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Determinants of Banks' Net Interest Margins in the CEE

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Determinants of Banks' Net Interest Margins in the CEE*

Mirna Dumičić and Tomislav Ridzak*****

Abstract

This research analyzes the main determinants of net interest margin of banks operating in Central and Eastern European countries in the period from 2000 to 2010. Results show that the trend of decreasing net interest margins in the CEE in the pre-crisis period had several drivers behind it. The main factors contributing to such developments were increased efficiency, decreasing costs of safety nets (bank capitalization) and relatively high capital inflows. In the crisis period, net interest margins in some countries decreased while in others they remained stable or grew slowly. Results suggest several reasons for this: in the countries where the interest margins fell, the weight of bad loans pressured the banks' earnings. For other countries the trend of decreasing margins stopped as the banks started propping up their capitalization.

Keywords: net interest margin, CEE

JEL classification: G21, G15

* The views expressed in the paper are authors' own, and do not necessarily represent the views of the Croatian National Bank.

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1. Introduction

Past few years in some of the CEE countries have been marked by the ongoing debate among politicians, financial industry, academic community and 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 and possibilities of banks in enhancing the recovery of real economy, especially in countries where credit activity is stagnating or is very low. One of the main questions raised in that context has been related to the options of lowering domestic interest rates and stimulating demand for credit in such 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, 2004, 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 profitability of the banking sector and therefore its stability and ability to support real economy (García-Herrero et al., 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 for the CEE countries in the period during and after the onset of the recent financial crisis. Most of the papers studying net interest margin in these countries focus on the period of consolidation in the early 2000s and post-consolidation period which has been marked by successful transformation of their banks into modern, market oriented financial institutions. But, the recent crisis, marked by a severe slowdown and drop in real GDP and 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 real economy.

Banks charge and pay many types of interest rates and have variety of different categories of assets and liabilities, so 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 indicators of the cost and efficiency of financial intermediation is bank's net interest

margin. It is calculated as the ratio of net interest income and total bank's 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, i.e. as it does not take into account other sources of income and costs for the bank and is not good representative of bank's marginal costs and revenues (for details see Brock and Suarez, 2000).

Higher net interest margins usually imply lower banking sector efficiency and have a negative impact on financial developments, resulting with lower investments and slower economic activity. They might also reflect high risk premia due to an inappropriate regulatory banking environment or a significant information asymmetry (Claeys and Vander Vennet, 2004). On the other hand, lower net interest margins usually mark deeper and more developed financial markets, encourage investment activities and support economic growth. But as emphasized by Schweiger and Liebeg (2009), the benefits of lower cost of financial intermediation will only effectuate 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 for around 110 banks in eleven CEE countries, with a special focus on the period before and after the outbreak of the global financial crisis. 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. Therefore, the independent variables are divided into three main groups: banking sector variables, country specific macroeconomic fundamentals and features of each banking market.

Research results should point out the most important determinants of the costs of financial intermediation and indicate 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.

The rest of the paper is organized in a following way. Section 2 summarizes the main findings from the literature investigating the main determinants of banks' profitability and costs of financial intermediation. Third part presents the data and methodology used in this research, while the main results are described in the section 4. Concluding remarks, as well as some policy implications based on the research outcome, are provided in the fifth section.

2. Literature survey

Most of the papers dealing with the determinants of banks' profitability, efficiency and the cost of financial intermediation base their empirical research on the microeconomic dealership model introduced by Ho and Saunders (1981), who view bank as a dealer facing uncertainty and costs coming from a 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 one 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 a 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 determination of the spread after bank specific and macroeconomic effects have been purged. Such approach is used by Brock and Suarez (2000), Saunders and Schumacher (2000) and Männasoo (2010). It is characteristic for a single country analysis where long time series were available. In Männasoo (2010) second step regression is done by vector error correction model.

Second type of empirical approach was to use single step approach and estimate reduced equation that depicts the banks' behaviour with respect to various determinants of net interest margin. This approach was mainly used on the cross country studies, where in addition to

bank and banking market specific variables researchers also included macroeconomic variables to capture the effect of banks' country of operation characteristics. Apart from that, the variables used are the same as the ones 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, 2004; 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 one, but extends it empirically. There are several potential problems addressed here. 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 et al., 2011). 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 to 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 et al., 2009; Dietrich and Wanzenried, 2011).

Table 1 presents some of the most relevant research papers which study banks' efficiency and cost of financial intermediation. Research results detect several prime drivers of net interest margins (managerial efficiency, macroeconomic volatility, competitive pressures). However, results regarding some determinants are divisive, most probably due to country (countries) and time periods selected for the analysis. Apart from that, papers also differ according to the methodology and variables used in the empirical part of research which can exacerbate differences.

Apart from net interest margin that is often used as a proxy for profitability and cost of financial intermediation, some authors use other variables as an alternative, such as return on average assets (ROAA) and return on average equity (ROAE). Explanatory variables in this context can generally be divided into several groups: bank-specific variables, country-specific banking market characteristics, country-specific macroeconomic variables and variables connected with the regulatory framework.

Table 1 Literature overview (1/2)

Article	Countries	Period	Methodology	Dependent var	Independent Variables	Main conclusions
Ho, T. J. S., 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., 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., 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 (short-term assets / total deposits), 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.
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, comparisson 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 e±ciency, capital adequacy and risk behavior. Foreign banks increased competition in the CEE countries. Interst 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 indeks. Operating costs (operating expenses / total assets). Degree of risk aversion (equity / total assets). Volatility of market interest rates (3M i. r. in the inter-bank market, treasury bonds with 3y and 10y maturity period). Credit risk (loans / total assets ratio). Interaction between credit risk and market risk. Average size of operations / volume of loans. Implicit interest payments ((operating expenses net of non-interest revenues) / total assets). Opportunity costs of bank reserves (liquid reserves / total assets). Quality of management (cost / income).	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.
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 (Loans / assets), Credit risk (Loan loss provisions / loans), Capital (Equity / assets), Operating expenses management (Operating expenses / assets), Size, Foreign ownership, Market share (in terms of assets of individual banks). *Industry-related variables*: Banking system reform (EBRD Index), Concentration (Herfindahl-Hirschman index). *Macroeconomic variables*: Inflation, Economic activity (Real per capita income).	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*, Working Paper 0910, Banco de Espana	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, Recapitalized, Market Share on Assties, Concentration (Herfindahl index), 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.

Table 1 Literature overview (2/2)

Article	Countries	Period	Methodology	Dependent var	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 withingroup 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 (Herfindahl index), payment of implicite interest rates, importance of noninterest revenues, economic conditions (real GDP growth rate, GDP per capita), 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* , Isntitute of Economic Studies, Charles University in Prague, Working Paper 11/2009.	Czech Republic	2000-2006	Arrelano-Bond dynamic panel dana 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.
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 variable* s - Herfindhal Indeks. *Macroeconomic factors* - Real GDP growth, Interest Rate.	Main determinats of banking spreads are cost of funding, operating expenses and possilibity to generate income from non-core business activities. Market concentration and macroeconomic variables positively influence banking spreads.
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, 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, the growth of total loans, funding costs, the business model and the effective tax rate. Prior 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 shown to be 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 (monthly st.dev. of 6M EURIBOR), risk aversion (sector capital adequacy ratio, variance in interest rates). *Residual spread* - inverse efficiency (operating expenses / total assets), liquidity (liquid assets / total liabilities ratio, credit risk (ratio of loans past due over 60 days / total loans), management quality (demand deposits / total liabilities), 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 (Herfindahl indeks). Credit risk (provisions for bad and doubtful debts / total loans). Off-balance sheet activities (off-balance shhet activities / total balance sheet). Operational Costs (operating expenses / total balance sheet). Capital Ratio (equity / total assets). Opportunity Coost (i.r. on 3M T-bill). Bank Size. Economic Growth Rate (real GDP 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.

Characteristics of individual banks are among the most important determinants of banks' business results and the costs of financing for their clients. **Bank-specific variables** most commonly used for this purpose are different items (or their ratios) from financial and other reports (measures of 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).

Operating costs and operational efficiency are generally found to be among the most important net interest margin determinants. That comes as no surprise as it is expected that banks with high unit costs require higher margins in order to cover their higher operating costs (Maudos and de Guevara, 2004), while in the same time higher operational efficiency allows banks to lower interest margins through lower loan rates or higher deposit rates (Claeys and Vander Vennet, 2004). Schweiger and Liebeg (2009) and Kasman et al. (2010) explicitly conclude that operating cost were the most important determinants of banks' net interest margin in the observed CEE countries.

Credit risk also belongs to the group of factors with highest impact on banks' interest margins (Schweiger and Liebeg, 2009; Saad and el Moussawi, 2012). As mentioned by Kasman et al. (2010), banks are expected to charge higher interest rates in order to compensate for covering anticipated and unanticipated credit risk and their results are in line with this expectation. In that context, Athanasoglou et al. (2006) emphasize the importance of credit risk management, which has not always been appropriate in the SEE region.

Capital adequacy is a common proxy for banks' creditworthiness (Kasman et al., 2009), as capital adequacy rules aim at preventing banks from accepting too much risk and ensuring banking sector stability (Claeys and Vander Vennet, 2008). On the other hand, it might also be expected that less capitalized banks are inclined to accept more risk seeking for higher returns, what might result with moral hazard behaviour (Schweiger and Liebeg, 2009).

Papers that specifically analyze the impact of bank size on interest margins report negative relationship between them (Kasman et al., Saad and el Moussawi, 2012; Hamadi and Awdeh, 2012). In the same time, Atanasoglou et al. (2006) report positive influence of size on profitability, what is explained by the benefits of economies of scale.

When studying the impact of the ownership structure on banks' behaviour it turned out that many researchers have encountered problems with obtaining consistent data, especially when analyzing a group of countries or changes in ownership structure during a certain time period. Lack of reliable data disabled Claeys and Vander Vennet (2004) from analyzing this influence despite the fact they have been aware of foreign banks' role in the reform of banking sector in CEE. Results reached by Athanasoglou et al. (2006) imply that foreign banks operating in the SEE countries are more profitable than domestic ones. On the other hand, Schweiger and Liebeg (2009) notify that foreign bank ownership positively affects interest margins in CEE, due to their cheaper sources of funding provided by mother banks. Unlike most of other studies, they also conclude that state ownership has no influence on interest margins, what is explained by their effort to copy commercial banks' behaviour. Similar group of countries was also studied by Kasman et al. (2010) who point out that difference between foreign and national banks is insignificant for interest margins.

The influence of **banking market structure** on banks' efficiency has been investigated in many papers and it is usually proxied by Herfindahl index[1] or Lerner index[2]. Intuitively, more competitive environment should result with lower interest margins, but as mentioned in Dietrich and Wanzenried (2009), higher concentration might also be a consequence of a strong competition among banks and therefore result with lower interest margins. Another way of looking at the impact of competition, as mentioned in Claeys and Vander Vennet (2004) and Schweiger and Liebeg (2009), is that it might encourage banks to take higher risk or not price it adequately, resulting with suboptimal interest margins and potentially leading to the instability of the whole banking sector. Therefore, some of the research papers provide the evidence that higher competition influences lower interest margins (Schweiger and Liebeg (2009), while Athanasoglou et al. (2006) report mixed evidence on relation between concentration and profitability, and similar is with Kasman et al. (2010) where results depend on the group of countries observed.

When looking at the impact of **macroeconomic conditions** on interest margins and efficiency, conclusions are also ambiguous. Brock and Suarez (2000) show that uncertainty and deterioration in macroeconomic conditions increase interest margins. Similar result where

[1] Sum of the squares of market shares in total assets of the individual banks.
[2] Proxy of market power = (Total revenue - total cost) / Total revenue.

positive macroeconomic developments have a significant negative impact on interest margins is reached by Schweiger and Liebeg (2009), as well as by Kasman et al. (2010) for the consolidation period in selected CEE countries, while this link disappeared in the post-consolidation period. Opposite to that, Claeys and Vander Vennet (2004) report that higher economic growth in Western Europe is related to higher interest margins, attributing that to more intense credit activity and better loan quality, while the coefficient on GDP growth in Eastern Europe turned out to be insignificant. Results of Athanasoglou et al. (2006) should also be mentioned as they show that real GDP per capita fluctuations do not have a significant impact on SEE banks' profitability. One of the things most authors agree on is that lower **inflation** implies lower interest margins.

Due to the problems with measurement, only few papers explore the impact of **regulatory costs** on the cost of financial intermediation. Ho and Saunders (1981) emphasize that cost of banks' funds is affected not only with the level of reserve requirements, but also with 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.

3. Data and selected variables

The dependent variable in empirical part of our research is the net interest margin. Explanatory variables could be bundled into three different groups:

1) The bank specific variables that measure credit risk, leverage, size, past growth and efficiency of the bank.

2) Country specific macroeconomic characteristics that are important as banks work in different economic environments. Although there was a tendency for margins to converge in the pre-crisis period, the margins from country to country are still different.

3) Features of the banking markets that influence the market power of each specific bank and impact the pricing policy, and therefore can pressure net interest margins.

All bank level data were obtained from the Bureau van Dijk Bankscope database. Macroeconomic data and data on interest rates were obtained from the Eurostat while the data

on exchange rates were downloaded from the Bloomberg system. Table 2 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 2 Data description

Category	Short	Name	Unit	Description	Source	Expected effect
Dependent variable	NIM_P	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	LOG(TEA)	Natural logarithm of total earning assets	Thosands EUR	Measures the size of the bank.	Bankscope.	-
	CIR_P	Cost to income ratio (%)	%	Costs of running the bank as percentage of income generated before provisions. Measure of operating efficiency.	Bankscope.	-
	TNIOI/AEA*100	Ratio of non interest revenue to average assets	%	Measures the revenues the banks have from other services such as fees and commisions. Higher revenue from such sources might be a compensation for lower interest revenues.	Bankscope.	-
	TCR	Total capital ratio	%	Total capital adequacy measure. It combines Tier 1 and Tier 2 capital as a percentage of risk weighted assets.	Bankscope.	+
	NL_TA_P	Net loans to total assets	%	Measures liquidity and risk. The higher the ratio the lower is additional liquidity and more risky is the bank for potential defaults.	Bankscope.	+
	L_CD_P	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.	+/-
	IL_GL_P	Ratio of impaired loans to gross loans	%	A measure of the amount of total loans which are doubtful. The lower this figure is the better the assets quality.	Bankscope.	+/-
	RIL_GL_P	Ratio of reserves for impaired loans to impaired loans	%	The higher this ratio is the better provided the bank for bad loans and assets quality is expected to be better.	Bankscope.	+/-
	T_PTP_P	Ratio of taxes paid and pre tax profit	%	This is a measure of the effective tax rate that the bank pays. The higher this ratio is the more tax bank pays.	Eurostat.	+
	RAST_MA_2-RAST_MA_2_D	Growth rate of gross loans	%	The difference between growth rate of gross loans for a bank and average growth rate of loans for the banks in the country of operation.	Own calculation using BankScope dana.	+/-
Banking market specific variables	TEA_RANK_3_SVI	Concentration	%	Share of total assets in a country held by three largest banks.	Own calculation using Bankscope dana.	+/-
Macroeconomic variables	GDP_P	GDP growth	%	Growth rate of real GDP.	Eurostat.	+
	CPI_P	Inflation	%	Average annual rate of change of HICP.	Eurostat.	+/-
	CA	Current account	%	Ratio of current account balance to GDP.	Eurostat.	+
	GGD	Government debt	%	Ratio of general government consolidated debt to GDP.	Eurostat.	+
	GDPPC	GDP per capita	%	Real GDP per capita.	Eurostat.	-
	DLOG(FX_AVG)	Exchange rate change	%	Change in the exchange rate of a country in which bank operates versus the euro. Increase means depreciation versus euro. The change is calculated using average annual exchange rate.	Bloomberg.	+/-
	DOLLAR	Eurisation dummy	%	Equals 1 if a country is significantlly euroised.	IMF (2009).	+
	SPREAD	Country spread	basis points	Spreads on international government bonds are calculated by using Merrill Lynch on generic bond yields.	Bloomberg.	-
	IR_3M_P	3 month money market rate	%	Domestic money market rate.	Eurostat.	+
	IR_3M_VOL	Volatility of domestic money market	%	Monthly rolling volatility of domestic money market rate, size of the rolling window is 4 months.	Own calculation based on Eurostat dana.	+/-

Table A-1 in the Appendix presents descriptive statistics for the panel data set used in the analysis. We analyse banks from 11 CEE countries: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. In total, the sample consists of 11 periods (from 2000 to 2010) and 113 cross sections. The data for 2011 was available for only small subset of banks and therefore excluded from the analysis. For the full sample this gives the minimum of 519 observations, after the missing bank-year items were deleted.

Prior to the analysis all variables were checked for stationarity using panel unit root tests. It is important to note that due to limited time dimension, the test might have low power. The results of the tests are presented in the Appendix (Table A-2).

Net interest margin measures the cost and efficiency of financial intermediation and it is determined by variables that can be influenced by bank's management, as well as by environmental variables mostly outside management's reach as those are primarily features of the market and country where bank operates.

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.

Efficiency is measured with cost to income ratio. This is 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. It measures how expensive it is for a bank to produce a unit of operating income in terms of costs not related to interest expense. More efficient banks should be able to generate more income using same resources. I.e., a bank with five branches and a loan turnover of 100 million EUR is more efficient than the bank with same number of branches with only 10 million EUR in loans given. Some authors (Claeys and Vander Vennet., 2008, García-Herrero et al., 2009) use efficiency scores estimated from the stochastic frontier functions, following Coelli (1996), but the data requirements for the calculation of stochastic frontier are rather heavy and using efficiency scores would reduce the number of usable observations in our data

set to less than 100. As a result, in this analysis we keep the cost to income ratio as the measure of managerial efficiency.

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

Risk and return are positively correlated in all economic models. A bank that takes more risk should be compensated with higher return - in this case - higher interest margin. In this research, risk is measured with several variables. Following Maudos and de Guevara (2004) and Kasman et al. (2010), credit risk is proxied by the ratio of loans to total assets. More loans in total assets mean more risk and imply higher interest margin.

Another potential risk is liquidity risk, especially after the start of financial crisis, when interbank market had been under severe pressure. Several authors document the liquidity hoarding, drop in volume and the increase in the interbank interest rates in the EU (Heider et al., 2009, Gabrielli, 2010). In addition to that, banks in CEE countries might also be susceptible to deleveraging as their owners need to fulfil tougher capital requirements (for example see the speech of the Magyar Nemeti Bank governor at the EBRD conference[3]). The impact of this ratio on the net interest margin can go in two directions. In the pre-crisis period, more wholesale funding instead of customer deposits would increase the net interest margin as the loans were cheap source of funding. However, in the crisis period, too much reliance on money market (or financing from parent institutions) could be a burden for the bank as these costs could significantly rise and capital inflows might dry out. In such circumstances the bank, if not properly hedged and is unable to quickly decrease assets, would probably record lower interest rate margin.

Capital adequacy ratio calculated as a share of capital in total risk weighted assets is a standard proxy for creditworthiness of the bank. Higher capital adequacy ratio implies that bank holds more capital compared to total assets. However, capital is more expensive

[3] Speec of the Hungarian central bank governor at G20 meeting, available at http://www.ebrd.com/downloads/news/simor-andras.pdf

compared to debt, so holding more equity reduces the tax shield and increases the tax bill. If competition on the market does not allow the bank to transfer the cost of excessive capital to the clients, this would imply that more capitalized banks would have lower net interest margins. Nevertheless, it is also important to note that higher capitalization ratio might imply that the bank expects higher losses on its loans in the future, as it deals with riskier clients. If these riskier clients pay higher rates, the expected sign of the relationship between capital adequacy ratio and net interest margin is positive.

Economies of scale also notably impacts banks' behaviour and results. Bigger banks can have lower costs per unit of income and therefore higher net interest margin. However, empirical findings on the CEE countries show that the gain in efficiency by increasing the size is limited and is related mostly to very small banks. Staikouras et al. (2008), show there are some gains in efficiency when bank transforms from small to medium sized bank, but also report there is some loss in efficiency when bank goes from medium sized to big. Another important question is whether bigger banks can charge higher or lower margins. An answer is hidden in the portfolio composition of each bank. If smaller banks work with riskier clients and charge them more, the resulting net interest margin might be bigger. In this research, bank size measured by natural logarithm of total earnings assets could also pick up differences between countries, i.e. the fact that bigger banks operate in the countries with margins that are higher due to other factors, potentially not adequately represented by country specific variables. Hence we also measured size on a relative basis, with respect to average bank in a specific country in a given year. As Bankscope database mostly omits small banks, the expected sign for the relationship between size and net interest margin is negative.

Loan growth might also be important determinant of net interest margin. Banks that want to achieve higher growth and capture market share might be willing to forgo part of the interest margin. In order to prevent country specific influences, the loan growth was normalized by the average growth in a specific country in a specific year.

In past few years it has become very popular in some CEE countries to debate about taxing banks, as they have come in the spotlight due to their profits that seem to defy crisis that is engulfing other sectors. Some governments have used this public perception in order to

impose additional tax on banks (Hungary[4]). The variable that measures the effective tax rate should demonstrate how banks in the CEE react to such changes. It would be reasonable to assume that additional bank tax would be transferred to the customers in a form of higher net interest margin, but only if the market conditions in terms of competitive pressures and loan demand allow for that. Otherwise, the impact of increased taxed might be unclear.

Finally, we also test for the influence of bad loans on net interest margins. It is measured by two variables, share of impaired loans in gross loans and 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. 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 level higher than expected loss and in bad times they are underrated. Fonesca and Gonzales (2008) document such behaviour. Consequently, the link between bad loans and net interest margin might be ambiguous.

Except bank specific variables, **banking market characteristics** also markedly influence net interest margin. Most of the papers presented in Table 1 account for industry related variables. Share of three largest banks measures the influence of market structure on the net interest margin. More concentrated banking market might imply higher margins for all banks in the market as banks exploit their market power.

Environment where the bank operates is captured by **country specific macroeconomic characteristics**. In order to measure economic performance, which can influence demand for loans and performance of existing loans, we use GDP growth, inflation, share of current account deficit in GDP and share of general government debt in GDP. Impact of exchange rate of net interest margin is captured by two variables. One is euroization dummy, which equals 1 for all significantly euroized economies, according to the IMF (2009) analysis. Banks operating in euroized economies might be exposed to a significant currency induced credit risk coming from the fact that their clients' assets and liabilities are usually not denominated in the same currency. If domestic exchange rate depreciates significantly, the loan quality might deteriorate and banks might charge higher margins. Second variable used as a proxy for

[4] http://www.imf.org/external/np/sec/pn/2012/pn1204.htm
[5] Kruger (2002), page 13, http://www.imf.org/external/np/sta/npl/eng/2002/rk0702.pdf

the exchange rate risk, the change of domestic currency exchange rate versus the euro, measures the influence of realised change in the exchange rate on net interest margins.

GDP per capita serves as an additional variable that proxies all other country specific factors that could not be included in the regression equation. Level of short term interest rates in the economy measures the stance of the economic policy and the volatility of these rates is an additional measure of country risk. Moreover, rise of the short term interest rates and their volatility might be a problem for the banks if their interest rate risk has not been properly hedged.

As an alternative for the set of macroeconomic variables, in one model specification we include only yield spread between government Eurobonds from the countries in our sample and German government bonds. Many research papers confirm that market participants discount all available information about fundamentals what is expected to be included in the price of bonds (recently Özatay et al., 2009 linked macroeconomic fundamentals and spread on government bonds). This specification also serves as a robustness check. We should note that in this specification all Slovak banks are dropped out of our data set as Slovakia's data on international bond spreads are not available. Also, time dimension for some other countries is shortened.

4. Stylized facts

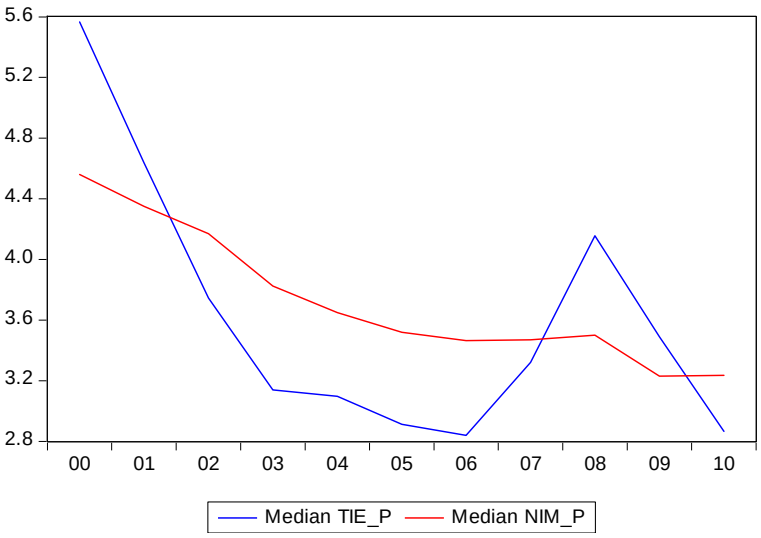
The sample covered in this research starts in the year 2000, when the banking sector consolidation in the CEE has gained momentum (Kasman et al., 2010) and foreign investors have already become very important players in domestic banking markets of these countries. After the year 2000, banks have continued to cut costs and enhance their efficiency.

In the period from 2000 to 2010 banking assets grew considerably. Current economic and financial crisis resulted with the slowdown and even a drop of asset levels in 2009, but in 2010, in the median the banks have continued to grow. After the turn of the century the subsequent period was marked by the decline in the level of bad loans and banks have enjoyed several years of tranquillity. However, after 2007, the share of impaired loans has

increased in all studied countries, although with significant differences among them. Opposite to that, after 2007 reserves for impaired loans have mostly declined.

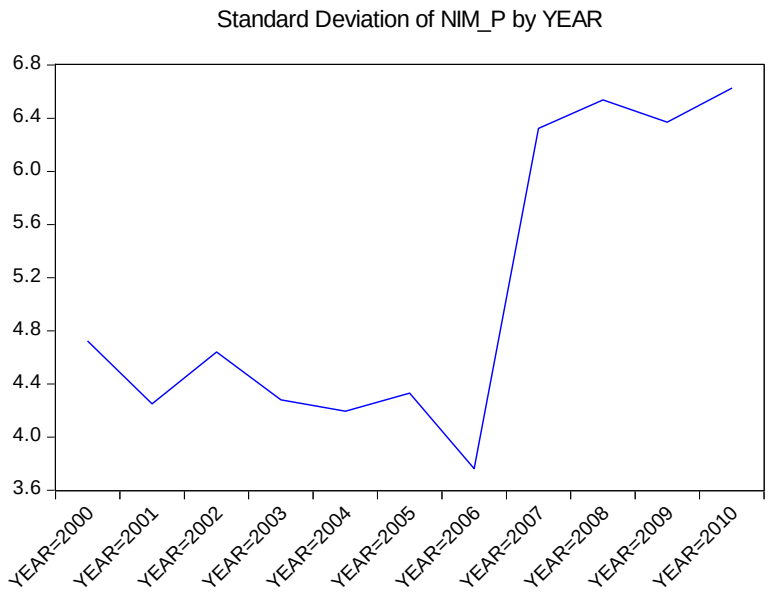
Net interest margins for the banks in selected CEE countries have been steadily declining from the 2000, together with interest costs (Figure 1). Financial crisis that began in 2008 was marked by additional decline of net interest margin. However, it should be noted that the standard deviation of net interest margin across banks was relatively low in the period prior to 2007, while from 2007 on it increased significantly. This could indicate that, after the period of relative tranquillity and business as usual in the CEE banking industry, ongoing financial crisis and recession caused the diversification where some banks business models came in to question (Figure 2). In terms of cross country comparison (Figure 3), until 2008 net interest margins have been steadily declining in all countries. After that, Baltic countries stand out with significantly lower margins compared to the previous period, but to other countries from the sample as well, while margins in those other countries remained relatively stable or slightly increased.

Figure 1 Net interest margin and total interest expenses over average earning assets for selected countries



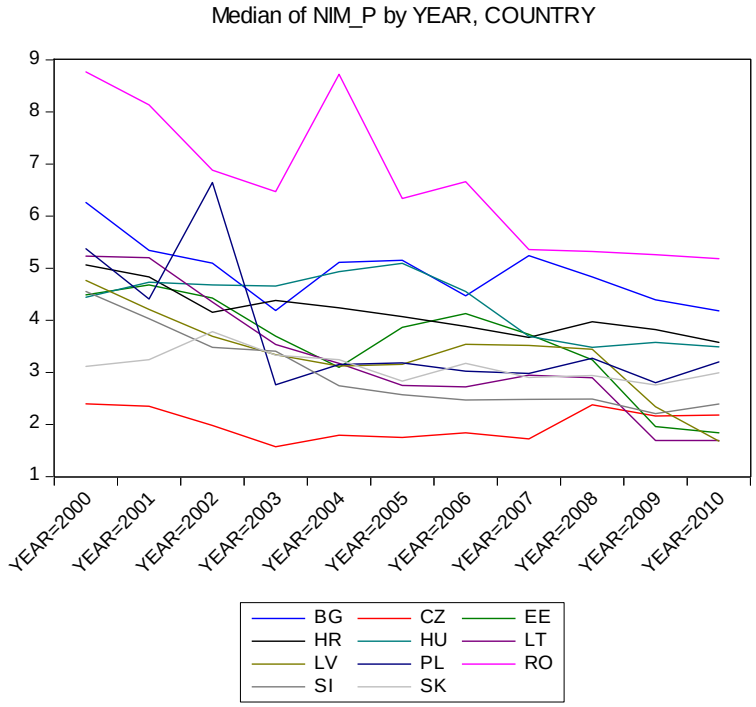
Source: Bankscope; own calculations.

Figure 2 The standard deviation of net interest margin in selected countries



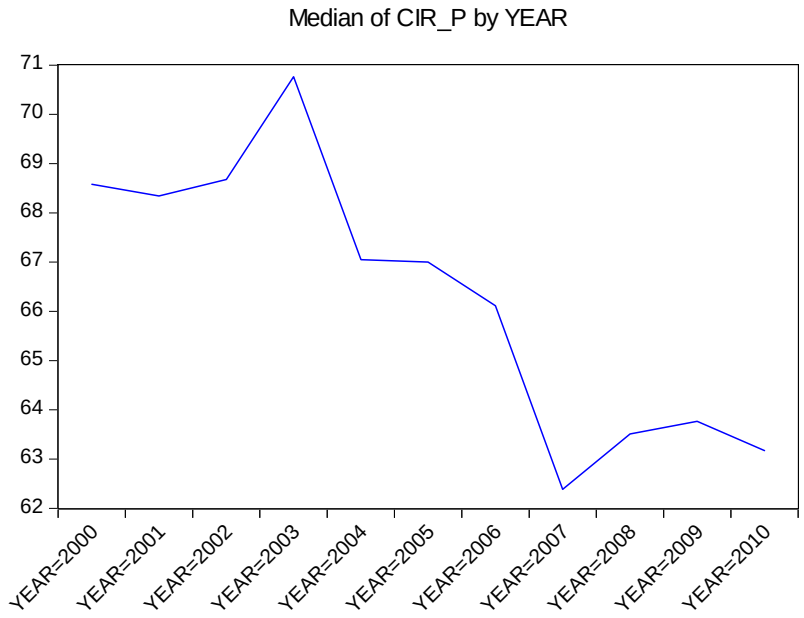
Source: Bankscope; own calculations.

Figure 3 Median net interest margins by country



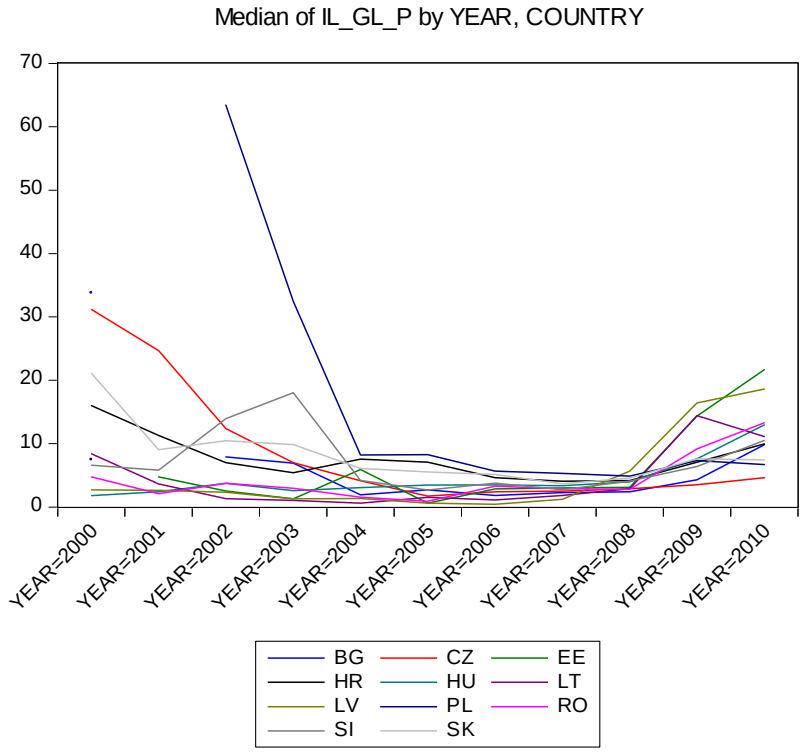
Source: Bankscope; own calculations.

Figure 4 Cost to income ratio for the median CEE bank



Source: Bankscope; own calculations.

Figure 5 Share of impaired loans in gross loans by country



Source: Bankscope; own calculations.

5. Methodology

We assume that the data generating process is described by:

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

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 2. Some variables in matrix **x** are country specific, i.e. they are the same for all banks from a given country. Error term has two orthogonal components, fixed effects μ_i and idiosyncratic shocks $v_{i,t}$.

Combination of relatively short time period, the use of 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 ordinary least squares with fixed effects and lagged dependent variable gives rise to dynamic panel bias (see Nickel, 1981 or Roodman 2006, page 17) because lagged dependent variable is correlated with error term by construction.[6]

Our data set has large cross section and relatively small time dimension, so the problems above can be solved together under the aegis on 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 lagged dependent variable as an explanatory variable. Resultantly, we estimate the equation (1) using Areallano and Bover (1995) system GMM estimator. We treat all bank

[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.

specific variables from Table 2 as endogenous and instrument them with their orthogonal transformations.

The econometric analysis is conducted on two sub-samples, pre-crisis period from 2000 to 2007 and the crisis period from 2008 to 2010. The economic slowdown and financial crisis were marked by the net interest margin decline for the median bank in the period from 2008 on, while the dispersions of the net interest margin across banks increased (Figure 1, Figure 2). At the same time, median bank's costs rose as both cost to income ratio and the share of bad loans increased. The choice of sub-periods was also confirmed by Chow test that shows statistically significant evidence of the break in the relationship between explanatory variables and the dependent variable for the period 2008 to 2010 with the test value of 25.46. This is more than the 5% table value of 1.71.

6. Empirical results

Results of the estimation are presented in the Table 3. There are two models presented, first one with macro variables and second one where these variables are replaced with yield spread that acts as a synthetic macro variable. Each of them is estimated for two sub-periods, pre-crisis period (2000 - 2008) and the crisis period (2008 - 2010). Hansen test for overidentifying restrictions which tests for instrument validity does not find evidence against the null of instrument validity. Robust standard errors are reported bellow estimates in Table 3.

Table 3 Estimation results

Eq Name:	Specification 1 Pre-crisis period	Specification 1 Crisis period	Specification 2 Pre-crisis period	Specification 2 Crisis period
Dep. Var:		Net interest margin		
Net interest margin lagged (-1)	0,6289 (0.0547)**	0,1983 (0.0977)*	0,5696 (0.0280)**	0,1803 (0.0499)**
Bank size	0,0000 (0.0000)**	0,0000 (0.0000)**	0,0000 (0.0000)**	0,0000 (0.0000)**
Cost to income ratio	-0,0228 (0.0051)**	-0,0148 (0.0055)**	-0,0168 (0.0023)**	-0,0349 (0.0033)**
Non interest income	0,0208 (-0,0142)	0,0039 (-0,0085)	-0,0311 (0.0031)**	0,0034 (-0,0047)
Capitalization	0,0487 (0.0113)**	0,0065 (-0,0198)	0,0343 (0.0048)**	0,0159 (-0,0162)
Net loans to total assets	0,0129 (-0,0075)	0,0162 (-0,0104)	0,0090 (0.0045)*	0,0113 (-0,0064)
Loans to customer deposits	0,0020 (-0,0013)	0,0006 (-0,0020)	-0,0006 (-0,0009)	-0,0001 (-0,0006)
Impaired loans to gross loans	-0,0023 (-0,0148)	0,0039 (-0,0117)	-0,0186 (0.0089)*	0,0054 (-0,0069)
Reserves for impaired loans to gross loans	0,0736 (0.0273)**	-0,0881 (0.0436)*	0,0570 (0.0207)**	-0,0621 (0.0215)**
Ratio of taxex paid and pre tax profit	0,0018 (0.0005)**	-0,0002 (-0,0014)	0,0006 (0.0003)*	0,0000 (-0,0009)
Growth rate of gross loans	0,0042 (-0,0038)	0,0147 (-0,0093)	0,0021 (-0,0014)	0,0009 (-0,0024)
3 mont money market interest rate	0,2088 (0.0545)**	-0,0856 (-0,0936)		
3 mont money market interest rate volatitlty	-0,0765 (0.0126)**	0,1115 (-0,1086)		
GDP growth	0,1170 (-0,0658)	-0,0556 (-0,0492)		
Inflation	-0,0683 (-0,0476)	0,0724 (-0,0666)		
Current account deficit as % of GDP	0,1523 (0.0417)**	0,0517 (-0,0478)		
Gross governement debt	0,0774 (0.0222)**	0,0271 (-0,0221)		
GDP per capita	-0,0001 (-0,0002)	0,0003 (-0,0003)		
Eurization dummy	-0,1377 (-0,2461)	1,0829 (-1,0020)		
Exchange rate change	-1,9103 (-1,6655)	-1,3070 (-1,9506)		
Concentration	-0,0657 (0.0311)*	-0,0427 (-0,0406)	0,0192 (-0,0115)	-0,0102 (-0,0151)
Country spread			-0,0023 (0.0005)**	-0,0001 (-0,0005)
Time dummies	Yes	Yes	Yes	Yes
Observations	168	216	141	193
Banks	70	95	64	86
Periods	7	3	7	3
Hansen J statistics	31,97	27,29	34,77	39,34
p value	0,42	0,20	0,66	0,12

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.

Results show that the determinants of net interest margins in two sub-periods are significantly different, but some variables retain their significance in both periods. We start by analyzing the importance of **bank specific variables**.

Among the variables that are important determinants of bank net interest margins in both periods cost to income ratio stands out, as expected and corroborated by other research (Table 1). Increase in efficiency contributes to decline in net interest margin. Declining cost to income ratio for the median bank in our sample from 2000 to 2007 (Figure 4) contributed to net interest margin decrease of about 15 basis points.

Bad loans measured by the share of impaired loans in gross loans turned out not to be a significant determinant of net interest margin neither in the pre-crisis nor in the crisis period. It seems that designating the loan as non-performing does not affect net interest margin. Probable explanation is that although defining the loan as bad implies some reservations need to be done, their level can be relatively small. On the other hand, increasing the share of reserves for impaired loans more directly affects interest income from the loans. The coefficient with the ratio of reserves for impaired loans to gross loans changes sign between periods. In the crisis period increased reservations hurt net interest income, while it is opposite in the pre-crisis period when increasing the reserves for bad loans increases the net interest margin. It could be concluded that in the pre-crisis period, when the economy in selected countries was strong and demand for loans high, banks transferred the costs of the impairment of bad loans to the customers. In the crisis period banks have not been able to conduct such transfer and impairments strongly influenced their net interest margin. From 2008 to 2011 median bank's net interest margin decreased by circa 35 basis points due to rise of reservations.

In the pre-crisis period, bank specific variables linked to the credit risk had a big influence on net interest margin. Positive coefficient with ratio of net loans to total assets shows that increase in credit risk was important factor that propped up the net interest margin for the CEE banks in the pre-crisis period. In that period banks took on more risk and for the median bank this ratio increased from 44.7 to 62.3, which would increase net interest margin on average for 35 basis points.

Capital adequacy ratio, our measure of bank creditworthiness, has a positive sign, implying that the banks aim to transfer the cost of higher capitalization to its clients through higher net interest margin. From 2000 to 2007 median capitalization in the CEE banking sector fell by 4.9 percentage points enabling the banks to lower the net interest margin for about 15 basis points on average.

Regression results show that additional taxation of the banks might not be an optimal solution in the long run if policymakers aim to keep borrowing costs low. Although the link between the taxes paid and net interest margin is insignificant in the crisis period, in the per-crisis period there is a positive link between them. So, even though the banks might not transfer higher taxes to their clients during the crisis, probably discouraged by already relatively poor credit demand, when the economic environment improves these costs will be transferred to loan takers. Nevertheless, it should be noted that our econometric model suggests that even if 20% more of banks pre tax profits are taxed away, the influence of the net interest margin is quite miniscule, around 4 basis points.

The coefficient with the lagged net interest margin is significant in both periods, but its value is much lower in the crisis period. As expected, this indicates that persistence of bank profits in the crisis is lower. In the pre-crisis period macroeconomic shocks in all sample countries were either non existent or weak comparing to the crisis period. In the crisis period the unravelling of risk taken on in previous years caused some banks' net interest margins to drop significantly. This is evident in the increased dispersion of net interest margin across banks and countries in the crisis period (Figure 2, Figure 3).

Although the size of the bank is statistically significant in all presented specifications, due to small coefficient value it is economically irrelevant. In the context of this discussion, it is important to note that this coefficient measures the influence of size after the effects of efficiency and risk have been cleaned out by other variables. This is important because in the literature on bank size has been liked to gains in efficiency and risk diversification (Staikouras et al., 2008).

Among the variables that depict **banking market characteristics**, increase in the share of three largest banks does not influence the net interest margin in the crisis period. In the pre-crisis period it unexpectedly decreases the net interest margin for the average bank. We also

tested whether this coefficient is determined by the influence three largest banks have on other banks, i.e. result of increased competition that drives other banks to lower their margins. The test was done by including two dummies, one that is equal to one if the bank is a member of the group of three biggest banks and another that is equal to one for all other banks. By multiplying these dummies with our concentration variable we got estimates for the impact of size of three largest banks and all other banks separately on net interest margin. The coefficients were insignificant in both periods according to separate and joint tests.

Among the **non bank variables**, in the pre-crisis period significant are domestic short term interest rate levels, volatility of these rates, gross government debt (as a percentage of GDP), GDP growth, and current account deficit. In the crisis period, none of the macroeconomic variables included turned out to be significant in determining net interest margins.

GDP and current account deficit as a share of GDP capture the effects of business cycle on net interest margins. Higher growth means more opportunities and more demand for credit and on average this increases banks' net interest margin.

Estimation results indicate that government behaviour influences bank margins also through demand channel. Increasing the government debt by 10% of GDP increases net interest margin charged by the banks by circa 80 basis points in the pre-crisis period. This might be due to two factors: increasing government consumption also increases other sector's economic activity and credit demand. Additionally, this might be an effect of the fact that loans to government do not require reservations in banks' books. During the crisis there is no statistically significant link between these two variables.

Model shows that increasing current account deficit decreased banks' net interest margins on average. The current account deficit roughly equals capital inflows to a certain country (excluding reserve assets movements). Increasing inflows, which marked countries in the sample in the pre-crisis period, make capital less scarce what enables banks to charge it less and results with lower net interest margin. This conclusion is indirectly corroborated by research of Arghyrou et al. (2009) which shows that the real interest rates of majority of EU members converge to EMU average.

Among remaining macroeconomic variables only interest rate related variables significantly influence the net interest margin and this relationship exist only in the pre-crisis period. Higher interest rates which indicate periods of monetary tightening imply higher net interest margins for the banks, which is comparable to the results of Claeys and Vander Vennet (2008). Also, as expected, the link between volatility and net interest margin is negative.

Results for the specifications where macroeconomic variables are substituted with yield spread on government bonds confirm our results. The significance of variables and the size of coefficients do not change notably. This also serves as a robustness test.

7. Conclusion

Period before the crisis (from year 2000 to 2007) was boon for the banks and their customers in the CEE. After the problematic beginning of the decade, increased efficiency and booming economies with high credit demand created a fertile ground for a strong credit growth. That increased risks that banks hold in their balance sheets and part of that risk was priced in net interest margin (as shown by significant effects of our proxies for risk). In the same period consumers experienced lower costs of financial intermediation as net interest margins decreased due to high capital inflows and competition on the funding market. Our regression results show that government intervention that aims to punish "excessive" banks' profit might not be an optimal solution as banks will seek to transfer the cost to clients as soon as market conditions allow. In addition to that, results also show a strong link between increasing public debt and growth of net interest margin. It follows that governments can decrease bank's profits by lowering their demand for loans.

However, during these boom years, banks on average decreased their capital buffers, as part of the decreasing costs of net interest margin was due to lower capitalization. After the onset of the crisis, the net interest margins across banks operating in CEE started diverging. Obviously, during the boom period some banks got better clients than others and some banks' business models were more stable.

The divergent movements of net interest margins by country in the crisis period should be interpreted in the light of presented findings. As the crisis erupted, the trend of decreasing net interest margins in most of the sampled countries stopped, while in others it accelerated (most

notably in Baltic countries and Bulgaria). According to our results, fall of the margins in mentioned countries might me caused by the fact that the weight of bad loans pressured the banks' earnings. For other countries the trend of decreasing margins stopped as the banks started propping up their capitalization. All this was happening during the period when the demand for loans was weak.

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Appendix

Table A-1 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	0.00
Cost to income ratio (%)	63.77	61.00	217.65	15.60	21.67	2.04	12.04	1819.18	0.00
Ratio of non interest revenue to average assets (%)	2.94	1.90	68.03	-1.94	5.42	7.58	73.17	95343.73	0.00
Total capital ratio	14.59	13.19	72.37	6.80	6.16	4.34	31.92	16863.24	0.00
Net loans to total assets	58.31	61.32	94.22	4.82	16.99	-0.63	2.92	29.50	0.00
Ratio of loans to customer deposits	115.45	96.87	950.52	5.65	85.05	4.00	29.59	14262.04	0.00
Ratio of impaired loans to gross loans	7.43	4.82	79.10	0.05	9.15	3.76	22.20	7865.95	0.00
Ratio of reserves for impaired loans to impaired loans	4.09	3.19	27.68	0.10	3.43	2.27	11.83	1824.88	0.00
Ratio of taxes paid and pre tax profit	16.40	18.20	500.00	-700.00	52.16	-2.73	109.09	208763.70	0.00
3 month money market rate	6.07	4.90	50.78	1.31	4.90	5.40	44.62	34201.97	0.00
Volatility of domestic money market	1.79	0.19	102.99	0.00	8.05	10.32	121.35	267001.20	0.00
GDP growth	2.71	4.20	11.20	-17.70	5.64	-1.56	5.71	315.33	0.00
Inflation	4.96	4.00	45.70	-1.20	4.69	4.45	34.11	19364.50	0.00
Current account	-5.26	-3.80	6.50	-21.60	6.52	-0.71	2.83	37.77	0.00
Government debt	32.99	29.15	81.30	9.00	16.76	0.77	3.02	43.80	0.00
GDP per capita	6998.65	7350.00	11700.00	2600.00	2423.16	0.01	2.08	15.83	0.00
Exchange rate change	0.00	0.00	0.27	-0.12	0.07	1.44	5.74	291.81	0.00
Concentration	53.98	53.92	87.01	35.92	12.26	0.37	2.18	22.40	0.00
Growth rate of gross loans	3.16	2.54	78.24	-92.00	21.13	-0.20	5.18	90.64	0.00
Country spread	176.03	126.57	691.85	-15.33	158.46	1.19	3.99	122.88	0.00

Source: Own calculations.

Table A-2 Panel unit root test results

Variable name	Levin, Liu & Chu (2002)	Im, Pesaran and Shin W-stat (2003)
Net interest margin (%)	I(0)	I(0)
Cost to income ratio (%)	I(0)	I(0)
Ratio of non interest revenue to average assets (%)	I(0)	I(0)
Total capital ratio	I(0)	I(0)
Net loans to total assets	I(0)	I(0)
Ratio of loans to customer deposits	I(0)	I(0)
Ratio of impaired loans to gross loans	I(0)	I(0)
Ratio of reserves for impaired loans to impaired loans	I(0)	I(1)
Ratio of taxes paid and pre tax profit	I(0)	I(0)
3 month money market rate	I(0)	I(0)
Volatility of domestic money market	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)
GDP per capita	I(0)	I(1)
Exchange rate change	I(0)	I(0)
Concentration	I(0)	I(0)
Growth rate of gross loans	I(0)	I(0)
Country spread	I(0)	I(0)

Source: Own calculations.