp. 189–200.

Baltagi, B. H. (1995). *Econometric Analysis of Panel Data*, New York: John Wiley and Sons.

Berger, A. N. and Mester, L. J. (1997). 'Inside the black box: What explains differences in the efficiency of financial institutions', *Journal of Banking and Finance*, 21, pp. 895–947.

Berglöf, E. and Bolton, P. (2002). 'The great divide and beyond – Financial architecture in transition', *Journal of Economic Perspectives*, 16, pp. 77–100.

Bikker, J. A. and Groeneveld, J. M. (2000). 'Competition and concentration in the EU banking industry', *Kredit und Kapital*, 33, pp. 62–98.

Bikker, J. A. and Haaf, K. (2002). 'Competition, concentration and their relationships: An empirical analysis of the banking industry', *Journal of Banking and Finance*, 26, pp. 2191–2214.

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

Bresnahan, T. F. (1989). 'Empirical studies of industries with market power', in Schmalensee, R. and Willig, R. D. (eds.), *Handbook of Industrial Organisation, Volume 2*, Amsterdam: North-Holland, pp. 1011–1057.

Claessens, S. and Laeven, L. (2004). 'What drives bank competition? Some international evidence', *Journal of Money, Credit and Banking*, 36, pp. 563–583.

De Bandt, O. and Davis, E. P. (2000). 'Competition, contestability and market structure in European banking sectors on the eve of EMU', *Journal of Banking and Finance*, 24, pp. 1045–1066.

Dermigüç-Kunt, A., Laeven, L. and Levine, R. (2004). 'Regulations, market structure, institutions and the cost of intermediation', *Journal of Banking and Finance*, 36, pp. 593–622.

Drakos, K. (2003). 'Assessing the success of reform in transition banking 10 years later: An interest margin analysis', *Journal of Policy Modeling*, 25, pp. 309–317.

Drakos, K. and Konstantinou, P. T. (2005). 'Competition and contestability in transition banking: An empirical analysis', *South-Eastern Europe Journal of Economics*, 2, pp. 183–209.

EBRD (1998). *Transition Report 1998: Financial Sector in Transition*, London: EBRD.

Fries, S. and Taci, A. (2005). 'Cost efficiency of banks in transition: Evidence from 289 banks in 15 post communist countries', *Journal of Banking and Finance*, 29, pp. 55–81.

Gelos, R. G. and Roldós, J. (2004). 'Consolidation and market structure in emerging markets banking systems', *Emerging Markets Review*, 5, pp. 39–59.

Grigorian, D. and Manole, V. (2002). 'Determinants of commercial bank performance in transition: An application of data envelopment analysis', *World Bank Policy Research Working Paper 2850*, June, Washington, DC: The World Bank.

Hainz, C. (2003). 'Bank competition and credit markets in transition economies', *Journal of Comparative Economics*, 31, pp. 223–245.

Hasan, I. and Marton, K. (2003). 'Development and efficiency of the banking sector in a transition economy', *Journal of Banking and Finance*, 27, pp. 2249–2271.

Neven, D. and Röller, L.-H. (1999). 'An aggregate structural model of competition in the European banking industry', *International Journal of Industrial Organisation*, 17, pp. 1059–1074.

Panzar, J. C. and Rosse, J. N. (1987). 'Testing for monopoly equilibrium', *Journal of Industrial Economics*, 35, pp. 443–456.

Shaffer, S. (1982). 'A non-structural test for competition in financial markets', in Federal Reserve Bank of Chicago, *Proceedings of a Conference on Bank Structure and Competition*, Chicago: Federal Reserve Bank of Chicago, pp. 225–243.

Shubik, M. and Levitan, R. (1980). *Market Structure and Behavior*, Cambridge, MA: Harvard University Press.

Verbeek, M. and Nijman, T. (1992). 'Testing for selectivity bias in panel data models', *International Economic Review*, 33, pp. 681–703.

Wooldridge, J. M. (1995). 'Selection correction for panel data models under conditional mean independence assumptions', *Journal of Econometrics*, 68, pp. 115–132.

Yildirim, H. S. and Philippatos, G. C. (2006a). 'Bank efficiency: Evidence from the transition economies of Europe', *European Journal of Finance*, forthcoming.

Yildirim, H. S. and Philippatos, G. C. (2006b). 'Competition and contestability in CEE banking industry', *Managerial Finance*, forthcoming.