Determinants of banks' net interest margins in Central and Eastern Europe

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Abstract

This research analyzes the main determinants of the net interest margin of banks operating in Central and Eastern European (CEE) countries in the period from 1999 to 2010. The results reveal several main drivers of net interest margins in the CEE. Prior to 2008 the net interest margins declined primarily due to strong capital inflows and stable macroeconomic environment. In the crisis period, significant rise in government debt accompanied by the increase in macroeconomic risks and abating capital inflows were pushing margins up while other factors such as low credit demand, higher capitalization and significantly increased share of non-performing loans pressured banks' margins down. The results also confirm the important contribution of higher efficiency to lowering banks' margins.

Keywords: net interest margin, CEE

1 INTRODUCTION

The past few years in some of the Central and Eastern European[1] (CEE) countries have been marked by an ongoing debate among politicians, the financial industry academic community and the general public about banking sector profitability, which has been characterized both as too high and too low, depending on the point of view. There have also been many opposite opinions about the role of banks and their ability to promote the recovery of the real economy, especially in countries where credit activity is stagnating or is very low. In that context, one of the main questions raised has been related to the banks' and policymakers' options of lowering domestic interest rates and stimulating demand for credit in such a way.

The cost of financial intermediation is an important determinant of total financing costs. According to the literature (i.e. Maudos and de Guevarra, 2004; Claeys and Vander Vennet, 2008; Kasman et al., 2010) there is a strong connection between the degree and cost of financial intermediation and economic growth, as funding costs have a significant impact on the investment level and capital allocation, and thus in turn on growth potential and the direction of economic activity. They also affect the profitability of the banking sector and therefore its stability and ability to support the real economy (García-Herrero, Gavilá and Santabárbara, 2009).

In spite of the importance of borrowing conditions for economic recovery and, in turn, for financial system stability, this area has not been researched extensively with respect to CEE countries in the period during and after the onset of the recent financial crisis. Most of the papers studying the net interest margins in these countries focus on the period of banking sector consolidation in the early 2000s and the post-consolidation period, which has been marked by a successful transformation of those banks into modern, market-oriented financial institutions. However, the recent crisis, marked by a severe slowdown and drop in real GDP and

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[1] Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia.

mostly very slow (if any) recovery combined with very mild credit activity of commercial banks, has drawn lots of attention to the interconnectedness between financial institutions and the real economy.

Banks charge and pay many types of interest rates and have a variety of different categories of assets and liabilities and there is no unique way of measuring the difference between what they charge for lending and the price of their funding sources. One of the best and most widely used indicator of the cost and efficiency of financial intermediation is a bank's net interest margin. It is calculated as the ratio of net interest income and total bank earning assets, where net interest income is equal to the difference between interest earned and interest paid. Regardless of its common use, it should be noted that this indicator has some potential weaknesses, as it does not take into account other sources of income and costs for the bank and is not good representative of a bank's marginal costs and revenues (for details see Brock and Suarez, 2000).

Higher net interest margins usually imply lower banking sector efficiency, marked by higher costs due to inefficient control of operating expenses, and have a negative impact on financial developments, resulting with lower investments and slower economic activity. They might also reflect a high risk premia due to inappropriate regulation of the banking sector or a significant information asymmetry (Claeys and Vander Vennet, 2008). On the other hand, lower net interest margins usually mark deeper and more developed financial markets, encourage investment activities and support economic growth. However, as emphasized by Schweiger and Liebeg (2009), the benefits of a lower cost of financial intermediation will only be effectuated if banks price risks in a prudent manner.

From banks' perspective, the net interest margin is an important determinant of their profitability, while from the real economy point of view, combined with the country risk, macroeconomic variables, client risk, competition, etc. it is one of the key factors influencing the overall level of interest rates for the private sector. In bank-centric systems dominant in European emerging markets where bank loans are the main funding source, factors that affect loan availability also influence the stability of the whole banking sector.

This research aims to find the main determinants of the net interest margin in eleven CEE countries: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia. The total sample consists of 12 periods (from 1999 to 2010) and 152 cross sections (banks). We are particularly interested to find out how *bank-specific variables* are important for the level of net interest margin compared to the specific conditions in the country where bank operates.

One of the main contributions of this paper to the existing literature is its analysis of the period after the onset of the financial crisis, which has not yet been done for this region. Apart from that, we use the Arellano and Bover (1995) system GMM estimator, which solves endogeneity problems and allows for the inclusion of a lagged dependent variable together with fixed effects to control for unobserved heterogeneity. Unlike most other papers dealing with CEE countries, we also take into account regulatory costs.

The results reveal several main drivers of net interest margins in CEE. Prior to 2008 the net interest margins declined primarily due to strong capital inflows and the stable macroeconomic environment. In the crisis period, a significant rise in government debt accompanied by the increase in macroeconomic risks and abated capital inflows pushed margins up while other factors such as low demand (due to weak economic performance), higher capitalization and significantly increased share of non-performing loans pressured banks' margins down. The results also confirm the important contribution of higher efficiency to lowering banks' margins. This leads to the conclusion that policymakers can influence the costs of financial intermediation by conducting prudent and sustainable policies aimed at preventing and mitigating risk accumulation and creating a stable macroeconomic environment, accordingly indirectly supporting economic activity.

The rest of the paper is organized in the following way. Section two summarizes the main findings from the literature investigating the main determinants of banks' profitability and costs of financial intermediation. The third section describes the data used in the empirical part of the paper, section four gives an overview of stylized facts, while the methodology is explained in the fifth part. The main results and robustness checks are presented in section six. Concluding remarks, as well as some policy implications based on the research outcome, are provided in the seventh section.

2 LITERATURE SURVEY

Table A1 (in the appendix) presents some of the most relevant research papers that study banks' efficiency and the cost of financial intermediation. The main question posed in the literature relates to the fundamental elements that influence the cost of financial intermediation. The literature identifies several prime drivers of net interest margins (managerial efficiency, macroeconomic volatility and competitive pressures). Regarding policy-related questions, the literature has looked into the role of macroeconomic, financial stability and regulatory policies as determinants of interest margins. For instance, one question relates to potential role of central banks in lowering interest rate volatility (Saunders and Schumacher, 2000) or the role of banking sector regulation in fostering market competition, building up stronger capital adequacy rules, lowering credit risk and thereby affecting net interest margins (e.g. Claeys and Vander Vennet, 2008; Maudos and de Guevara, 2004; Hasan Khan and Khan, 2010).

In terms of the empirical framework most of the papers base their empirical research on the microeconomic dealership model introduced by Ho and Saunders (1981), who view the bank as a dealer facing uncertainty and costs coming from the stochastic nature of loan demand and deposit inflows, which are covered by different fees. There are three empirical approaches in estimating this model, depending on the availability of the data and the interest of the researchers.

The first approach is based on a two-step procedure, where in the first step the net interest margins are regressed on a set of bank specific explanatory variables. The resulting constant in this regression is a measure of the pure interest margin for the country in question, which is calculated for each time period. In the second step, the time series of pure interest rate spread is regressed on the second set of explanatory variables: macroeconomic variables, interest rates and their volatility. The constant term in this step reflects the effects of market structure on the spread determination after bank specific and macroeconomic effects have been cleaned out. Such an approach is characteristic of a single-country analysis with long time series (Brock and Suarez, 2000; Saunders and Schumacher, 2000; and Männasoo, 2010). In Männasoo (2010) second step regression is done by vector error correction model.

The second type of empirical approach was to use the single step approach and estimate a reduced equation that depicts the banks' behaviour with respect to various determinants of net interest margin. This approach has been mainly used in cross-country studies, where in addition to bank and banking market specific variables researchers also include macroeconomic variables to capture the effect of banks' country of operation characteristics. Apart from that, the variables used are the same as those in the previous approach. In terms of estimation techniques, this approach uses estimates on a pooled dataset, generalized least squares or least squares with fixed effects (Claeys and Vander Vennet, 2008; Maudos and de Guevara, 2004; Kasman et al., 2010; and Hasan Khan and Khan, 2010).

The third type of empirical approach builds on the second, but extends it empirically. Several potential problems are addressed here. The first is that the net interest margins show a tendency to persist over time, which could be a sign of competitive position of the bank, serially correlated macroeconomic shocks and information opacity (Dietrich and Wanzenried, 2011). An additional problem could be endogeneity. As García-Herrero et al. (2009) explain, more profitable banks may be able to increase their equity more easily by retaining profits or they could invest in advertising campaigns to increase size, which can increase their profitability. Finally, as before, the researcher needs to take care of unobservable heterogeneity which is usually controlled by using fixed effects. This is why some authors opted for the GMM estimator which solves these problems (García-Herrero, Gavilá and Santabárbara, 2009; Dietrich and Wanzenried, 2011).

Apart from the net interest margin some authors use different variables as an alternative proxy for bank profitability and cost of financial intermediation such as return on average assets (ROAA) and return on average equity (ROAE) (Athanasoglou, Delis and Staikouras, 2006; Dietrich and Wanzenried, 2011).

The literature surveyed shows that the characteristics of the individual banks are among the most important determinants of banks' business results and financing costs for their clients. Variables most commonly used for this purpose are different items (or their ratios) from financial and other reports that measure operational efficiency, quality of management, income structure, balance-sheet structure, credit activity, capital adequacy, liquidity, risk aversion, loan quality, credit risk, interest risk, opportunity costs of bank reserves, as well as bank size and ownership structure.

Conclusions about the impact of macroeconomic conditions on interest margins and banking sector efficiency have been ambiguous. Uncertainty and deterioration in macroeconomic conditions might increase interest margins and vice versa, but as mentioned by Claeys and Vander Vennet (2004), higher economic growth could also result in higher interest margins due to more intense credit activity and better loan quality. One of the things most authors agree on is that lower inflation implies lower interest margins.

Due to the problems with measurement, few papers explore the impact of regulatory costs on the cost of financial intermediation. Ho and Saunders (1981) emphasize that the cost of banks' funds is affected not only by the level of reserve requirements, but also by the opportunity cost of holding reserves usually measured by short-term risk free rate. Brock and Suarez (2000) and Saunders and Schumacher (2000) agree that higher reserve requirements get translated into higher interest spreads.

The influence of banking market structure on banks' efficiency has been investigated in many papers and is commonly measured by the Herfindahl index[2] or Lerner index[3]. Specific features of the banking markets influence the market power of each specific bank and impact the pricing policy, and therefore can pressure net interest margins. This implies that a more competitive environment should be able to support lower interest margins, but as mentioned in Dietrich and Wanzenried (2011), higher concentration might also be a consequence of a strong competition among banks and therefore result in lower interest margins. Another way of looking at the impact of competition, as noted by Claeys and Vander Vennet (2004) and Schweiger and Liebeg (2009), is that it might encourage banks to take a higher risk or not price it adequately, resulting in suboptimal interest margins and potentially leading to the instability of the whole banking sector.

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[2] Sum of the squares of market shares in total assets of the individual banks.
[3] Proxy of market power = (Total Revenue − Total Cost) / Total Revenue.

3 DATA AND SELECTED VARIABLES

We analyse banks from 11 CEE countries, and the sample consists of 12 periods (from 1999 to 2010) and 152 cross sections. For the full sample this gives the minimum of 823 observations, after the missing bank-year items were deleted. Table 1 lists the data used together with the sources and descriptions. Before the econometric analysis the data were revised and checked for extreme values and possible reporting errors. Table A2 in the appendix presents descriptive statistics for the panel data set used in the analysis. All variables have also been checked for stationarity using panel unit root test (table A3), but it is important to note that due to limited time dimensions these tests might have a low power.

The dependent variable in the empirical part of research is the net interest margin. It measures the cost and efficiency of financial intermediation and is determined by the variables that can be influenced by a bank's management, as well as by environmental variables that are primarily features of the market and country where the bank operates, mostly outside the management's control.

Explanatory variables are divided into three groups: bank specific variables, country specific macroeconomic characteristics and banking market specific variables (table 1).

While measuring the impact of the bank specific variables we focus on several major factors that contribute to the bank's performance: efficiency in conducting its operations, risk, leverage, possible substitution between interest and non-interest revenues and finally, benefits of the economy of scale.

Cost to income ratio measures the banks' efficiency. This variable shows how expensive it is for a bank to produce a unit of operating income in terms of costs not related to interest expense. It is expected that banks with high unit costs require higher margins in order to cover these expenses (Maudos and de Guevara, 2004), while at the same time higher operational efficiency allows banks to lower interest margins through lower loan rates or higher deposit rates (Claeys and Vander Vennet, 2008).

Banks might be willing to forgo part of their interest income if they substitute other forms of income for it, i.e. fees and commissions on other services. As found by Kasman et al. (2010), this substitution effect might be very important in explaining the level of net interest margin. This is why some banks have lower interest rates for clients that use a group of other services provided by the bank.

TABLE 1

Data description

Category	Designation in the formula	Name	Unit	Description	Source	Expected effect
Dependent variable	y	Net interest margin	%	Net interest income divided by average earning assets. Net interest income is defined as the gross interest income plus dividend income.	BankScope	n/a
Bank specific variables	x	Cost to income ratio	%	Measure of operating efficiency is calculated as the ratio of sum of personnel expenses and operating expenses such as depreciation, amortisation, administrative expenses, occupancy costs, software costs, operating lease rentals, audit and professional fees and other operating expenses of an administrative nature and operating income before provisions. Measures costs of running the bank as percentage of income generated before provisions.	BankScope	–
		Total capital ratio	%	Total capital adequacy measure. It combines Tier 1 and Tier 2 capital as a percentage of risk weighted assets. Proxy for a regulatory cost related to capital adequacy requirements.	BankScope	+
		Ratio of noninterest revenue to gross revenue	%	Measures the revenues the banks have from other services such as fees and commissions. Higher revenue from such sources might be a compensation for lower interest revenues.	BankScope	–
		Ratio of loans to customer deposits	%	This liquidity or funding ratio indicates to what extent the bank's relatively illiquid loans are funded by relatively stable customer deposits rather than wholesale or market funding.	BankScope	+/–
		Ratio of reserves for impaired loans to impaired loans	%	A higher ratio implies better provisions of the bank for bad loans and assets quality.	BankScope	+/–

Category	Designation in the formula	Name	Unit	Description	Source	Expected effect
Banking market specific variables	w	Concentration	%	Share of total assets in a country held by three largest banks.	Own calculation, BankScope data	+/–
Macro-economic variables	z	GDP growth	%	Growth rate of real GDP.	Eurostat	+
		Current account	%	Ratio of current account balance to GDP.	Eurostat	+
		Government debt	%	Ratio of general government consolidated debt to GDP.	Eurostat	+
		Inflation	%	Average annual rate of change of HICP.	Eurostat	+/–
		3 month money market rate	%	Domestic money market interest rate.	Eurostat	+
		Country spread	basis points	Spreads on international government bonds, own calculation based on Merrill Lynch government bond yield data.	Bloomberg	–
		Regulatory cost	%	Calculated as the ratio of bank reserves held at central bank and M3, this variable serves as a proxy for a part of the regulatory costs.	IFS	+

Credit risk belongs to the group of factors with the highest impact on banks' interest margins (Schweiger and Liebeg, 2009; Saad and El-Moussawi, 2010). Following Maudos and de Guevara (2004) and Kasman et al. (2010), it is proxied by the ratio of loans to total assets. Banks are expected to charge higher interest rates in order to compensate for higher credit risk. In that context, Athanasoglou, Delis and Staikouras (2006) emphasize the importance of credit risk management, which has not always been appropriate in the SEE region.

The ratio of loans to customer deposits represents a proxy for the liquidity risk, which has become particularly significant during the financial crisis when the interbank market was almost frozen and marked by liquidity hoarding, a drop in volume and an increase in the interbank interest rates in the EU (Heider, Hoerova and Holthausen, 2009; Gabrielli, 2010). Apart from that, banks in the CEE countries might have also been affected by deleveraging as their owners need to fulfil tougher capital requirements[4]. The impact of this ratio on the net interest margin

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[4] Speech of the Hungarian Central Bank Governor at G20 meeting, available at http://www.ebrd.com/downloads/news/simor-andras.pdf.

can be ambiguous, depending on whether deposits are cheaper than wholesale funding.

Capital adequacy ratio is a standard proxy for the creditworthiness of the bank. Capital adequacy rules are set by the regulator with the aim of preventing banks from accepting too much risk and ensuring banking sector stability (Claeys and Vander Vennet, 2008), although the actual level of capital adequacy that bank maintains is a result of combination of factors (regulation, market pressures, business strategy of the bank). Expected sign of relationship between net interest margin and capital adequacy ratio can go both ways, depending on the magnitude of transfer of these factors to clients. According to Saunders and Schumacher (2000), it is expected that banking systems with lower regulatory costs (such as reserve and capital requirements) have narrower margins.

An additional measure of regulatory costs is a ratio of bank reserves held at the central bank and M3. It is expected that countries with higher costs of regulation will have more reserves placed with the central bank. We are aware that such a measure has some drawbacks but we believe that in the studied period it is a good proxy for regulatory costs in the CEE countries.

The influence of non-performing loans on the net interest margins is measured by the coverage of impaired loans with reserves. The rise in the share of non-performing loans and increased reservations for bad loans hurt bank's profitability, especially during the crisis. International accounting standards (IAS 39) stipulate that the interest on the loan that is impaired is accrued only on the recoverable amount[5]. Provisions for bad loans can also be used as tool for income smoothing, where in good times provisions are on a level higher than the expected loss and in bad times they are underrated, as documented by Fonesca and Gonzales (2008). Consequently, the link between nonperforming loans and net interest margin might be ambiguous.

The influence of market structure on the net interest margin is measured by the share of the three largest banks in total assets of the banking sector. A more concentrated banking market might imply higher margins for all banks in the market as banks exploit their market power.

In order to measure the macroeconomic conditions in the banks' environment we use GDP growth, inflation, share of current account deficit in GDP and share of general government debt in GDP. Level of short term interest rates in the economy measures the stance of the economic policy. As an alternative, we estimate a specification that includes only yield spread on comparable government eurobonds from the observed countries and German government bond instead of a full set of macroeconomic indicators. This approach was motivated by findings presented in

[5] Kruger (2002), page 13, http://www.imf.org/external/np/sta/npl/eng/2002/rk0702.pdf.

part of the literature on the determinants of emerging market bond spreads showing that the bond spreads include information about macroeconomic developments and other available information (Ferrucci, 2003; Alexopoulou, Bunda and Ferrando, 2009; Özatay, Özmen and Sahinbeyoglu, 2009). This specification also serves as the robustness check. Due to data availability, in this part of analysis time dimension for some countries is shortened.

4 STYLIZED FACTS

The median net interest margin for the sampled banks has been steadily decreasing during the studied period, indicating falling costs of financial intermediation. In the period prior to 2008 countries in the sample experienced relatively high rates of GDP growth combined with on average high capital inflows (measured by relatively high current account deficits) and were marked by high credit growth rates. Since 2008, as the crisis hit, GDP growth and capital inflows decreased significantly, together with credit activity (figure 1). Government debt to GDP increased from the beginning of the sample, especially after the onset of the crisis.

FIGURE 1

*Net interest margin, GDP growth, government debt and current account deficit (%)*
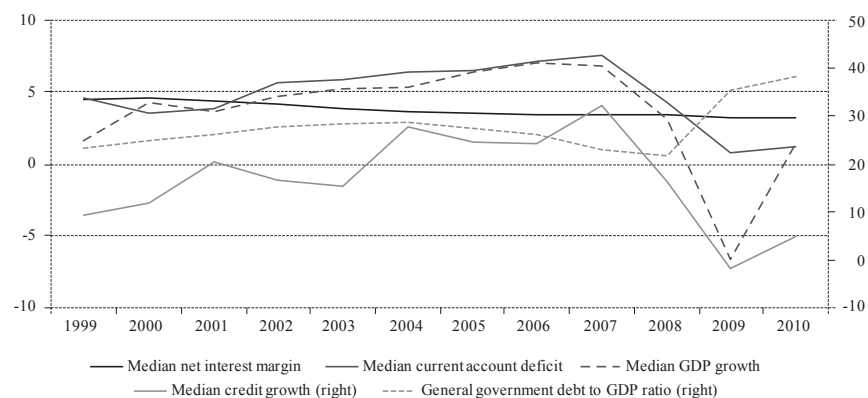
Source: Bankscope, Eurostat, own calculations.

Regarding bank specific variables, it should be noted that our sample starts in the year 1999, when the banking sector consolidation in CEE gained momentum (Kasman et al., 2010) and foreign investors had already become very important players in the CEE banking market. This process was marked by significant cost cutting and improved efficiency. The share of reserves for impaired loans, which was somewhat higher at the beginning of the sample (due to the Russian crisis and the still relatively underdeveloped bank management in the 1990s), gradually fell as assets grew. Similarly, the capital adequacy ratio for the median bank fell, implying on average, lower regulatory costs and reduced safety nets for the banks.

After the onset of the crisis, reserves for impaired loans increased as the share of nonperforming loans rose significantly and capitalization increased as banks and regulators started building safety nets (figures 2 and 3).
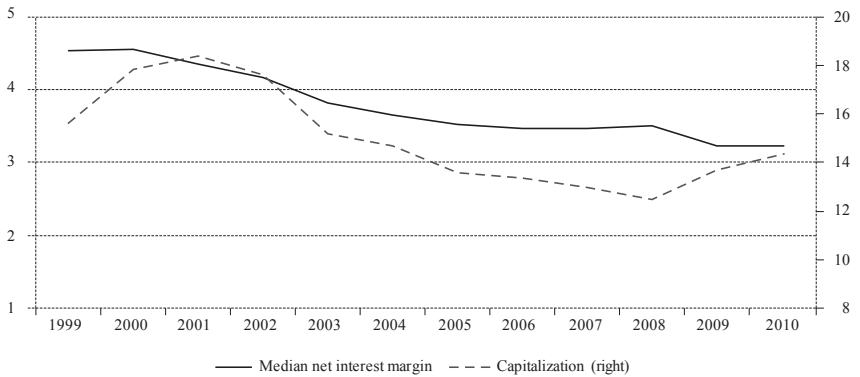
FIGURE 2

Net interest margin, reserves for impaired loans and cost to income ratio (%)
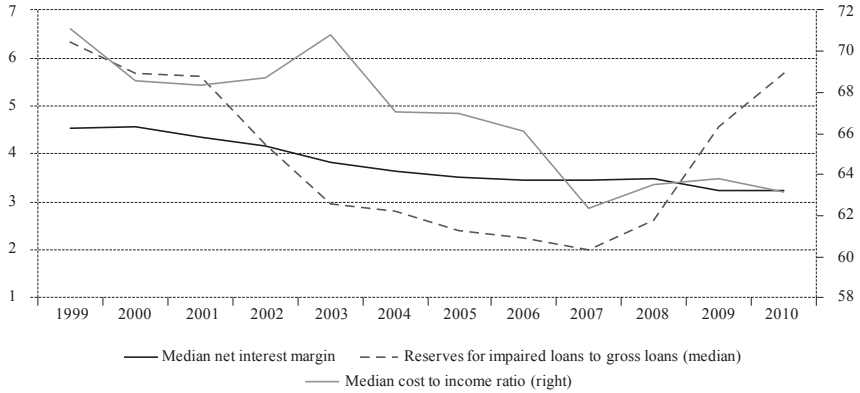
Source: Bankscope, own calculations.

FIGURE 3

Net interest margin and capital adequacy ratio (%)

Source: Bankscope, own calculations.

In the pre-crisis period the standard deviation of net interest margin across banks was relatively low and increased significantly after it. This indicates that, after a period of relative tranquility in the CEE banking industry, the ongoing financial crisis and recession brought about diversification as a result of an accumulation of risks that were not properly managed (figure 4).

FIGURE 4
Standard deviation of net interest margin (%)
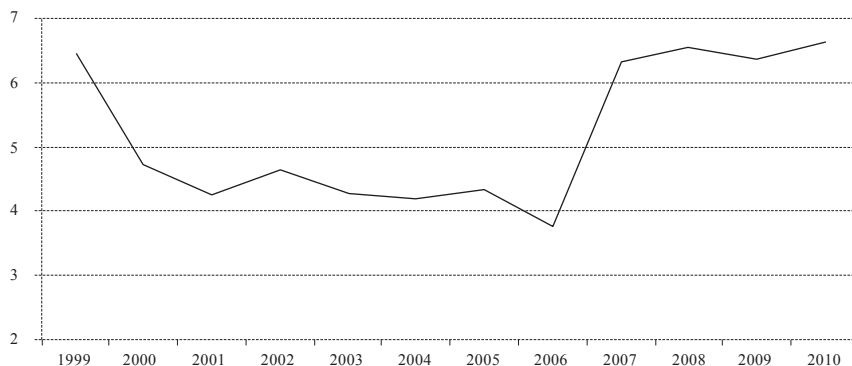
Source: Bankscope; own calculations.

Finally, the share of non-interest income in gross revenue for the CEE banks fell significantly in the post 2008 period. This is probably due to the fact that various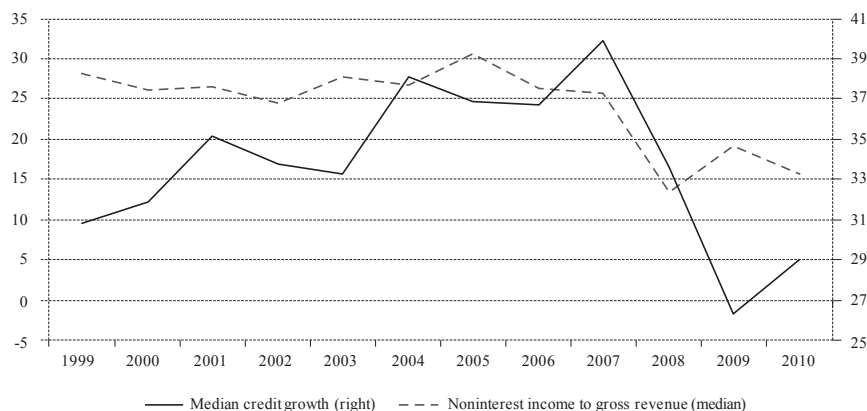 charges were linked with the credit granting process (figure 5) and as the credit activity dried out, this had an impact on non-interest income as well.

FIGURE 5
Credit growth and noninterest income to gross revenue (%)

— Median credit growth (right)   - - - Noninterest income to gross revenue (median)

Source: Bankscope; own calculations.

Based on these observations, the main hypotheses on the determinants of interest rate margins can be formulated as follows:

1) Favourable macroeconomic conditions and high capital inflows are correlated with lower net interest margins.

2) Among bank specific variables, increased efficiency, decreasing capitalization and reserves for impaired loans are linked with lower net interest margins.

5 METHODOLOGY

The data generating process is assumed to be defined by:

$$
\begin{aligned}
y_{i,t} &= \alpha y_{i,t-1} + x'_{it} \beta + \varepsilon_{i,t} \\
\varepsilon_{i,t} &= \mu_i + v_{i,t} \\
E[\mu_i] &= E[v_{i,t}] = E[\mu_i v_{i,t}] = 0.
\end{aligned}
\tag{1}
$$

The subscripts i and t are for the bank and year respectively.

Net interest margin is represented by $y_{i,t}$, x is the matrix of explanatory variables presented in table 1. Some variables in matrix x are country specific, i.e. they are the same for all banks from a given country. The error term has two orthogonal components, fixed effects μ_i and idiosyncratic shocks $v_{i,t}$.

The combination of a relatively short time period, the use of a lagged dependent variable, bank specific fixed effects and possible endogeneity problems with bank specific variables make the use of least squares unfeasible as the estimates are not consistent. Using OLS with fixed effects and lagged dependent variable gives rise to dynamic panel bias (see Nickel, 1981; or Roodman, 2006) because the lagged dependent variable is correlated with error term by construction.[6]

Our data set has a large cross section and relatively small time dimension, so the problems mentioned above can be solved by using the Arellano and Bover (1995) system GMM estimator. This estimator uses lagged levels of dependent variable and orthogonal deviations of other endogenous variables as instruments. By using orthogonal transformations it allows for the use of a lagged dependent variable as an explanatory variable. Consequently, we estimate the equation (1) using Arellano and Bover (1995) system GMM estimator. We treat all bank specific variables from table 1 as endogenous and instrument them with their orthogonal transformations.

6 EMPIRICAL RESULTS AND ROBUSTNESS

The estimated model is

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\begin{aligned}
y_{i,t} &= \alpha y_{i,t-1} + x'_{it} \cdot \beta_{BS} + w'_{it} \cdot \beta_{BM} + z'_{it} \cdot \beta_M + \varepsilon_{i,t} \\
\varepsilon_{i,t} &= \mu_i + t_t + v_{i,t}
\end{aligned}
\tag{2}
$$

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[6] Modifying an example of Roodman (2006), consider a company × year panel and a firm that has a large negative temporary shock to its employment in one period. As a result fixed effect for this firm for all years will be lower. If the shock happens in time t, in time $t+1$ the lagged dependent variable is lower together with fixed effect. This positive correlation between error term and regressor violates the consistency assumption by inflating the coefficient estimate for lagged dependent variable.

The three vectors of variables represent the banks-specific ($x_{i,t}$), banking market-specific ($w_{i,t}$) and macroeconomic variables ($z_{i,t}$) described in table 1 and $y_{i,t}$ represents the net interest margin. Subscripts i and t are for i-th bank and t-th time period. Error term has a bank-specific (μ_i) and a time-specific part (t_t), which are controlled for in the estimation.[7] Finally, the dot operator (.) represents element by element multiplication.

The estimation results are presented in table 2. Equation 2 is in the first step estimated for the whole sample period (specification 1). As a robustness test, we perform structural break tests by using the form of Chow test for GMM estimated equations, the Andrews and Fair (1988) test. The existence of a possible break is tested in 2007 and 2008. For both years the test finds insufficient evidence against hypothesis H_0 of parameter stability.[8] To test for the possible breaks in some specific parameters we use a dummy variable named CRISIS which equals 1 in years 2008, 2009 and 2010 and zero otherwise.

The results of our baseline specification show that there is a relatively high persistence of net interest margin across time, as the coefficient with the lagged net interest margin is relatively high and significant (specification 1, table 2). This justifies the inclusion of lagged values of net interest margin in the estimated regressions.

All included macroeconomic indicators proved to be statistically significantly linked to the net interest margin, meaning that the environment in which banks operate significantly influences their performance. The link between GDP growth and net interest margin is positive, implying that periods of high growth can result in higher net interest margins due to more intense credit activity and better loan quality, as noted by Claeys and Vander Vennet (2004) (it should be noted though that the p value for the GDP growth is *0.051* in specification 1 and that is insignificant at standard levels in specification 2). According to the presented results, the relatively big capital inflows that CEE countries experienced in the observed period (measured by current account deficit) had a positive effect on the cost of financial intermediation. The results show that higher capital inflows were linked with on average a lower net interest margin charged by the banks. In contrast, the correlation of general government debt and net interest margin is on average positive, implying that government debt accumulation increases the net interest margin, probably due to increased macroeconomic risks and the potential unsustainability. Inflation is positively correlated with net interest margin, in line with the findings in the studied literature, while the relation between interest rates and interest margins is negative.

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[7] The significance of time specific fixed effects was tested using the Wald test after GMM estimation. The significance of bank specific fixed effects was done applying the Hausman test after fixed effects regression. Both tests show strong evidence against the null hypothesis which states that the effects are equal to 0.

[8] Test value for 2007 is 0.082 and for 2008 0.074, which is much less than the 5% or 10% critical value for Chi-squared distribution.

TABLE **2**

Estimation results

Equation name	Specifications				
	1	**2**	**3**	**4**	**5**
Dependent variable	Net interest margin				
Net interest margin lagged (-1)	0.5046 (0.0200)**	0.4411 (0.0230)**	0.5005 (0.0139)**	0.5842 (0.0240)**	0.4361 (0.0333)**
Cost to income ratio	-0.0060 (0.0016)**	-0.0047 (0.0015)**	-0.0045 (0.0016)**	-0.0071 (0.0017)**	0.0031 (0.0016)
Total capital ratio	-0.0044 (0.0032)	-0.0078 (0.0023)**	-0.0012 (0.0020)	0.0108 (0.0039)**	0.0347 (0.0091)**
Ratio of noninterest revenue to gross revenue	-0.0221 (0.0027)**	-0.0221 (0.0026)**	-0.0176 (0.0025)**	-0.0224 (0.0028)**	-0.0304 (0.0031)**
Ratio of loans to customer deposits	0.0005 (0.0006)	0.0014 (0.0007)	0.0007 (0.0004)	0.0020 (0.0007)**	0.0026 (0.0007)**
Ratio of reserves for impaired loans to impaired loans	-0.0245 (0.0059)**	-0.0310 (0.0055)**	-0.0276 (0.0044)**	-0.0244 (0.0067)**	-0.0404 (0.0089)**
3 month money market interest rate	-0.1231 (0.0171)**	-0.0962 (0.0181)**			
GDP growth	0.0285 (0.0146)	0.0250 (0.0177)			
Inflation	0.1156 (0.0184)**	0.1138 (0.0174)**			
Current account	0.0848 (0.0120)**	0.0890 (0.0126)**			
Government debt	0.0285 (0.0077)**	0.0406 (0.0091)**			
Concentration	0.0227 (0.0136)	-0.0005 (0.0131)	0.0693 (0.0083)**	-0.1173 (0.0135)**	0.0039 (0.0120)
Total capital ratio * Crisis		-0.1154 (0.0159)**	-0.1175 (0.1174)**	-0.2539 (0.0205)**	-0.1196 (0.0140)**
Country spread				0.0048 (0.0005)**	0.0027 (0.0006)**
Regulatory cost					-0.0060 (0.0047)
Time dummies	Yes	Yes	Yes	Yes	Yes
Observations	823	824	858	640	506
Banks	152	152	153	131	122
Periods	12	12	12	10	8
Hansen J statistics	84.49	76.65	81.38	78.87	71.05
p value	0.1307	0.2738	0.2873	0.2707	0.2547

Notes: Robust standard errors are in brackets, all estimators are of panel GMM system types, Arellano and Bover (1995). Hansen J statistics and p value are for Hansen test for overidentifying restrictions.

* Significance at 5%; ** significance at 1%.

Source: Own calculations.

Among the *bank-specific variables*, most of the coefficients have the expected signs. The cost to income ratio is negatively correlated with net interest margin, implying that relatively less efficient banks marked by higher cost to income ratio had higher net interest margins, as concluded by the most of the analysed authors (table A1). The ratio of non-interest income to gross revenue is significant and negative suggesting that banks with a higher share of non-interest income in their gross revenues charged lower margins for loans granted and collected additional revenue through various charges connected to credit activity. Reserves for impaired loans are significantly negatively correlated with net interest margin. This most probably stems from the fact that the banks are not allowed to accrue interest on bad loans. The only unexpected result in this specification is that the capitalization ratio is not significant. As many other researchers find evidence of this link (i.e. Claeys and Vander Vennet, 2008 for the CEE countries), we test for the potential structural break in this relationship. By interacting the aforementioned crisis dummy with total capitalization ratio we get specific estimates for the partial correlation of capitalization with net interest margin in the pre-crisis and crisis periods (specification 2, table 2). The results show that there is a structural change in the relationship between total capitalization ratio and net interest margin. The partial correlation between total capitalization ratio and net interest margin is negative and much higher in the crisis period, implying that increasing capital during the crisis can be very costly for the bank.

As robustness check we estimated several modified specifications. In the third specification macro variables are excluded (specification 3, table 2), while in the fourth specification all macro variables are replaced with the yield spread on government bonds acting as synthetic macro variable (specification 4). In this specification Slovenia and Estonia fall out of the sample because there are no comparable data on the yield spreads available for these countries. Also, the data for Slovakia have missing values in years 2009 and 2010. The fifth specification includes a regulatory cost variable (specification 5) that is also not available for Slovenia and Estonia and has missing values for the majority of countries in the period before 2003. In this shortened sample (specifications 4 and 5) the ratio of loans to customer deposits becomes significant, implying that banks that had fewer deposits in their funding mix charged a somewhat higher margin. Additionally, the coefficient on the total capitalization ratio in the pre-crisis period in these specifications (specifications 4 and 5) is positive, albeit the value is small. Finally, we should note the concentration ratio is significant in some specifications (specifications 3 and 4) but it is not robust as it changes signs.

Regarding additional regressors in specifications 4 and 5, two results seek special attention. Firstly, the yield spread variable included in specification 4 shows that increased country risk is linked to higher cost of financial intermediation. This corroborates results of other specifications where macroeconomic risks are on average positively correlated with net interest margin (specifications 1 and 2).

Secondly, the correlation of regulatory costs and net interest margin is negative (specification 5), however this relationship is not statistically significant.

We have also performed robustness test that splits sample in two parts: highly euroized economies (Bulgaria, Croatia, Estonia, Hungary, Latvia, Lithuania and Slovenia prior to eurozone entry) vs. others. The Andrews-Fair (1988) test statistic is 16.62, which is less that critical value of 37.65 for 5% significance level.

In sum, we can conclude that the estimation results showed to be robust in these tests. The statistical significance of the coefficients remains the same across specifications and their sizes do not change significantly.

7 CONCLUSION

In this research we analyzed the main net interest margin determinants of banks operating in Central and Eastern European countries from 1999 to 2010. We used the Arellano and Bover (1995) system GMM estimator which is robust to endogeneity problems and allows for the inclusion of a lagged dependent variable together with fixed effects to control for unobserved heterogeneity.

The results imply there have been several main drivers of decline in net interest margins in CEE in the pre-crisis period. Prior to 2008 the net interest margins declined primarily due to strong capital inflows, a stable macroeconomic environment (low inflation and low short term interest rates) and a fall in the share of nonperforming loans in the balance sheets of the banks. On the other hand, the economic boom (relatively high GDP growth rates) and rising government debt allowed banks to charge somewhat higher margins due to high demand for credit. In the crisis period, rapidly increasing government debt and the associated increase in macroeconomic risks together with declining capital inflows were propping up margins while other factors such as low demand (due to weak economic performance), higher capitalization and significantly increased share of non-performing loans pressured banks' margins down.

The results of the estimation also show that throughout the studied period increased efficiency in the CEE banking sector has led to lower margins. The important implication of this result for banks' management is that the banks which are not able to lower their costs (and margins) will lose their competitive position and subsequently market share.

When looking at the possible manoeuvring space for policy makers' actions that could affect the costs of financial intermediation and in turn interest rates, and therefore indirectly support economic activity our results indicate that a stable macroeconomic environment and significant capital inflows support lower net interest margins. On the other hand increasing government debt and associated macroeconomic risks are linked with higher margins. Finally, in line with general

opinion, pressures by the regulators to increase capital during the crisis will result in lower banks' operating profitability, which might make some banks business models unviable.

APPENDIX

TABLE A1
Literature overview

Research paper	Countries	Period	Methodology	Dependent variables	Independent variables	Main conclusions
Ho, T. J. S. and Saunders, A. (1981): *The Determinants of Bank Interest Margins,* Journal of Financial and Quantitative Analysis, 16(4), 581-600.	USA	q4/1976-q4/1979	Two step regression procedure	NIM	Implicit interest rate, opportunity cost of reserves, default premiums, size of transactions, market structure, interest rate volatility.	Interest margin is determined by four main factors – managerial risk aversion, size of transactions, degree of market competition and the variance of interest rates.
Saunders, A. and Schumacher, L. (2000): *The determinants of bank interest rate margins: an international study,* Journal of International Money and Finance, 19(6):813-832.	Germany, Spain, France, Great Britain, Italy, Switzerland and USA	1988-1995	Two step regression procedure	NIM	Management's risk aversion, size of transactions, variance of the interest rate on deposits and loans, institutional costs, regulatory costs and credit risk exposure costs.	Main determinants of net interest margin are interest rate volatility, as well as regulatory restrictions, such as minimum capital and liquid reserves requirements and implicit interest rates. There is a trade-off between assuring bank solvency in form of high capital/asset ratios and lowering the cost of financial intermediation.
Brock, P. L. and Rojas Suarez, L. (2000): *Understanding the behaviour of bank spreads in Latin America,* Journal of Development Economics, 63(1):113-134.	Argentina, Bolivia, Chile, Colombia, Mexico, Peru and Uruguay	Depending on a country, mostly first half of 1990s	Two step regression procedure	Interest spread	*First step* – NPLR, capital ratio, cost ratio, liquidity ratio, time effects. *Second step* – interest rate volatility, inflation rate, GDP growth rate.	Interest spreads are positively correlated with operating costs and NPLs, as well as with the reserve requirements. Deterioration in macroeconomic indicators results with an interest spread increase.

Research paper	Countries	Period	Methodology	Dependent variables	Independent variables	Main conclusions
Claeys, S. and Vander Vennet, R. (2008): *Determinants of Bank Interest Margins in Central and Eastern Europe: A Comparison with the West,* Economic Systems, 32, 197-216.	36 European countries – CEE countries, comparison with Western Europe	1994-2001	Single-step estimation procedure	NIM	*Country-specific bank market characteristics* – degree of concentration. *Country-specific macroeconomic conditions* – inflation, real GDP growth, real short term interest rate. *Bank-specific characteristics* – operational efficiency, capital adequacy, market share, loans/total assets, demand and savings deposits/total deposits. *Regulatory features* – degree of bank and enterprise reform in the CEE.	Important determinants of margins in Western and Eastern European countries are concentration, operational efficiency, capital adequacy and risk behavior. Foreign banks increased competition in the CEE countries. Interest margins in CEE reduced due to higher operational efficiency.
Maudos, J. and de Guevara, J. F. (2004): *Factors Explaining the Interest Margin in the Banking Sectors of the European Union,* Journal of Banking and Finance, 28, 2259-2281.	EU – Germany, France, the United Kingdom, Italy and Spain	1993-2000	Single-step estimation procedure	NIM	Market structure – Herfindahl index, Lerner index. Operating costs, degree of risk aversion, volatility of market interest rates, credit risk, interaction between credit risk and market risk, average size of operations/volume of loans. Implicit interest payments, opportunity costs of bank reserves, quality of management.	Reduction of net interest margins is compatible with a relaxation of the competitive conditions (increase in market power and degree of concentration), as this effect has been counteracted by lowering of interest rate risk, credit risk and operating costs.

Research paper	Countries	Period	Methodology	Dependent variables	Independent variables	Main conclusions
Athanasoglou, B. P., Delis, M. D. and Staikouras, C. K. (2006): *Determinants of bank profitability in the South and Eastern European region*, Bank of Greece, Working Paper No. 47, September.	Albania, B&H, Bulgaria, Croatia, FYROM, Romania and Serbia-Montenegro.	1998-2002	The least squares estimation with fixed effects and random effects models	ROA, ROE	*Bank-specific variables* – liquidity, credit risk, capital, operating expenses management, size, foreign ownership, market share. *Industry-related variables* – banking system reform, concentration. *Macroeconomic variables* – inflation, economic activity.	All bank specific variables significantly affect bank profitability (except liquidity). Financial reforms and improvement in the structure of the banks' aggregated balance sheet are important determinants of their profitability. Concentration positively affects bank profitability. When looking at macroeconomic variables, inflation has a strong effect on profitability, while the impact of real GDP per capita fluctuations is not that significant.
García-Herrero, A., Gavilá, S. and Santabárbara, D. (2009): *What explains the low profitability of Chinese banks*, Banco de Espana, Working Paper 0910.	China	1997-2004	Generalized Method of Moments (GMM) estimator technique following Arellano and Bover (1995)	Pre-provision profit, ROA	*Bank-specific variables* – loan growth, loans/assets, deposits/assets, equity/assets, rank technical inefficiency, foreign capital, listed banks, recapitalized banks, market share on assets, concentration, real interest on loans, maximum spread. *Macroeconomic variables* – real GDP growth, inflation, interest rates volatility. Dummies for different types of Chinese banks.	Main causes of low profitability are poor asset quality, low efficiency and scarce capitalization, as well as the scarcity of private-ownership and concentration of assets in a few large state-owned banks.

Research paper	Countries	Period	Methodology	Dependent variables	Independent variables	Main conclusions
Schwaiger, M. S. and Liebig, D. (2009): *Determinants of the Interest Rate Margins in Central and Eastern Europe,* Oestereichische Nationalbank, Financial Stability Report No. 14.	CEE EU member states and Croatia	2000-2005	Fixed effects model using the within group estimator for dealership model	NIM	Risk aversion, interest rate risk, credit risk, interaction of credit and interest risk, operating costs, average size of operations, competitive structure, payment of implicit interest rates, importance of noninterest revenues, economic conditions, ownership structure.	Credit risk is the most important driver of interest margins in CEE, while the impact of interest rate risk is limited. Lower operating costs, increased efficiency, positive economic developments and financial deepening result with lower net interest margins. Foreign ownership positively affects interest margins, while state ownership does not make a difference.
Horváth, R. (2009): *Interest Margins Determinants of Czech Banks,* Institute of Economic Studies, Charles University in Prague, Working Paper 11/2009.	Czech Republic	2000-2006	Arrelano-Bond dynamic panel data framework	NIM	*Bank-specific variables –* fee income/assets, capital adequacy, total loans/assets, administrative costs/assets, size. *Market structure –* Herfindahl index. *Macroeconomic conditions –* inflation, real GDP growth.	Lower interest margins are associated with higher efficiency, price stability, size of the bank and higher capital adequacy.

Research paper	Countries	Period	Methodology	Dependent variables	Independent variables	Main conclusions
Kasman, A., Tunc, G., Vardar, G. and Okan, B. (2010): *Consolidation and commercial bank net interest margins: Evidence from the old European Union members and candidate countries*, Economic Modelling 27, 648-655.	New EU members from the CEE and candidate countries	1995-2006, 2 sub-periods: consolidation (1995-2000) and post-consolidation (2001-2006)	Single-step estimation approach	NIM	*Bank-specific variables* – operating cost, credit risk, default risk, capital adequacy, implicit interest payments, size, deposit to equity ratio and managerial efficiency. *Country-specific market characteristic* – degree of concentration, Lerner index. *Country-specific macroeconomic conditions* – CPI, economic growth, stock market capitalization/GDP.	NIM is negatively related to size and managerial efficiency in both sub-periods. Merger and acquisition improve banks' efficiency while economies of scale contributes to lowering the interest rate spread. Macroeconomic variables proven to be statistically insignificant in the second sub-period, probably implying that the differences among countries decreased during the convergence process.
Hasan Khan, M. and Khan, B. (2010): *What Drives Interest Rate Spreads of Commercial Banks in Pakistan?* Empirical Evidence based on Panel DaTa, SBP Research Bulletin, Vol. 6, No. 2.	Pakistan	1997-2009	Single-step estimation procedure	Banking spread (returns on avg earning asset – cost of avg funds)	*Bank-specific variables* – non-interest/total income, share of non-remunerative deposits, administrative expense/total expense. *Industry-specific variables* – Herfindhal Index. *Macroeconomic factors* – real GDP growth, interest rate.	Main determinants of banking spreads are cost of funding, operating expenses and possibility to generate income from non-core business activities. Market concentration and macroeconomic variables positively influence banking spreads.

Research paper	Countries	Period	Methodology	Dependent variables	Independent variables	Main conclusions
Dietrich, A. and Wanzenried, G. (2011): *Determinants of bank profitability before and during the crisis: Evidence from Switzerland*, Journal of International Financial Markets, Institutions and Money, 2, 307-327.	Switzerland, 372 commercial banks	1999-2009; 2 subperiods: pre-crisis (1999-2006), post-crisis (2007-2009)	Generalized Method of Moments (GMM) estimator technique following Arellano and Bover (1995)	ROAA, ROAE, NIM	*Bank specific determinants* – equity/total assets, cost/income, loan loss provisions/total loans, yearly growth of deposits, difference between bank and market growth of total loans, bank size, interest income share, funding costs, bank age, bank ownership, nationality. *Macroeconomic and industry-specific characteristics* – effective tax rate, real GDP growth, term structure of interest rates, Herfindahl index.	Profitability is primarily determined by five factors: operational efficiency, growth of total loans, funding costs, business model and the effective tax rate. Prior to the crisis ownership was irrelevant for banks' profitability, but after the crisis state-owned banks turned out to be more profitable that privately owned banks. Market structure is important prior the crisis, but not after.
Männasoo, K. (2012): *Determinants of Bank Interest Spread in Estonia*, Working Paper Series 1/2012, Eesti Pank.	Estonia	December 1998 – June 2011	Two step regression procedure	Interest spread	*Pure spread* – market structure, interest rate volatility risk, risk aversion. *Residual spread* – inverse efficiency, liquidity, credit risk, management quality, fees/interest earning assets, deposit guarantee payment costs/total deposits, foreign owned capital in the bank, non-affiliation dummy, loan portfolio dummies, bank dummies.	Interest spread is primarily determined by the level of risk aversion and market structure of the banking sector, while the impact of interest rate volatility is modest.
Saad, W. and El-Moussawi, C. (2010): *The Determinants of Net Interest Margins of Commercial Banks in Lebanon*, Journal of Money, Investment and Banking, Issue 23.	Lebanon	2000-2010	Least squares	NIM	Market structure, credit risk, off-balance sheet activities, operational costs, capital ratio, opportunity cost, bank size, economic growth rate, inflation rate.	The main determinants of net interest margin are: opportunity cost, credit risk, bank capitalization, market structure, off-balance, size and economic growth.

TABLE A2
Descriptive statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
Net interest margin (%)	3.83	3.45	12.63	-0.08	1.89	1.46	6.35	366.08	0.0
Cost to income ratio (%)	63.77	61.00	217.65	15.60	21.67	2.04	12.04	1,819.18	0.0
Ratio of noninterest revenue to gross revenue (%)	37.08	36.68	272.46	-364.77	24.86	-3.00	57.26	228,471.40	0.0
Total capital ratio	14.59	13.19	72.37	6.80	6.16	4.34	31.92	16,863.24	0.0
Ratio of loans to customer deposits	115.45	96.87	950.52	5.65	85.05	4.00	29.59	14,262.04	0.0
Ratio of reserves for impaired loans to impaired loans	4.09	3.19	27.68	0.10	3.43	2.27	11.83	1,824.88	0.0
3 month money market rate	6.07	4.90	50.78	1.31	4.90	5.40	44.62	34,201.97	0.0
Concentration	53.98	53.92	87.01	35.92	12.26	0.37	12.18	22.40	0.0
GDP growth	2.71	4.20	11.20	-17.70	5.64	-1.56	5.71	315.33	0.0
Inflation	4.96	4.00	45.70	-1.20	4.69	4.45	34.11	19,364.50	0.0
Current account	-5.26	-3.80	6.50	-21.60	6.52	-0.71	2.83	37.77	0.0
Government debt	32.99	29.15	81.30	9.00	16.76	0.77	3.02	43.80	0.0
Regulatory costs	16.85	13.34	44.25	6.24	9.32	1.09	3.46	354.51	0.0
Country spread	176.03	126.57	691.85	-15.33	158.46	1.19	3.99	122.88	0.0

Source: Own calculations.

TABLE A3

Panel unit root test results

Variable name	Levin, Liu & Chu (2002)	Im, Pesaran and Shin (2003)
Net interest margin (%)	I(0)	I(0)
Cost to income ratio (%)	I(0)	I(0)
Ratio of noninterest revenue to gross revenue (%)	I(0)	I(0)
Total capital ratio	I(0)	I(0)
Ratio of loans to customer deposits	I(0)	I(0)
Ratio of reserves for impaired loans to impaired loans	I(0)	I(1)
Concentration	I(0)	I(0)
3 month money market rate	I(0)	I(0)
GDP growth	I(0)	I(0)
Inflation	I(0)	I(0)
Current account	I(1)	I(0)
Government debt	I(0)	I(1)
Growth rate of gross loans	I(0)	I(0)
Regulatory cost	I(0)	I(0)

Source: Own calculations.

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