

## **WHAT DRIVES (THE DECLINE OF) BANK INTEREST RATE MARGINS IN CENTRAL AND EASTERN EUROPE?**

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### **ABSTRACT**

Bank interest rate margins are among the most important indicators of the cost of financial intermediation. Although interest rate margins in Central and Eastern Europe (CEE) are still well above Western European levels, they declined significantly over the last years. We attribute this decline to improved operating performance in CEE banking systems. In addition, we provide evidence, that (the proximity of) EU-membership has given the banking sector in CEE rather different dynamics to other emerging market economies. We document that in contrast to the literature, foreign ownership has a positive effect on margins, whereas foreign entry did not influence *domestic* banks' interest rate margins. Furthermore, we detect positive risk premia for both interest and credit risk, indicating risk adjusted pricing of loans and deposits. Our data however also provides some evidence for moral hazard behaviour.

**JEL CLASSIFICATION:** G21, E40, C33.

**KEYWORDS:** Banking, Interest rate margins, Central and Eastern Europe.

### **1. INTRODUCTION**

The participation in or proximity of EU-integration has led to a process of rapid financial deepening all across Central and Eastern Europe (CEE). Whereas a number of CEECs have been struggling with open or latent banking crises in the early phase of the transition process, large parts of CEE have witnessed wide ranging banking sector reforms strengthening the institutional set up of banking systems as well as banks' operating performance since the formal opening of membership negotiations of EU enlargement of numerous countries in the late 1990ies.<sup>1</sup> The pervasive entry of foreign banks into the region's banking markets has played a catalytic role in this respect providing both a transfer of know how and financial resources.

In this paper, we focus on the determinants of banks' interest rate margins against the background of the transition process of CEECs in the run-up to EU membership looking at a sample of banks of the New Member States (NMS) 10 plus Croatia from 2000 to 2005.<sup>2</sup>

Interest rate margins in CEE have been declining over the last years, although they still remain well above levels to be observed e.g. in the EU-15 (see e.g. Walko/Reininger, 2004). With banks playing a decisive role in the intermediation of funds for these economies, the price of financial intermediation, namely banks' net interest rate margin, is of double interest. On the one hand, a low cost of financial intermediation is desirable from a social welfare perspective. On the other hand however, this is only the case if risk shifting problems can be successfully prevented and banks adequately price credit and interest rate risks. In the light of rapid loan growth in CEE banking markets (see e.g. Cottarelli *et al.* 2004, or Backé *et al.*, 2006), risk adjustments in loan pricing seem all the more important in order to prevent the hidden accumulation of credit risks (see Hilbers *et al.* 2005).

By looking at the determinants of interest rate margins, this paper intends to address both of these issues. We investigate whether margins fluctuate alongside banks risk exposure. We furthermore have a look at the reasons for the more recent decline in interest rate margins and investigate which environmental factors and/or banking system characteristics contribute to lower costs of financial intermediation in terms of lower margins. In this respect, both a massive entry of foreign banks, as well as rapid financial deepening has accompanied the decline in margins since the turn of the millennium. Starting from the late 1990s, large foreign (mostly EU-15) banking groups have entered into CEE banking markets. As of 2005, with the only exception of Slovenia, all of the region's banking sectors in our country sample are largely foreign owned with the foreign owned share in total banking assets ranging from some 60% in Romania to 99% in Estonia. At the same time financial intermediation ratios have increased markedly mirroring the regions progress in both economic and financial sector reform – looking at our country sample, the ratio of banking assets to GDP almost doubled from 2000 to 2005 from some 42% to 71%.

In analysing interest rate margin dynamics in CEE in the run-up period to EU membership, we thus want to shed some light on three specific questions:

1. *What explains the continuous reduction in banks' interest rate margins in CEE?*

Given the fact that interest rate margins are considerably lower within the EU-15 than in the NMS (see e.g. ECB 2006), it could be hypothesized that progress in terms of financial deepening and/or the liberalization of the economic system is a viable means to lower the cost of financial intermediation. The widespread presence of foreign banks could also be linked to the decrease in margins.

The behaviour of margins is however also linked to both the structure of banking markets as well as bank efficiency. Higher margins could e.g. be due to a lack in competition (structure conduct hypothesis), or be a direct effect of banks' efficiency levels (efficient structure hypothesis).

2. *To what extent do bank interest rate margins fluctuate alongside banks' risk exposure?*

We expect CEE bank interest rate margins to have a positive relationship with both credit risk and interest rate risk, which would reflect risk adjusted pricing of bank loans as well as bank debt (see e.g. Maudos/Fernández de Guevara, 2004). The strength of this relationship may however depend on bank characteristics, e.g. bank capitalization. In this regard moral hazard behaviour would entail thinly capitalized banks responding less to changes in credit/interest rate risks.

The extent to which a bank's earnings base is diversified is another issue that could possibly impact interest rate margins: The complete reliance on interest rate income would expose a risk averse bank to more idiosyncratic risks of this earnings stream than the same banks would have if it had diversified its earnings into the non-interest income business (see e.g. Elsas *et al.*, 2006 or Stiroh, 2004).

3. *Does the ownership model of a bank impact bank margins?*

Regarding the role of the ownership model in financial sector dynamics, we focus on differences in foreign vs. domestic ownership. For completeness, we also address the issue of state vs private ownership.

As regards foreign vs. domestic ownership, interest rate margins may differ between foreign and domestically owned banks for a number of reasons, e.g. efficiency gaps (see e.g. Bonin *et al.*, 2005), or a different customer base.<sup>3</sup> In addition, ownership by a foreign *bank*, as it is most often the case in CEE may wield an influence on margins through potentially lower refinancing cost of subsidiary banks as they have access to internal capital markets and/or benefit from implicit guarantees from their parent institutions (see e.g. BIS, 2006). However, as the Argentine example has shown, the explicit benefit of these implicit guarantees is not always to be taken for granted for fear of "cut and run strategies" in crises times.<sup>4</sup>

Another dimension of foreign ownership that has received some attention in the literature is how foreign entry affects domestic banks. In this respect, foreign bank entry is usually associated with technology transfer and financial innovation, an increase in competition as well as an improvement of financial system infrastructure (see e.g. Dages *et al.*, 2000).

Concerning state ownership, it is usually associated with lower profitability due to inefficiencies, connected lending, or the promotion of other than pure business motives (e.g. banks being used as a means for economic policy), despite the fact that state owned banks may also profit from implicit or explicit state guarantees lowering their refinancing costs.<sup>5</sup>

In investigating the determinants of bank interest rate margins, our paper therefore relates to two strands of literature. From a modelling perspective, we build

on a microeconomic dealership model of Maudos/Fernández de Guevara (2004), which is an extension of the original Ho/Saunders (1981) model on bank interest rate margins.<sup>6</sup> Empirically different variants of the model have been applied to the U.S. banking market (see e.g. Angbazo, 1997), to a number EU-15 banking markets (see Saunders/Schuhmacher, 2000, Maudos/Fernández de Guevara, 2004 or Liebeg/Schwaiger, 2007). Drakos (2003) and Clays/Vander Vennet (2008) have applied the Ho/Saunders (1981) model to CEE banks for the early period of transition in the 1990s.

A second block of literature looks at the effect of the ownership structure of banks on bank performance in emerging markets (including – among Asian and Latin American countries – CEECs).<sup>7</sup> We link our results to this literature as well by investigating the impact of differing ownership models on interest rate margins, as foreign ownership is a distinctive feature of CEE banking markets.

The papers closest to ours are the papers by Drakos (2003) and Clays/Vander Vennet (2008). Besides some differences in the focus of the investigation as well as the estimation methodology<sup>8</sup>, the main difference between our paper and theirs is that they cover the early period of transition in the 1990s for an extensive sample of CEE countries. We however concentrate on the run-up period of transition from 2000 to 2005 of those countries that were immediately affected by (the proximity of) EU membership.

The choice of our dataset of course raises the question of what makes this time period of the CEECs transition process different from both other emerging market economies and the early transition period in the 1990s. In this respect, EU membership of CEECs is likely to give the CEE-transition process idiosyncratic dynamics. The immediate post transition period in CEE was inter alia characterized by widespread state ownership in the banking sector, soft budget constraints going along with close ties to state owned companies and pervasive connected lending culminating in open or latent banking crises. The subsequent opening up of banking markets by means of large scale privatization coupled with foreign entry restored confidence in the banking sector and set the stage for rapid financial deepening (see e.g. Havrlychik/Jurzyk, 2006). These effects were reinforced by the immediate consequences of EU integration. Most notably, (the proximity of) EU integration has speeded up wide ranging reforms in the economic and financial systems of CEECs based on an existing core set of legislation. With respect to the financial sector, the implementation of the *acquis communautaire* has e.g. led to the strengthening of governance and of the working of financial markets including through more pervasive financial supervision. The recent/ongoing implementation of EU directives of capital adequacy (Basel II) or the Markets in Financial Instruments Directive (MIFID) are two prominent examples epitomizing the catalytic role of EU membership in financial sector reform. In addition, the strong presence of EU-15 banks in CEE financial markets gave a further boost to the convergence process in CEE through wide ranging knowledge and capital transfers unseen in other emerging market economies in Asia or Latin America (see e.g. Herzberg and Watson, 2007).

As the banking markets of our sample changed considerably in the move from early transition in the 1990ies to EU membership in the current decade, there are good reasons to believe that earlier results on the determinants of interest margins for either the immediate post transition period in CEE or other emerging markets are not representative for the run-up period to EU-membership of CEECs. This conjecture is supported by Claeys/Vander Venet (2008) who found significant differences in the behaviour of bank interest margins between European mature markets and markets in transition for the period of 1994 to 2001. Furthermore, Lensink/Hermes (2004) showed that the influence of foreign bank entry on the domestic banking market is also dependent on the stage of the economic development of the country considered. To the best of our knowledge, there is no paper that addresses the dynamics of banks interest rate margins in CEE during the later stage of transition leading the way to EU-membership and provides an explanation for the continuing margin decline over the last years.

Our results reveal that the decline in margins from 2000 onwards was mostly caused by gains in operating performance as well as the progress made in financial deepening. In contrast to the literature, we furthermore find a positive effect of foreign ownership on margins, although foreign entry has no effect on domestic CEE-banks' interest rate margins. In addition, we provide evidence for the risk adjusted pricing of bank loans and deposits mirrored by positive risk premia for both interest and credit risk. Moral hazard however seems to be an issue with CEE banks. We furthermore document a tradeoff between non-interest revenues and interest margins revealing some importance of diversification in revenue streams.

Following an outline of the underlying theoretical model in Chapter 2, Chapter 3 specifies the empirical application. The fourth Chapter presents our results and Chapter 6 concludes.

## **2. DETERMINANTS OF BANK INTEREST RATE MARGINS**

Our paper on the determinants of banks' interest rate margins in CEE builds on a microeconomic dealership model in the line of Ho/Saunders (1981). From a modelling perspective, we apply the Maudos/Fernández de Guevara (2004) model of interest rate margins. Intuitively their model works in the following way: Banks are risk-averse agents taking deposits and granting loans. Both loans and deposit demands arrive randomly, with the probability of arrival depending on the margin the bank charges and the elasticity of demand for loans/the supply of deposits. The random character of deposit supplies and loan demands exposes them to interest rate risk. When taking deposits and not having concurrent loan demand the bank faces reinvestment risks on its assets side, when granting loans and not having concurrent deposit supply it faces refinancing risks on the liability side. As, *inter alia* due to information asymmetries some of the loans will not be repaid, the bank also faces credit risk. A risk-averse agent will demand a higher margin for both interest rate and credit risks. In addition, Maudos/Fernández de Guevara (2004)

argue that operating costs, which may e.g. vary due to product differentiation, impact margins. Even in the absence of any kind of risk, banks will have to cover their operating costs, which are a function of the deposits taken and the loans granted.<sup>9</sup> Thus banks operating at higher cost levels will need to charge higher margins. The model further predicts interest rate margins to be an increasing function of the average size of a bank's operations because more risk is concentrated in a single customer. Margins are also predicted to be a decreasing function of the degree of competition in a banking market.

To sum up, the theoretical model of Maudos/Fernández de Guevara (2004) list the following determinants of a bank's interest rate margin and their predicted directions of influence:

- the degree of *risk aversion* of a bank (the higher the risk aversion the higher the interest margin),
- the *competitive structure* of the banking market (the lower competition the higher the margins),
- *interest rate risks* (the more volatile the money market rates the higher reinvestment and refinancing risk resulting in higher margins in case of a risk-averse agent),
- *credit risks* (the higher credit risks the higher interest rate margin),
- the *interaction* between credit and interest rate risks,
- the bank's *operating costs* (the higher the operating costs the higher the margin a bank has to or is enabled to charge) and
- the average *size* of a bank's operation (the higher the average size of operations the higher the risk concentrated in single customers and the higher the margin a risk-averse agent demands).

The margin explained by these factors is referred to as the "pure" or model based interest rate margin in the literature. From an empirical point of view, a number of other factors reflecting market imperfections, bank specific components or macroeconomic influences might lead to deviations from these "pure" margins. The *payment of implicit interest* in the form of loan or deposit related commissions obviously have to be considered in this context (see Saunders/Schumacher, 2000). The *quality of management* (see Angbazo, 1997) may also have an effect on empirical margins – more efficient banks should have higher margins. Stroh (2004) furthermore documents an interplay between non-interest and interest revenues that could hinge on *income diversification*. *General economic conditions* (see Bikker/Hu, 2002) could also wield an influence in this context. With respect to CEE, the aforementioned widespread presence of foreign banks as well as the diminishing role of state ownership makes the *ownership structure* of banks an issue too. In an empirical model of bank margins, these factors also have to be captured.<sup>10</sup>

Thus, the observed interest rate margin of bank  $i$  in country  $j$  at time  $t$ ,  $IRM_{ijt}$ , is given by:

$$IRM_{ijt} = f \left[ PIM_{ijt}(\bullet), X_{ijt}, Y_{jt} \right] \quad (1)$$

where  $PIM_{ijt}$  is the pure interest rate margin,  $X_{ijt}$  is a vector of bank specific control variables, and  $Y_{jt}$  is a vector of industry-specific and macro-control variables.

### 3. EMPIRICAL MODEL

In order to capture unobserved cross section specific effects, we estimate a fixed effects model using the within group estimator for our dealership model. The fixed effects specification is clearly preferred vis-à-vis both a random effects model<sup>11</sup> and first differencing.<sup>12</sup> As a Pesaran (2004) test indicates the presence of cross sectional dependence in our sample, we display standard errors robust to cross sectional correlation following Driscoll/Kraay (1998). The empirical specification thus takes the form.<sup>13</sup>

$$IRM_{ijt} = const + \sum_{k=1}^K \alpha_k PIM_{kijt} + \sum_{l=1}^L \beta_l X_{lijt} + \sum_{m=1}^M \gamma_m Y_{mjt} + u_{ijt} \quad (2)$$

$$\text{and } u_{ijt} = \mu_{ij} + v_{ijt}$$

where  $IRM_{ijt}$  is the interest rate margin of bank  $i$  in country  $j$  in year  $t$ ,  $\alpha_k$  are the  $K$  coefficients of the variables determining the pure interest margin  $IRM_{ijt}$ ,  $\beta_l$  are the  $L$  coefficients of the bank-specific control variables, and  $\gamma_m$  are the  $M$  coefficients of the industry-specific and macro-control variables, that are constant over all banks in a given year and country  $j$ .  $u_{ijt}$  consists of the individual effect  $\mu_{ij}$  and the residual term  $v_{ijt}$ .<sup>14</sup>

Empirically, the *interest rate margin* is measured as net interest income in relation to total assets. The “pure” margin determinants as proposed by the model are proxied by the following variables:

*Risk aversion* is captured by the equity to total assets ratio – the higher the ratio, the higher is a bank’s risk aversion. *Interest rate risk* is captured by the standard deviation (within a year) of daily interbank money market rates, whereas *credit risk* is measured by the ratio of customer loans to total assets, with the ratio of loan loss provisions to net income (risk-earnings ratio) being used to check for the robustness of results. *The interaction of credit risks and interest risks* is covered by introducing an interaction term between the interest rate risk and the respective credit risk specifications. *Operating costs* are computed as the relation of operating expenses to total assets. The average *size* of operations is captured by the log of total customer loans. The *competitive structure* of the market is captured by the Herfindahl - Hirschman - Index<sup>15</sup> calculated for each banking market with the concentration ratio of the 5 largest banks in any banking market being used in a robustness check.<sup>16</sup>

A number of environmental variables and bank characteristics are used in order to account for empirical deviations from pure margins. Following Angbazo (1997), Saunders/Schumacher (2000) and Maudos/Fernandes de Guevara (2004), the *payment of implicit interest rates* is measured by the ratio of the difference between non-interest expense minus other (i.e. non-interest) operating income to total assets. The *quality of management* is proxied by the cost-income ratio, the *importance of non interest revenues* is calculated by the ratio of non-interest revenues to total assets<sup>17</sup>, the change in *economic conditions* is proxied by the real GDP growth rate in a given year for each country as well as by the index of economic freedom provided by the Heritage Foundation. The log of *GDP per capita* is intended to measure the differing stages of economic convergence and thus to some extent also proxies the development of the banking sector with respect to technological change. We use the intermediation depth, i.e. the relationship of total banking assets to GDP for robustness purposes in this respect.

Regarding the issue of *ownership structure*, foreign ownership is captured by the share of foreign ownership in a given bank at a given point in time. To see if results are stable to alternative variable definition, we also use a foreign ownership dummy which is 1 in case the largest shareholder is a foreign company and 0 otherwise. In order to analyze the impact of foreign entry on domestic banks, we use the overall share of foreign owned bank assets in total bank assets of a country in a given year. We use a dummy for state ownership of each bank in each year which assumes a value of 1 if state ownership is above 50% (we use the 25% threshold to check for robustness of results) and 0 otherwise.

In this context, we have to address two econometric issues. To begin with, the use of dummy variables in a fixed effects model is problematic. In principle, as long as there is enough variation within cross sections over time, dummy variables can be used in a fixed effects model too. If there is variation in the dummy variable only with relatively few cross sectional units, it will however be hardly possible to get a precise estimator (see Wooldridge, 2003). For our dataset, this should not be too much of a concern with respect to foreign ownership<sup>18</sup>, as numerous banks became foreign owned over the sample period (see Table 1). As for state ownership however, we need to exercise considerably more caution in interpreting our results as we have far fewer (though larger) state owned banks changing owners (see also Table 1).

The second econometric issue concerns potential endogeneity. The use of foreign ownership as a right hand side variable implicitly assumes its exogeneity. In our case, this is equivalent to the assumption that foreign bank presence at any time  $t$  is determined by market or bank characteristics at time  $t-1$ . As this assumption seems quite restrictive, we perform a test for the exogeneity of foreign ownership following Wooldridge (2002) which confirms the strict exogeneity of foreign ownership. This result is in keeping with the findings of Claessens *et al.* (2001) and Havrlychik/Jurzyk (2006). Claessens *et al.* (2001) document that (in contrast to e.g. a low cost environment,



low taxes etc.) the net interest margin is insignificant for the entry decision of a foreign bank. Havrlychik/Jurzyk (2006) show that the higher profitability of foreign banks is acquired rather than “inherited”.

### **3.1. Data**

Our data on banks’ balance sheets and profit and loss accounts stem from Bureau van Dijk’s Bankscope database. The database consists of 402 banks out of eleven countries in CEE, namely the 10 CEE Countries that joined the EU in 2004 and 2007 respectively plus Croatia, which was officially granted the candidate country status in 2004.<sup>19</sup> Our time span includes 6 years and ranges from the year 2000 to 2005. Incomplete data availability with respect to a number of variables we use reduces our sample to an unbalanced panel of 247 banks with 930 observations, for which a time series of ownership information for each bank was constructed out of the Bankscope database. Interbank rates are taken from Bloomberg, GDP per capita and real GDP growth from Eurostat and the source of the Freedom Index is the National Heritage foundation.

Table 1 shows the evolution of our variables for the median bank for the years 2000 to 2005. Following a common trend also observed in Western European countries (see e.g. Liebeg/Schwaiger 2007), the interest rate margin (*IRM*) decreased from 3.5% in 2000 to 2.7% in 2005. During the same period operating costs (*OPEXPRATIO*) also decreased markedly – from 4.7% to 3.2%. So did cost-income ratios (*CIR*, from 63.2% to 47.8%), non-interest revenues (*NONINTREV2*, from 2.3% to 1.8%), and implicit interest payments (*IIP*, from 1.4% to 0.4%), indicating substantial gains in the efficiency for banks in CEE. The evolution of interest rate risks (*STDIBR*) is rather volatile over the time span, but was lower in 2005 than at the beginning of the decade. Our proxy for credit risks (*CRR*) increased during the sample period, whereas risk aversion (*RISKAV*) declined slightly. Neither the Herfindahl index (*HHI*), 0.154 in 2005, nor concentration (*CR5*), 71% in 2005, did vary to a large degree over time. GDP growth (*GDPGROWTH*) was in range of 4% to 5.3%. The freedom index (*FREEDOM*) did not change substantially, whereas intermediation depth (*INTERM*) increased rapidly from 38% of GDP to 88%.

Concerning our ownership variables the median share of foreign ownership (*FOREIGNSHARE*) increased noticeably from 45% in 2000 to 85.5% in 2005, depicting the change in banking ownership structure during our sample period. The share of banks that had a dominant foreign owner (*LARGESTFOREIGN*) paralleled this development and grew from 54.1% (i.e. 46 banks) to 68% (120 banks) from 2000 to 2005. State ownership played a minor and decreasing role in CEE banking markets: 5.7% of all banks had the state as majority shareholder in 2005, down from 8.2% in 2000.

## **4. RESULTS**

Table 2 shows the results of our reference model, Table 3 discusses various robustness checks, Table 4 presents the results on the hypothesis of potential moral hazard behaviour and Table 5 contains the findings on how foreign ownership affects

Table 1

	<i>Definition, sample medians*</i>	2000	2001	2002	2003	2004	2005
IRM %	Net interest income to total assets	3.447	3.219	3.325	3.143	2.896	2.688
OPEXP RATIO %	Operating costs to total assets	4.716	3.900	3.953	3.710	3.502	3.239
RISKAV %	Equity ratio	9.834	10.053	10.066	10.153	9.732	9.272
CRR %	Customer loans to total assets	41.742	44.933	49.635	55.024	53.711	54.893
LLPR %	Loan loss provisions to net interest income	13.180	9.245	11.240	8.850	9.220	9.450
STDIBR	Standard deviation of inter-bank rates for each country	0.860	0.963	0.810	1.332	0.619	0.584
CIR %	Cost-income ratio	63.230	55.641	55.637	52.877	49.789	47.760
CROSSIBR	Interaction between LLPR and STDIBR	4.150	5.642	4.753	2.092	2.073	1.546
NONINTREV %	Non-interest revenues to total income	40.733	38.239	36.666	37.304	37.690	41.109
NONINTREV2%	Non-interest revenues to total assets	2.283	1.971	1.905	1.789	1.820	1.789
IIP %	Operating expenses minus non-interest income to total assets	1.439	0.910	0.865	0.797	0.498	0.366
HHI	Herfindahl Index by country calculated on the basis of total assets	0.143	0.145	0.135	0.133	0.135	0.154
CR5	Market share of five largest banks in a country	71.000	70.000	71.000	70.000	67.000	71.000
SIZE	Log of total customer loans	12.017	12.166	12.162	12.157	12.396	12.985
GDPGROWTH %	Annual growth of real GDP	4.200	4.300	4.600	4.300	5.300	4.300
INTERM %	Total banking assets of a country to its nominal GDP	37.635	69.464	62.156	71.873	77.327	87.596
GDP PER CAP	Log of GDP per capita (in EUR)	9.149	9.170	9.208	9.231	9.311	9.354
FREEDOM	Economic freedom index by the heritage foundation ranging from 0 (lowest) to 100 (highest)	62.964	60.072	64.336	61.536	62.217	62.446
CROSSKK	Interaction between LLPR and CRR	0.425	0.538	0.455	0.410	0.331	0.303
FOREIGN SHARE	Share of foreign ownership for each bank %	45.000	50.465	70.835	65.830	75.000	85.520
LARGEST FOREIGN	Dummy (1 if largest owner is foreign), % of total obs. if dummy is 1	54.118	54.237	60.667	61.257	64.115	67.797
STATE50	Dummy (1 if state owns more than 50%) % of total obs. if dummy is 1	8.235	11.017	7.333	7.330	7.656	5.650
STATE25	Dummy (1 if state owns more than 25%) , % of total obs. if dummy is 1	8.235	11.017	8.000	7.85	8.134	6.215
	Number of observations in a given year	85	118	150	191	209	177

Sources: Bankscope, Bloomberg, Heritage Foundation, Eurostat.\* Median by bank or country depending on variable definition.

domestic banks. Econometrically a Hausmann test as well as a test for serial correlation in residuals following Wooldridge (2002) confirms the use of a fixed effects model vis-à-vis a random effects model or first differencing.

#### **4.1. Reference Model**

Coming back to our reference model, we will start by summing up the main results first and then further elaborate on the issue of bank risk taking and ownership.

Most determinants of the pure interest rate margins have the predicted sign of influence and are significant. Operating costs have a positive significant influence as do risk aversion, credit risk and interest rate risk. When looking at the sensitivity of the margin with respect to these determinants, it becomes apparent that credit risk is the most important driving force of interest rate margins. A 10 per cent increase in credit risk would lead to a margin increase of 14.1 bp, whereas an increase in interest rate risk of the same magnitude would only entail a one basis point increase.<sup>20</sup> Furthermore operating costs also have a sizeable impact on margins – a 10 per cent decrease in operating costs will lead to a margin reduction by 3.9 bp. On the contrary, size does not have any significant influence. Lower costs, lower risk aversion, lower credit as well as lower interest risks therefore induce lower interest rate margins.

The negative sign of the competition variable however contradicts the expectation from the theoretical model. A possible answer for this contradiction may come from the theory of contestable markets – the contestability of markets could make increasing concentration (as measured by the Herfindahl index) compatible with a decrease in margins. The wave of foreign bank entries that CEE banking markets experienced from the late 1990s onwards, is a case in point in this regard.

Concerning bank specific variables of the interest margin model, cost-income ratio and non-interest revenues have negative and significant coefficients. A 10 per cent increase in the cost-income ratio decreases margins by 10.9 bp and a 10 per cent increase in non-interest revenues causes margins to drop by 6.0 bp. Implicit interest payments also have the expected positive and significant influence: The more services are devoted to generating interest income (i.e. not covered by other operating income), the higher the interest rate margin is. The effect is however comparatively small with the interest rate margin change amounting to only 1.7 bp for a 10% change in implicit interest rate payments.

All in all, our results seem to be more in line with the efficient structure hypothesis than with the structure performance hypothesis. The more efficient a bank's management is in terms of lower cost-income ratios, the higher is its interest rate margin. The fact that bank interest rate margins in CEE are to a considerable extent determined by their efficiency is in line with earlier results of Claeys/Vander Vennet (2008).

Looking at the effect of banks' ownership model, foreign ownership has a significant, though small, positive impact on margins – a 10% increase in the share of

ownership increases margins by only 1.9 bp. State ownership on the contrary, has no significant impact.

With respect to the country specific environmental variables, the index of economic freedom has the predicted negative sign, but is insignificant. GDP per capita however, which can serve as an indication for the progress made in the transition process does have a significant negative effect on margins – a 10% increase in GDP per capita induces a sizeable decrease in bank interest margins by 5.4 bp.

**Table 2**  
**Determinants of Interest Margin of Banks in CEE, 2000-2005, Reference Model**

	<i>Dependent variable: net interest margin (IRM)</i>		
	<i>Coefficient</i>	<i>Standard error</i>	<i>p-Value</i>
OPEXPRATIO	0.11937	0.01746	0.000
RISKAV	0.03435	0.00766	0.000
CRR	0.02559	0.00361	0.000
STDIBR	0.00140	0.00051	0.006
CIR	-0.02288	0.00228	0.000
CROSSKK	-0.00085	0.00060	0.158
NONINTREV2	-0.01474	0.00283	0.000
IIP	0.45928	0.02643	0.000
HHI	-0.02285	0.00674	0.001
SIZE	0.00006	0.00060	0.915
GDPGROWTH	0.00010	0.00021	0.626
GDPPERCAP	-0.01293	0.00311	0.000
FOREIGNSHARE	0.00217	0.00088	0.014
FREEDOM	-0.00016	0.00012	0.202
STATE50	0.00090	0.00140	0.517
_CONS	0.15524	0.02766	0.000
no. of observations	930		
no. of groups	247		
Hausmann Test	0.0000		
Test for ser. correl. <sup>+</sup>	0.0001		
R-Squared	0.6075		

<sup>+</sup> Wald test for serial correlation in the idiosyncratic errors of a linear panel-data model following Wooldridge (2002).

#### 4.2. Robustness checks

In order to check for the robustness of these results, we estimated models using alternative variable definitions (models (1) to (6) in Table 3). Model (1) uses the loan loss provision ratio (*LLPR*) as a proxy for credit risk. Model (2) is estimated with a new variable for non-interest revenues, namely their share in total assets. Models (3) and (5) use different variable definitions for capturing the influence of foreign/state ownership. *LARGESTFOREIGN* is a dummy which assumes a value of 1 if the largest

shareholder is a foreign shareholder and 0 otherwise (instead of the share of foreign ownership in the reference model), and *STATE25* is a dummy which has the value 1 if state ownership is above 25% (instead of 50% in the reference model) and 0 otherwise. Model (4) uses intermediation depth (i.e. the banking assets of a country to its nominal GDP) as an alternative to GDP per capita in the reference model. Model (6) uses the concentration ratio of the 5 largest banks in any country instead of the Herfindahl index.

The results of our reference model are by and large confirmed by the robustness checks we perform in models (1) to (6) with several smaller exceptions. Loan loss provisions do not have a significant influence on margins. Due to the fact that provisioning ratios in a rapidly growing market are rather low (see e.g. OeNB, 2007), their ability to proxy credit risk is limited. Furthermore, this finding is in line with the presumption that loan loss provisions are affected by a number of other factors besides credit risks, especially earnings management, making them a sometimes misleading measure of credit risk. Furthermore, competition when measured by the concentration ratio of the 5 largest banks in any banking market, is no longer significant. This result mirrors the difficulty in finding a sensible proxy for competition in banking markets – although they are very popular in empirical banking studies, both the Herfindahl index as well as concentration ratios can at best approximate competitive conditions.<sup>21</sup>

An interesting aspect concerns the influence of intermediation depth on margins. Apparently, the higher developed the banking market of a country is in terms of its size relative to GDP, the lower the interest margin is. A 10% increase in intermediation depth causes margins to drop by 5.1 basis points. This result lends further support to our earlier conclusion that the progress made in the transition process had a significant impact on banks' margins.

To conclude, although the robustness checks performed underpin our confidence in our estimation results, we need to consider a number of caveats when interpreting our results. One certainly is the choice of empirical proxies for variables. Due to data restrictions, especially the proxies for credit and interest rate risk are rather crude and perhaps do not fully cover all aspects of these risk categories. A similar argument applies to our proxy for competition. Furthermore results on the role of state ownership have to be treated with caution, as changes from public to private ownership occur only for few cross sectional units.

Coming back to our first question on the reasons for the decline in interest rate margins of CEE banks over the last years, we can thus conclude that an enhanced operating performance as well as progress in the transition process are the main driving forces behind the margin reductions experienced from 2000 onwards. This can be seen when comparing the overall development of the determinants of interest margins in our model over the time period of 2000 to 2005 with the sensitivities of margins to changes in these determinants. During this time period margins decreased

by 76 bp for the median bank. As for operating costs, a 10% decrease leads to a margin reduction of 3.9 bp. Operating costs declined by more than 30% from 4.7% to 3.2% for the median bank in our sample. Ceteris paribus, this would lead to a margin reduction of some 12 bp. A similar argument applies to financial deepening. Our model shows that a 10% increase in GDP per capita means a 5.4 bp decrease in the interest margin. The median of GDP per capita increased by more than 40% from 8,300 Euro in 2000 to

**Table 3**  
**Determinants of Interest Margin of Banks in CEE, 2000-2005, Robustness Checks**

	<i>Dependent variable: net interest margin (IRM)</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Coefficient</i>	<i>Coefficient</i>	<i>Coefficient</i>	<i>Coefficient</i>	<i>Coefficient</i>	<i>Coefficient</i>
OPEXPRTIO	0.24250***	0.21207 ***	0.11943 ***	0.12165 ***	0.11932 ***	0.11846 ***
RISKAV	0.02225***	0.03998 ***	0.03406 ***	0.03203 ***	0.03434 ***	0.03233 ***
CRR		0.02766 ***	0.02580 ***	0.02667 ***	0.02558 ***	0.02547 ***
STDIBR	0.00088**	0.00186 ***	0.00143 ***	0.00181 ***	0.00141 ***	0.00136 **
CIR	-0.02779***	-0.02593***	-0.02288***	-0.02310 ***	-0.02288 ***	-0.02295***
CROSSKK		-0.00133 **	-0.00091	-0.00087	-0.00085	-0.00091
NONINTREV2	-0.02042***		-0.01477***	-0.01491 ***	-0.01474 ***	-0.01489***
IIP	0.44499***	0.44913 ***	0.45671 ***	0.46620 ***	0.45933 ***	0.45861 ***
HHI	-0.01686***	-0.02160***	-0.02224***	-0.02675 ***	-0.02283 ***	
SIZE	0.00249***	-0.00013	-0.00001	-0.00098	0.00006	0.00009
GDPGROWTH	0.00017	0.00019	0.00012	0.00012	0.00010	0.00020
GDPPERCAP	-0.01447***	-0.01320***	-0.01303***		-0.01294 ***	-0.01165***
FOREIGNSHARE	0.00291***	0.00238 ***		0.00153	0.00215 **	0.00195 **
FREEDOM	-0.00018	-0.00016	-0.00015	-0.00020	-0.00016	-0.00014
STATE50	0.00005	0.00198	0.00108	0.00156		0.00125
_CONS	0.15358***	0.15563 ***	0.15641 ***	0.05530 ***	0.15530 ***	0.13684 ***
LLPR1	-7.44e-06					
CROSSIBR1	-0.00002***					
NONINTREV		-0.25194***				
LARGESTFOR-N			0.00221 ***			
INTERM				-0.00583***		
STATE25					0.00087	
CR5						0.00211
no. of observations	827	930	930	930	930	930
no. of groups	222	247	247	247	247	247
R-Squared	0.6328	0.6153	0.6076	0.5693	0.6075	0.6050
Test for ser. correl. <sup>+</sup>	0.0000	0.0002	0.0001	0.0001	0.0001	0.0001
Hausmann test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

\*\*\*, \*\*, \* indicate significance at 1%, 5%, 10% level

*Note:* As we lack information on LLPs for 25 cross sectional units, the number of observations and groups in Model (1) is not in line with the reference model.

<sup>+</sup> Wald test for serial correlation in the idiosyncratic errors of a linear panel-data model following Wooldridge (2002).

11,900 Euro in 2005, leading – *ceteris paribus* – to a margin reduction by some 20 bp. Replacing GDP per capita with intermediation depth produces a similar result. Intermediation depth rose by 40% from 63% to 88% - a 10% increase decreases margins by 5.1 basis points. Given that intermediation ratios in CEE are still way behind Eurozone averages (some 284% as opposed to a median of 86% for the CEECs in our sample)<sup>22</sup>, we can expect margins in CEE to decline significantly in the future, as the depth of financial intermediation approaches Euroarea levels.

### **4.3. Risk Taking**

In the light of loan growth rates well above 20% in some countries, concerns have been mounting, that lending growth may come at the expense of a hidden accumulation of credit risks (see e.g. Hilbers et al. 2005 or Herzberg/Watson, 2007). Our results indicate that the pricing for loans and deposits is risk adjusted - both credit and interest rate risk wield a significant influence on bank margins. These risk premia indicate that banks have a first line of defence against loan losses before having to tap their equity buffers.

Moreover non-interest revenues and interest rate margins seem to interact. Our results show a tradeoff between these two income categories. As already hinted at in the introduction, this could be seen as evidence for the hypothesis that besides credit and interest rate risk, diversification effects in banks' income sources influence the pricing of loans and deposits. Alternatively, this tradeoff could be due to cross selling opportunities - banks are willing to accept lower margins, as the establishment of the client relationship enables them to profit in terms of non-interest revenues as well.

Although these results appear in line with expectations, moral hazard behaviour could still be hidden underneath. In order to check for moral hazard behaviour, we follow a commonly used approach in the literature (see e.g. Berger/DeYoung, 1997) and split our sample into two alongside banks' equity ratios. We chose the 25% quantile to separate our sample. If moral hazard is indeed present, we expect the margins of thinly capitalized banks to be less sensitive to interest rate and credit risk. Table 4 provides the estimation result of both subsamples.

These results indeed provide some – though weak – evidence for the moral hazard hypothesis: in fact we note that interest rate risk is *negatively* significant for margins for thinly capitalized banks. Furthermore, the credit risk coefficient for thinly capitalized banks is smaller than for their peers. Therefore the interest rate margins of thinly capitalized banks are less sensitive towards both credit and interest rate risk than the margins of their peers with higher equity ratios. In light of the fact that current loan loss provision levels in CEE are rather low, *inter alia* due to the rapid growth of credit portfolios (see e.g. Boss *et al.* 2007), the fact that banks with a comparatively lower equity base are those, who react less sensitively to changes in interest rate and credit risk, appears worrying. The order of magnitude in terms of the difference of sensitivities in credit and interest rate risk between thinly capitalized banks vis-à-vis their peers is about 3 basis points for a 10% increase in both risk factors and thus limited.

**Table 4**  
**Risk Shifting - Subsamples Split Along the 25% Quantile of the Tier 1 Ratio**

	<i>Dependent variable: net interest margin (IRM)</i>	
	<i>(1) Thinly cap. banks</i>	<i>(2) Remaining banks</i>
	<i>Coefficient</i>	<i>Coefficient</i>
OPEXPRATIO	0.08224 ***	0.16298 ***
RISKAV	0.12326 ***	0.02895 **
CRR	0.01735 ***	0.02123 ***
STDIBR	-0.00105 *	0.00123 *
CIR	-0.01369 ***	-0.02662 ***
CROSSKK	0.00333 ***	-0.00064
NONINTREV2	-0.00489 **	-0.02363 ***
IIP	0.43286 ***	0.43760 ***
HHI	0.01622 *	-0.02440 **
SIZE	-0.00208	-0.00006
GDPGROWTH	0.00005	-0.00006
GDPPERCAP	-0.01413 **	-0.00773
FOREIGNSHARE	0.00256 ***	0.00338 *
FREEDOM	-0.00025 *	-0.00020 **
STATE50	-0.00387	0.00153
_CONS	0.18244 ***	0.11777 ***
no. of observations	246	684
no. of groups	96	206
R-Squared	0.7811	0.6120
Test for ser. correl.+	0.0166	0.0001
Hausmann test	0.0000	0.0000

\*\*\*, \*\*, \* indicate significance at 1%, 5%, 10% level

Note: As the split in the 25% quantile was made for the pooled dataset, the number of groups is larger than 247, whereas the number of observations (930) is in line with the reference model.

+ Wald test for serial correlation in the idiosyncratic errors of a linear panel-data model following Wooldridge (2002);

#### 4.4. Ownership

In our case, foreign ownership has a positive influence on bank margins. This is e.g. in contrast to Claessens *et al.* (2001) and Micco *et al.* (2007) for a broad sample of developing countries as well as Drakos (2003) for a sample of CEE banks in the early stage of transition. One reason for this difference is the fact that foreign ownership could reduce CEE banks' refinancing costs (see e.g. BIS, 2006). Average bank financial strength ratings (BFSR) in CEE are e.g. considerably lower than in EU 15 countries, where most of their parent banks reside (see e.g. Moody's 2007). As BFSR mirror the "stand alone" risk of a bank not considering guarantees by parent banks, this indicates that CEE banks are indeed to gain (on average) from better ratings of their parents, either because they have access to the internal capital market of their



parent, or because they profit outright from these “implicit” guarantees in the form of better short or long term ratings. Fears of “cut and run strategies” of foreign banks in times of crisis could however limit the value of these guarantees. What makes CEE special in this respect is the fact that foreign ownership is considerably more common than in other developing countries. It is worthwhile considering that most of the foreign banking groups active in the region earn a significant portion of their income in these countries. The Italian Unicredit Group, Austrian Erste Bank and Raiffeisen International or the Belgian KBC group are cases in point. The widespread presence of foreign ownership in the region however reduces the risk of “cut and run” strategies, as these banks incur a considerable reputation risks by letting an individual subsidiary fail in case of a crisis. Thus the implicit guarantee by foreign parent banks seems to be more credible in CEE than in other developing markets which in turn would explain lower refinancing costs. More sophisticated risk management techniques implemented as a result of the know-how transfer going along with foreign ownership could be another reason why foreign owned banks are charged less for their debt.

A look at our data indeed reveals that foreign owned banks do have a lower cost for debt capital than their domestic peers. If the largest shareholder comes from abroad the average cost of debt capital is 2.76%, whereas it is 2.94% for banks with a domestic owner as largest shareholder.<sup>23</sup> In a perfectly competitive market, it may be argued that foreign banks would use these comparatively lower refinancing costs to expand their market share. Empirical evidence however suggests that CEE banking markets cannot be characterized by perfect competition but rather by monopolistic competition (see e.g. Yildirim and Philippatos, 2002, Koutsomanoli-Fillipaki and Staikouras, 2004, or Mamatzakis et al. 2005). Thus it does not come as a surprise to see lower refinancing costs not being passed on entirely to customers. Another aspect of CEE banking market is noteworthy in this regard: the rapid expansion of the CEE banking market itself offers important growth opportunities to banks without having to grab market share from competitors.

In a second step, we also want to analyse, how foreign entry affected domestic banks in CEE. To this end, we split our sample into domestic and foreign owned banks (based on whether the largest shareholder comes from abroad or not). The variable of interest therefore is the share of foreign ownership in country  $i$  at time  $t$  (*FOREIGN*). Incorporating the findings of Lensink/Hermes (2004) that the relevance of foreign ownership for domestic banks may depend on the level of economic development, we also include an interaction term (*INTERACTION*) between the degree of foreign ownership and a country's GDP per capita. Column (1) in Table 5 shows the results for the subsample of domestic banks. For completeness, the estimation was also done for the foreign bank subsample (see column (2) in Table 5).

Our evidence shows no significant effect of foreign entry on domestic banks' net interest rate margins. These results are in line with Lensink/Hermes (2004) who showed that the entry of foreign banks is in fact very prominent only for countries in

early stages of development. As the CEECs in our sample have progressed significantly in their transition process and since foreign entry (or at least the threat of foreign entry) was widespread across the region at the beginning of the observation period already, most effects of foreign entry on domestic banks should have occurred already.

**Table 5**  
**Domestic versus Foreign Ownership**

	<i>Dependent variable: net interest margin (IRM)</i>	
	<i>(1) Domestic</i>	<i>(2) Foreign</i>
	<i>Coefficient</i>	<i>Coefficient</i>
OPEXPRTIO	0.11293 ***	0.08291 **
RISKAV	0.04551 ***	0.04140 ***
CRR	0.03403 ***	0.01980 **
STDIBR	0.00277 ***	-0.00022
CIR	-0.01663 ***	-0.05202 ***
CROSSKK	-0.00325 *	0.00174 ***
NONINTREV2	-0.00940 ***	-0.02512 ***
IIP	0.38179 ***	0.65887 ***
HHI	-0.01282 ***	-0.01250
SIZE	-0.00231 **	0.00412
GDPGROWTH	0.00045 *	-0.00004
GDPPERCAP	-0.00387	-0.02191 ***
FREEDOM	-0.00018	-0.00021 ***
STATE50	-0.00108 **	(Dropped)
_CONS	0.08017 *	0.25938 ***
FOREIGN	0.01312	-0.00185
INTERACTIONF	-2.01e-07	2.67e-07
no. of observations	363	571
no. of groups	105	167
R-Squared	0.6609	0.7141
Test for ser. correl. <sup>+</sup>	0.0130	0.0006
Hausmann test	0.0000	0.0000

\*\*\*, \*\*, \* indicate significance at 1%, 5%, 10% level

<sup>+</sup> Wald test for serial correlation in the idiosyncratic errors of a linear panel-data model following Wooldridge (2002);

*Note:* As the split between domestic and foreign ownership was made for the pooled dataset, the number of groups considering Models (1) and (2) is larger than 247, whereas the number of observations (930) is in line with the reference model.

By comparing the results for domestic and foreign banks, we can see that foreign owned banks are less affected by GDP growth than their domestic peers. This result is in keeping with earlier empirical studies (see e.g. deHaas/Lelyfeld 2006, Havrlychik/Jurzyk 2006) showing that foreign banks may act as a stabilizing force in the potential cyclicity of credit supply of their host country.

In contrast to Drakos (2003), our results on the influence of a bank's ownership model on its margins furthermore reveal that state ownership has no significant influence on interest rate margins. It may however be argued, that in later stages of economic development and/or in countries with a low share of state ownership, state banks cease to play a development role in the economy and simply mimic the behaviour of private banks. The rapidly progressing process of economic convergence of the CEECs in our sample over the last years would thus explain why our results for CEE differ from those of Drakos (2003) who studied the early transition period.<sup>24</sup> These results are also compatible to Micco *et al.* (2007) who found that state ownership is only relevant for developing but not for industrialized countries.

## 5. SUMMARY

In this paper we apply a microeconomic dealership model of interest rate margins to banks in CEE in the late transition period of the years 2000 to 2005. The most important features of this late transition period in CEE are the widespread dominance of foreign banks originating to a large extent in the "old" EU and the adoption of legal and economic standards of the EU. It is above all this latter point which is why the 2000-2005 period exhibits different dynamics in CEE banking sectors vis-à-vis other emerging banking markets as well as the early transition period in CEE, which was marked by widespread banking crises.

We document that a better operating performance of banks as well as the progress made by CEE countries in the transition process were key factors contributing to lower interest rate margins and thus lower costs of financial intermediation in these countries. Both the continuation of the financial deepening process in CEE as well as further improvements in banks' operating performance towards Western European levels are expected to contribute to a further downward alignment of CEE banks' interest rate margins to EU-15 levels in the medium term. We also found support for the efficient structure hypothesis in CEE banking markets as a bank's interest rate margins is the higher the more efficient its management is.

Our results furthermore show that credit risk is by far the most important driver of interest rate margins in CEE banking, whereas interest rate risk has only a minor impact. With respect to bank risk taking, we therefore document positive risk premia in bank margins for both interest rate and credit risk. In addition we find a tradeoff between non-interest revenues and interest margins revealing some importance of income source diversification. We however also discovered some evidence that thinly capitalized banks react less sensitive to credit and interest rate risks, indicating the existence of moral hazard behaviour, although its impact on margins are limited.

In contrast to findings in the literature so far, foreign ownership has a positive effect on CEE banks' interest rate margins. We attribute this to the fact that banks owned by foreign companies (mostly banks) can refinance more cheaply than their domestic peers due to the access of subsidiaries to the internal capital market of the

holding banking group and/or implicit guarantees by the parent institution. Foreign entry however has no significant impact on domestic banks' margins in the run-up period to EU membership for CEECs, indicating that this effect may have occurred already beforehand. The fact that foreign-owned banks are less sensitive to changes in GDP growth than domestic owned banks furthermore supports the view that they add stability to the cyclical behaviour of credit supply in their host countries. Contrasting results on other emerging economies, state ownership has no influence on margins confirming the view that state-owned banks simply mimic commercial banks in later stages of economic development.

## NOTES

1. In 1998, the EU formally launched accession negotiations with five CEE applicant countries - the Czech Republic, Estonia, Hungary, Poland and Slovenia. In late 1999, the European Commission (EC) extended the number of countries by recommending opening negotiations with Romania, the Slovak Republic, Latvia, Lithuania and Bulgaria. Membership negotiations with all countries except Bulgaria and Romania were finalized by 2002 culminating in the first round of the 5<sup>th</sup> wave of EU enlargement in 2004. Romania and Bulgaria joined in a second round in 2007.
2. We also consider Croatia in our sample, which applied for EU membership in 2003 and was granted the formal candidate country status by the European Council in mid-2004.
3. Foreign banks' entry into the market could e.g. have been motivated by the expansion of their domestic clients abroad.
4. Empirically Micco *et al.* (2007) did not discover a significant effect of foreign ownership on bank interest rate margins for developing countries.
5. Empirically, this is confirmed by Micco *et al.* (2007) for broad sample of developing countries as well as Drakos (2003) for the early transition period in CEE.
6. The original Ho/Saunders (1981) model has been extended to include different kinds of loans/deposits (see Allen, 1988), the volatility of money market interest rates (see McShane/Sharpe, 1985), credit risk (see Angbazo, 1997), and operating costs (see Maudos/Fernández de Guevara, 2004).
7. See Claessens *et al.* (2001), Lensink/Hermes (2004) and Micco *et al.* (2007) for emerging markets in general, as well as Uiboupin (2004) and Fries *et al.* (2006) for CEE.
8. Claey's/Vander Vennet (2008) do not investigate the effect of ownership structure but rather focus on investigating why margins in CEE are well above Western European levels. Drakos (2003) includes data on ownership and documents a negative effect of foreign entry and state ownership on margins. These results may to some extent however be spurious, as he does not control for operating costs. In applying the Maudos/Fernández de Guevara (2004) we include the effect of operating costs into the modelling of interest rate margins, which turns out to be highly significant. Econometrically our approach differs from the above papers insofar as we allow for unobserved individual effects as well as cross sectional correlation.
9. As in a perfectly competitive environment the prices are set by the market, simply resulting in exit of banks with high expenses, some doubts on this argument may be justified. Higher operating costs may however also generate product differentiation due

to higher service and/or higher marketing expenses and therefore enable a bank to charge higher interests rates for loans and offer lower interest rates for deposits. In this respect, Fries and Taci (2005) e.g. argue that banks in transition are moving from defensive restructuring of the banking operations (cost cutting) to operating strategies based on service improvements and innovation, which requires higher level of spending.

10. The distinction between an empirically observed interest rate margin and a pure margin that induces the need for control variables is common to dealership models in the line of Ho/Saunders (1981). In this respect see also Angbazo (1997), Saunders/Schuhmacher (2000) or Maudos/Fernández de Guevara (2004).
11. A Hausmann specification test rejects the hypothesis of a random effects model adequately modelling individual effects. The p-values for the respective Hausmann tests are displayed for each model specification that is estimated (see Tables 2, 3, 4 and 5).
12. For large  $N$  and small  $T$  (which is the case for our sample), the choice between a fixed effects vs. a first differenced model depends on the efficiency of the respective estimators, which is determined by the serial correlation of errors. Following Wooldridge (2002), we perform a test for serial correlation in the idiosyncratic errors using the first differencing approach. The test rejects the null hypothesis of no autocorrelation in differenced errors, indicating that the fixed effects model is more efficient than first differencing. The p-value of the test statistic is again provided for every specification in Tables 2, 3, 4 and 5.
13. As several papers indicate the persistence of bank profits over time (see e.g. Athanasoglou *et. al.*, 2005, or Goddard *et. al.*, 2005) we also performed a dynamic panel data approach, using the one-step GMM-estimator by Arellano/Bond (1991) introducing common time effects to capture the potential influence of cross-section dependence. The lagged interest rate margin variable was however found to be insignificant. Furthermore, to make sure non-stationarity does not affect our data, we performed a panel data unit root test according to Maddala/Wu (1999), resulting in the rejection of the null-hypothesis of non-stationarity. The p-value of the test statistic for the dependent variable (IRM) is 0.0000 (based on a  $\chi^2$ -value of 1247.378) for the null hypothesis of a unit root.
14. Given the presence of large differences in the size of individual banks, heteroskedasticity could be a problem in our sample. We control for this by using a robust estimator of variance-covariance matrix of the parameter estimates.
15. Herfindahl-Hirschman indices ( $HHI$ ) for each country and year are computed as

$$HHI = \left[ \sum_{i=1}^N \left( \frac{X_i}{\sum_{j=1}^N X_j} \right)^2 - \frac{1}{N} \right] \bigg/ \left[ 1 - \frac{1}{N} \right] \text{ where } X_1, \dots, X_N \text{ denote the total assets of all } N \text{ banks}$$

in any given country existing at time  $t$ . These indices take on values between 0 (representing perfect “granularity”) and 1 (total concentration).

16. The use of the Herfindahl index as well as the market concentration ratio as a right hand side variable of course implicitly assumes that market concentration is exogenous to the change in banks’ interest rate margins. In order to make sure that our parameter estimates are not distorted by the endogeneity of the competition variable (which would lead to inconsistent parameter estimates), we perform a test for the exogeneity of the Herfindahl index and the concentration ratio following Wooldridge (2002), confirming the hypothesis of strict exogeneity of our competition variables. Results can be obtained from the authors upon request.

17. The definition of the variables that measure the payment of implicit interest rates and the importance of non interest revenues may raise concerns of multicollinearity, as do the definitions of the variable measuring the quality of management and operating costs. In order to check for multicollinearity we computed variance inflation factors (VIFs) for all independent variables based on a pooled OLS regression. VIFs are obtained by regressing an explanatory variable  $i$  on all other independent variables. As a rule of thumb, VIFs greater than 10 would indicate a problem of multicollinearity (see Gujarati, 1995). In case of our reference model, VIFs range from 1.23 to 5.17, thus multicollinearity does not seem to be a problem. In addition, we computed pairwise correlations between these variables, which were rather small too (not above 0.4). Furthermore we checked for the stability of parameter estimates when omitting individual variables. The empirical results in Chapter 5 – to the extent of being comparable – proved to be insensitive towards leaving out these variables one by one. Trading off the potential problem that could arise by omitting variables with their potential collinearity, we decided to include all variables in the model.
18. Note that we a foreign ownership dummy is only used as a robustness check, in the reference model, the share of foreign ownership in each bank is used.
19. Therefore the countries included are Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, and Slovakia.
20. All sensitivities have been evaluated at sample medians of the year 2005 as depicted in Table 1.
21. We also estimated a Lerner Index for every banking market following Angelini and Ceterolli (2003). As we were however lacking enough data points for a number of countries, results turned out to be highly instable to comparatively small variations in parameter definitions. We therefore restrained from including those results in our robustness checks.
22. For Euroarea data see e.g. Rossi *et al.* (2007).
23. Although the empirical literature is showing contradicting results on the issue, some authors (see e.g. Micco *et al.*, 2007) find an interaction between foreign ownership and operating costs. In our case, this could have an impact on the effect of foreign ownership on margins. If foreign ownership and operating costs e.g. correlate positively, we would underestimate the effect of foreign ownership on margins, as the interpretation of the foreign ownership coefficient is always made on a *ceteris paribus* argument (thus at a given level of operating costs). With our dataset, we in fact find a negative though insignificant correlation. Thus we could in fact be overestimating the influence of foreign ownership on margins. Following Wooldridge (2003), we therefore have reestimated the reference model leaving out operating costs to see whether our results remain stable. The coefficient on foreign share stays significant, however is, as expected, slightly lower (0.0017 instead of 0.0020). On the stability of other results see also footnote 17.
24. Some of these differences to Drakos (2003) could also be due to the fact that we control for cost and competition effects.

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