Bank risk-taking in CEE countries

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Abstract.
This study examines whether the lowering interest-rate environment in CEE countries since the early 2000's increased bank risk-taking behaviour. We employ 6,979 annual observations from the Bankscope database over the period 1997-2011 and find a positive relationship between bank risk-taking, measured by *risk assets,* and interest rates. On the contrary, there is a negative relationship between *non-performing loans* and interest rates. These results are robust across a number of different specifications that account, *inter alia*, for the potential endogeneity of interest rates and/or the dynamics of bank risk. Moreover, we provide evidence that these findings are mainly driven by the banking sector of the Russian Federation rather than that of the rest CEE countries.

JEL classification: G21; E43; E52

Keywords: Interest rates; Bank risk-taking; Panel data; Russian and CEE banks

1. Introduction.

There has been a growing research interest on whether the relatively low interest rates of the early to mid 2000s increased the risk-taking appetite of banks. A low interest-rate environment leads to a reduction of bank margins and informational asymmetries. As a consequence, banks react by softening their lending standards, thus raising the level of risk assets in their portfolios and worsening the equilibrium risk of failure. The main theoretical argument for such a behavior relies on the works of Keeley (1990) and Dell' Ariccia and Marquez (2006). Certain exogenous shocks that lead to lower informational asymmetries and bank margins through increased competition may increase bank incentives for higher yield in more risky projects. According to Rajan (2006), such a bank behavior could be attributed to a low interest rate environment.

A number of empirical papers has recently examined this issue. Indicatively, Jimenez *et al.* (2008) employ data on Spanish banks and find that an expansionary monetary policy is indeed associated with higher credit risk. Ioannidou *et al.* (2009) use the Bolivian case as a quasi-natural experiment of exogenously-taken monetary policy and find very similar results. Brissimis and Delis (2009) are more concerned with whether monetary policy fluctuations cause differential bank behavior towards their lending and risk-taking decisions on the basis of internal bank characteristics. Altunbas *et al*. (2009) provide evidence that there is a positive relation between bank size and risk-taking, while liquidity is negatively related to risk. Delis and Kouretas (2011) analyze the bank risk-taking channel in EU countries over the period 2001-2008 and provide strong evidence in favour of a negative relationship between bank risk-taking and interest rates.

The vast majority of these studies use data either from the U.S. or the euro area banking sector. To the best of our knowledge there is no study that examines the issue of bank risk-taking in the lowering interest rate environment of the CEE economies. Certainly, even today the level of interest rates in those economies is not as low as the ones in developed countries, however there is a dramatic fall during the last decade and therefore one may argue that for these economies an interest rate of 5 percent can be considered as low given the particular circumstances. There has been a number of recent studies that examine several aspects of the Russian and CEE banking system (see Haselmann and Wachtel, 2007; Fungacova and Solanko, 2008; Juurikkala *et al*., 2009, Mamonov, 2012; Pawlowska, 2012; Pestova and Mamonov, 2012). However, none of these studies examine the impact of lowering interest rates on bank risk taking for these countries.

The banking sector of the transition economies have changed substantially in the last 15 years. Thus, this period presents an interesting framework to study the behaviour of financial intermediaries in a set up quite different from the one found in the US, the Eurozone and Japan with highly developed banking sectors. There are four stages of the banking sector development in CEE countries that we can identify during this period. The first stage relates to the establishment of financial intermediaries operating in the early 1990s. The second involves the emergence of bank failures and systemic crises which occurred mainly during the mid-1990s and affected all transition economies. The third relates to a restructuring process through privatization and the entry of foreign banks. This lengthy process covers not just the banking sector but the overall financial sector and is fully reflected in the development of the respective stock markets as well. Another

important feature is that foreign banks dominate the banking sector in most of the CEE countries. Lastly, the fourth stage involves a substantial improvement of the regulatory framework of the banking sector in these economies (see also Haselman and Wachtel, 2007).

We use a large unbalanced international dataset that covers 1,629 commercial, savings and cooperative banks operating in Russian Federation and ten CEE countries for the period 1997-2011. The empirical analysis is based on the use of the level of interest rates as the theoretical propositions of Dell' Ariccia and Marquez (2006) and Rajan (2006) suggest because an expansionary monetary policy could still imply relatively high levels of interest rates as is the case of CEE countries. We also argue that modeling this relationship allows us to focus more on the side of bank behavior and less from the side of the central bank's policy goals. The important issue under this specification is that we estimate risk equations that follow directly from the literature on the determinants of bank risk taking.

The rest of the paper is organized as follows: Section 2 describes the data while Section 3 discusses the econometric methodology and presents the results. Concluding remarks are given in Section 4.

2. Data and Variables' Description.

We build a large unbalanced dataset with annual data from the Bankscope database on commercial, savings and cooperative banks operating in CEE countries for the period 1997-2011. To avoid double-counting, we use data from unconsolidated accounts were available, otherwise from consolidated accounts with no unconsolidated companion data

available in Bankscope. Countries included in the sample are Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russian Federation, Slovak Republic and Slovenia. The total number of observations included in the dataset is 6,979, while the number of banks is 1,290, the vast majority of which are Russian banks, due to the large size of the banking sector of this country relatively to the other CEE countries.

Due to this characteristic of the dataset, we perform our analysis for the whole panel, as well as for the Russian Federation vis-a-vis the other CEE countries. Furthermore, this choice is dictated by the different characteristics of the banking sector in the countries under examination (see among others, Haselmann and Wachtek, 2007; Fungacova and Solanko, 2008; Juurikkala et al., 2009; Gajewski *et al*., 2012; Pawlowska, 2012) as well as the different macroeconomic shocks these countries experienced during the late 1990's and the 2000's. For example, the Russian crisis in 1998 has affected the banks in the country, while the other CEE countries were at that time at an early stage of financial development. Later on, during the first half of 2000's, Russian Federation' economy experienced high growth rates and paid out its external debt in full due to high commodities prices at the international markets. This is reflected in the declining path of its interest rates and certainly helped its banking sector to grow while it may have affected the risk-taking behavior of its banks. On the other hand, during the period examined, many of the other CEE countries were trapped into lower growth rates, severe crises (e.g., Estonia, Hungary) or anti-inflationary policies that kept interest rates at high levels for several years (e.g., Romania). Clearly, it is of much interest to examine the risk-taking behavior of banks in such a diverse landscape of macroeconomic conditions characterized however by declining, in general, interest rates.

Table 1 lists the variables employed along with their definitions and sources. Specifically, as dependent variables we use *risk assets* and *non-performing loans* to proxy for bank risk-taking (see for example, Laeven and Levine 2009, Delis and Kouretas, 2011), defined, respectively, as the ratio of total earning assets to total assets, and the ratio of non-performing loans to total loans. The former accounts for the level of risk in bank balance sheet, while the latter proxies for the quality of bank portfolio. Larger values of these two variables reflect higher risk for the bank.

Insert Table 1 here

Bank risk-taking behavior is shaped on the basis of the bank's balance sheet and income statement characteristics. Thus, as control variables, we use size, defined as the natural logarithm of total real assets measured in constant 2000 prices;[1] capitalization, defined as the ratio of equity to total assets; profitability, defined as the ratio of profit before taxes to total assets; and efficiency, defined as the ratio of total operating income to total expenses. Size proxies for a bank's relative power in the banking industry of a country and is often used in the literature as a proxy for bank risk-taking behavior. Capitalization reflects to only its past risk-taking behavior, since higher equity is related to a more prudent behavior towards risk, but is also related to the bank's ability to absorb losses when things get worse in the credit markets. The relationship between profitability and bank risk may run both ways. Higher profitability during a certain year may reflect a

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[1] We calculate real assets using the monthly CPI, rebased in 2000 prices for each country, and taking the average over twelve months for each year.
 We also perform our analysis with size measured in current prices. The results remain essentially unchanged.

higher risk appetite for the bank, especially during upturns, since higher risk is rewarded with higher yields. This could force the bank to continue or even expand its risk-taking behavior in the next year. On the other hand however, during a turning point in the business cycle or at the onset of a crisis, this increased risk in the bank's balance sheet may result in lower profitability during the next fiscal year and accumulating bad loans, thus restricting the ability of the bank to continue its past risk-taking activities. For these reasons, we employ profitability lagged once in our regressions, recognizing its endogenous relationship to the risk taking behavior of the bank. Efficiency may proxy for the bank's ability in managing risks while also accounts for its risk attitude.

We also control for the general macroeconomic conditions that affect bank risk-taking behavior and expansion in each country using the real GDP growth rate (y-o-y). The role of this variable is especially important in our context since the heterogeneity in macroeconomic conditions, both across countries and within time, is large.

Since in this paper we are interested at examining the role of interest rates in the risk-taking behavior of banks, we need to employ the proper level of interest rate in our estimating equation. To this end, we use three different interest rates, namely the central bank policy interest rate, a short term rate and a long term rate, so as to investigate the role of interest rate in bank risk-taking under different term horizons. All are calculated as annual averages of the relevant monthly series. More in detail, the central bank policy rate is the official refinancing operation rate for each country (the relevant Euro area rate for Slovak Republic, Slovenia and Estonia, after the adoption of the euro for these countries - in 2009, 2008 and 2011, respectively). The short term rate is the 3-month money market rate (we proxy with the 3-month Treasury bill rate for Slovakia where to

money market rate is not available in Datastream), and the long rate is the government bond yield long term rate.

To get a clearer picture of the evolvement over time of the interest rate environment banks faced during the 1997-2011 period in the countries under examination, we present two figures; the first plots the short term interest rates, the second the long term ones. Both figures eloquently capture the differing monetary conditions between the sample countries, while describe the common characteristic among them, namely the consistent lowering of interest rates and the improvement of the macroeconomic environment.

Insert Figures 1 and 2 here

As figure 1 indicates, short term interest rates exhibit the same pattern for most CEE countries. In particular, there has been a substantial decline in the interest rates level during the period 1997-2004. This was the outcome of a change in the monetary policy adopted by the monetary authorities in order to fulfill the Maastricht criteria. When the new enlargement of the European Union took place in May 2004 short term interest rates in most CEE economies have converged to a good extent to the average level of EU-15. The only exception during that period was Russian Federation since the short term interest rates rose from approximately 7% in mid 1997 to as high as 22% in 2000. This increase could be attributed to the negative effects of the Russian financial crisis. However, since September 2000 the average, across countries, short term interest rate declined substantially reaching the lowest point of about 5% in 2005. This trend of

declining short term interest rates was reversed mainly for Latvia and Russian Federation during the financial crisis of 2007-2009 although they have been constantly declining since 2010 in all CEE economies.

The picture emerging from figure 2 is similar. The long run interest rates have constantly declining since 1997. This decline is evident in particular for the Russian Federation following the aftermath of the currency crisis of the spring of 1998. Overall the long run interest rates have fallen to approximately 5%. Once again we notice that the long run interest rates of Latvia and Lithuania rose during the recent financial crisis following the enormous capital outflows and the drastic devaluation of national currencies.

Table 2 reports descriptive statistics for the variables employed in the analysis. We report the mean, standard deviation, and the minimum and maximum values for each variable. Also, Table 3 shows that correlation coefficients between the main variables of our study are low to suggest multicollinearity issues.

Insert Tables 2 and 3 here

3. Empirical Analysis.

The general empirical model to be estimated is a dynamic fixed effects model of the following form:

$$r_{it} = a + \delta_i + \beta r_{it-1} + \gamma i_t + \sum_j \varepsilon_j B_{jit} + \zeta \, \mathrm{growth}_t + \eta_t + u_{it} \qquad (1)$$

where the risk variable, r, of bank i at time t is written as a function of its value at t-1 to account for possible persistence; the interest rate variable, i, for each country; a set of j bank-level control variables discussed above, B_{ijt}; real GDP growth rate (y-o-y) for each country, *growth,* while η_t is a full set of time dummies to capture common shocks or trends in the dependent variable.

The model is estimated with the fixed effects IV estimator[2] to take into account the endogeneity of the interest rate to the macroeconomic environment in each country (Jimenez *et al*., 2008; Ioannidou *et al*., 2009; Delis and Kouretas, 2011). To this end, we use the relevant Euro area interest rate, following di Giovanni *et al*. (2009). The CEE countries more or less follow closely the monetary policy of the ECB, as these countries are among the main trading parties of the Eurozone, while many of them are following stabilization programs in order to fulfill the criteria of the Maastricht treaty so as to be accepted in the future as members of the Eurozone. Indeed, this instrument is proved to be a successful instrument since it passes successfully a number of econometric tests, such the Stock-Yogo (2005) test for weak instruments.

Table 4 reports the results of equation (1) for the whole sample when *risk assets* are used as dependent variable in columns (1)-(3) and non-performing loans in columns (4)-(6).

Insert Table 4 here

As this table indicates, the coefficients of all interest rates employed are positive and significant at the 1% level when *risk assets* are considered to be the dependent variable.

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[2] We also estimated the model using the Arellano-Bover/Blundel-Bond GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998), to tackle the potential endogeneity of bank characteristics. The results, available upon request, were virtually the same.

This result indicates that an increase in the level of interest rates results to an increase in the level of risk in banks' balance sheets. Furthermore, it is shown that risk assets are related positively with both size and efficiency whereas they are negatively related with capitalization. Finally, the coefficient of growth is positive and highly statistically significant in all cases.

When non-performing loans is employed as the dependent variable we obtain the opposite results. Specifically, irrespectively of the interest-rate chosen, the coefficients are negative and highly statistically significant. This is a rather puzzling result since it implies that as the interest rate decrease the non-performing loans increase. A plausible explanation for this seemingly puzzling result is that non-performing loans where gradually declining in the period under examination, after their soaring during the turbulent times of the mid to late 1990s for the vast majority of the countries in the sample. Furthermore, non-performing loans are negatively related with size and efficiency and positively related with capitalization. Finally there is a negative and statistically significant relationship between non-performing loans and growth.

As mentioned above, to examine whether our results are driven by the Russian banking sector which is over-represented in the sample we perform the analysis for the Russian banking sector alone and then in the other ten CEE countries. Unfortunately, the relatively small number of banks that operate in each one of these ten CEE economies does not allow us to conduct the analysis for each country separately. The results for the Russian banking sector and that from the other CEE countries are reported in Tables 5 and 6 respectively.

Insert Tables 5 and 6 here

In the case of the Russian Federation the coefficient estimates for the interest rate indicate a positive and highly statistically significant relationship with *risk assets*. In addition, *risk assets* are positively related to size and efficiency and negatively to efficiency, while the coefficient of growth is positive and statistically significant at the 1% level. Turning to *non-performing loans*, the results for the interest rate are of the opposite direction, i.e., there is a strong negative relationship with any of the interest rate variables employed. Size and efficiency have a negative effect on *non-performing loans* whereas capitalization a positive one. As previously, growth has a strong positive effect on this proxy of bank risk-taking behaviour.

The results obtained for the ten CEE countries are very much striking in difference compared to the ones for the Russian Federation. Specifically, none of the estimated coefficients of the control variables is statistically significant. This outcome may suggest that there are missing effects in this relationship, such as the presence of foreign banks in the domestic banking sector. If this is the case, one may argue that the effect of monetary policy on interest rates is rather weak. This negligible effect is further reinforced by the fact that the interest rates enter insignificantly to both measures of bank risk for the ten CEE economies. The implication of such finding is that the results for the whole sample are dictated by the Russian banking sector, characterized by a small number of foreign banks.

Our analysis up to now has focused on the relationship between measures of bank risk-taking and the level of interest rate. This approach was taken following the theoretical propositions of Dell' Ariccia and Marquez (2006) and Rajan (2006) who

argue that an expansionary monetary policy could still imply relatively high levels of interest rates. The lending channel literature focuses on changes in interest rates and how they affect changes in bank risk (e.g., Kashyap and Stein, 2000; Angeloni *et al.*, 2003). To check the robustness of our results, we examine the impact of changes in interest rates on changes in bank risk variables. To this end, we estimate the following equation:

$$(\Delta)r_{it} = a + \delta_i + \beta(\Delta)r_{it-1} + \gamma(\Delta)i_t + \sum_j \varepsilon_j(\Delta)B_{jit} + \zeta\ growth_t + \eta_t + u_{it} \quad (2)$$

where (Δ) denotes changes of the respective variable over the previous year. We employ the same control variables as in equation (1) and estimate equation (2) using the same econometric methodology, i.e., fixed effects IV. Tables 7, 8 and 9 report the results for the whole sample, the Russian banking sector and that of the rest ten CEE countries, respectively. The overall evidence for both bank risk-taking measures is that the effects of all three measures of interest rate changes as well as of the changes of the control variables are similar to the ones obtain when levels of the variables are used.

Insert Tables 7, 8 and 9 here

In the case of the Russian banking sector, as reported in table 8, the change of *risk assets* is positively related to the change in interest rate whereas the results for the control variables remain qualitatively similar as in equation (1). The same holds for the results when the change in *non-performing* loans is considered as the dependent variable: changes in interest rates have a negative sign. However, in this case the effects of

changes in efficiency and capitalization are insignificant. The results for ten CEE, reported in table 9, for both measures of bank risk the coefficients of both the interest rates and the control variables are statistically insignificant except that of growth.

4. Conclusions

In the aftermath of the financial crisis of 2007-2009 there has been a growing literature in an attempt to provide economic explanations of the roots of this phenomenon. It is by now well documented that financial markets deregulation, the creation of complex financial instruments, poor corporate governance, poor performance of rating agencies in several instances as well as the dramatic increase of shadow banking provided the seeds of the crisis. A second source is laid in the prolonged period of low levels of interest rates in market-based economies which led to considerable expansion of credit. Although deregulation of financial markets and the low interest rate environment was perceived by many economists and practitioners as a vehicle for accelerated growth and economic prosperity (see Shleifer, 2009), the severity of the crisis led many developed and emerging economies to a recession. Therefore, we eventually realized that the efficient functioning of the banking system depends crucially on the appropriate assessment of bank risk coupled with restrictions in bank risk-taking incentives.

During the 2000s the CEE economies went through further adjustments in order to complete their transition process. Following the Russian currency crisis in the spring of 1998 we observed a shift in the adopted monetary policy which is documented in a drastic decline in the short term and long term interest rates. This decline became obvious in particular in the period before the CEE economies joined European Union in May

2004. Although the levels of interest rates in CEE economies have not fallen to the extremely low levels that we observed in the U.S., the Eurozone and other developed countries, the purpose of this study is to examine the bank-risk taking behaviour in CEE countries using annual data for the period 1997-2011.

Our empirical results revealed a positive relationship between bank risk-taking, measured with risk assets to total assets, and various definitions of interest rates. However, when we employ non-performing loans as the dependent variable then the relationship of this bank risk measure and interest rates is negative. A plausible explanation for this seemingly puzzling result is that non-performing loans where gradually declining in the period under examination, after their soaring during the turbulent times of the mid to late 1990s for the vast majority of the countries in the sample. An increase in the (much lower than in the 1990s) interest rates was interpreted as a sign of a fast growing economy. Thus, this finding could reflect a gradual cleansing of bank loan portfolios during this period. Furthermore, when we examined the risk-taking channel of monetary policy we found out that this channel is mainly driven by the banking sector of the Russian Federation, since it is shown to be absent in the rest ten CEE economies.

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Figure 1.

Short term rates

Legend: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Russian Federation, Slovakia, Slovenia, Romania (right scale)

Figure 2.

Long term rates

Legend: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, Russian Federation (right scale)
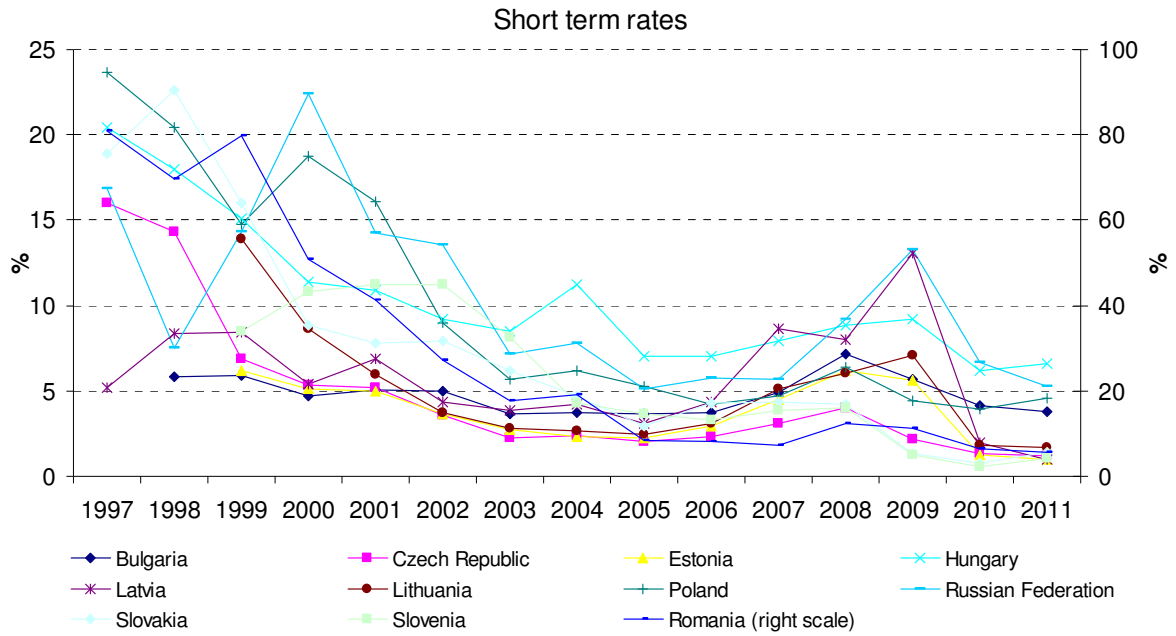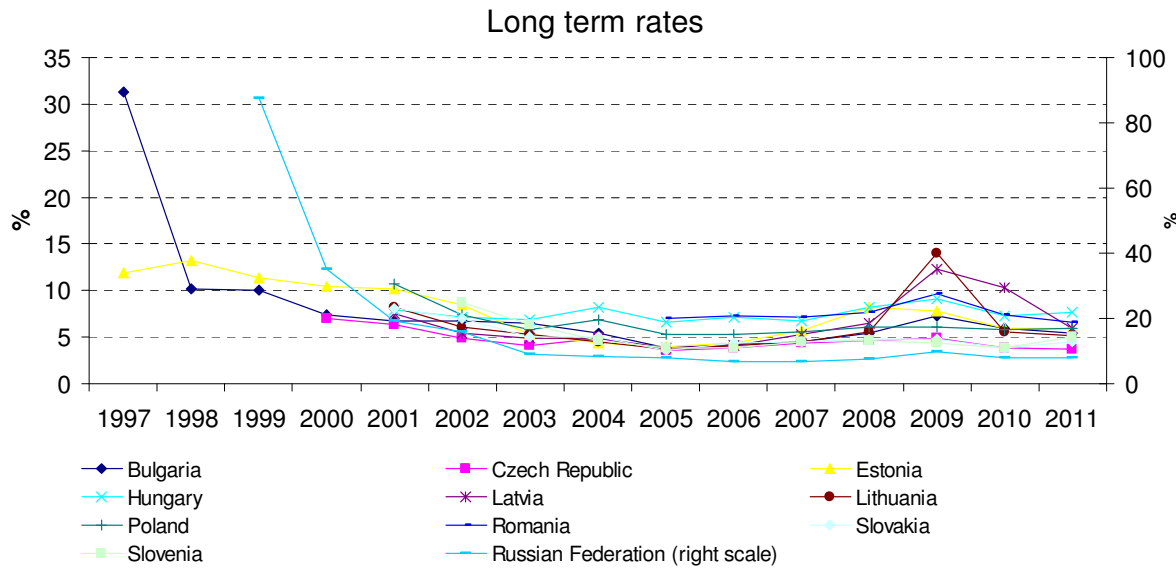
Table 1. Variables' definition and sources

Variable	Definition	Source
Risk assets	Ratio of total earning assets to total assets	Bankscope and authors' calculations
Non-performing loans	Ratio of non-performing loans to total loans	
Size	Natural logarithm of real (in 2000 prices) total assets	
Capitalization	Ratio of equity to total assets	
Profitability	Ratio of profits before taxes to total assets	
Efficiency	Ratio of total operating income to total expenses	
Growth	Real DP growth rate (y-o-y)	World Bank - WDI
Central bank rate	Annual average of monthly central bank interest rate	Datastream
Short term rate	Annual average of monthly 3-month money market rate	
Long term rate	Annual average of monthly government bond yield -long term- interest rate	

Table 2. Descriptive statistics

	Mean	St. deviation	Max	Min
Dependent variables				
Risk assets	0.862	0.114	1.000	0.005
Non-performing loans	0.074	0.092	1.000	0.000
Control variables				
Size	6.497	1.892	16.746	-1.450
Capitalization	0.214	0.165	0.999	-0.401
Profitability	0.021	0.029	0.292	-0.253
Efficiency	0.980	0.375	3.726	-0.501
Growth	0.038	0.050	0.122	-0.179
Central bank rate	0.107	0.062	0.645	0.002
Short term rate	0.083	0.064	0.808	0.005
Long term rate	0.082	0.055	0.873	0.035

Notes: For variables' definition, see table 1. Unbalanced panel for the 1997-2011 period. Countries included in the sample are: Bulgaria (25 banks), Czech Republic (28 banks), Estonia (3 banks), Hungary (29 banks), Latvia (12 banks), Lithuania (6 banks), Poland (52 banks), Romania (27 banks), Russian Federation (1,065 banks), Slovak Republic (18 banks), Slovenia (21 banks).

Table 3. Correlation matrix

	Risk assets	Non-performing loans	Size	Capitalization	Profitability $_{t-1}$	Efficiency	Growth	Central bank rate	Short term rate	Long term rate
Risk assets	1									
Non-performing loans	-0.035	1								
Size	0.002	0.025	1							
Capitalization	-0.128	0.248	-0.002	1						
Profitability $_{t-1}$	0.001	0.044	0.024	0.199	1					
Efficiency	0.010	0.156	0.006	0.272	0.306	1				
Growth	-0.017	-0.040	0.009	-0.021	-0.038	0.071	1			
Central bank rate	-0.137	-0.010	0.028	0.095	0.093	0.092	-0.022	1		
Short term rate	-0.055	-0.009	0.008	0.061	0.106	0.039	-0.703	0.568	1	
Long term rate	-0.134	0.046	0.022	0.071	-0.021	-0.046	-0.193	0.776	0.466	1

Notes: For variables' definition, see table 1.

Table 4. Whole sample – Dynamic panel fixed effects IV estimation

	Risk assets			Non-performing loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable	0.263***	0.242***	0.260***	0.357***	0.373***	0.361***
	(7.519)	(7.044)	(7.318)	(4.266)	(4.736)	(4.596)
Size	0.019***	0.010**	0.007	-0.028***	-0.014***	-0.007**
	(3.373)	(2.140)	(1.299)	(-6.515)	(-4.030)	(-2.198)
Capitalization	-0.070***	-0.085***	-0.097***	0.058**	0.079***	0.102***
	(-2.776)	(-3.554)	(-3.968)	(2.191)	(3.015)	(4.053)
Profitability $_{t-1}$	0.014	-0.029	0.080	-0.243*	-0.144	-0.276***
	(0.224)	(-0.505)	(1.165)	(-1.905)	(-1.178)	(-2.644)
Efficiency	0.018***	0.020***	0.024***	-0.012**	-0.015***	-0.020***
	(3.762)	(4.333)	(4.754)	(-2.337)	(-2.726)	(-3.880)
Growth	0.050**	0.171***	0.092**	-0.123***	-0.355***	-0.152***
	(2.573)	(5.374)	(2.517)	(-8.041)	(-7.990)	(-4.456)
Central bank interest rate	0.622***			-0.958***		
	(7.512)			(-9.574)		
Short term rate		0.372***			-0.671***	
		(6.382)			(-6.441)	
Long term rate			0.503***			-0.605***
			(2.783)			(-3.316)
Diagnostics						
Wald test	12.575	10.809	6.391	17.927	16.262	7.650
# of Obs.	5,335	5,405	5,163	4,731	4,771	4,635
# of Cross-sections	1,014	1,024	1,000	935	944	927
LM stat (underidentification test)	311.33	150.91	38.48	267.32	107.63	27.73
F stat (weak identification test)	670.12	278.11	51.54	546.03	166.77	36.96

Notes: Dependent variable is risk assets in columns (1) – (3) and non-performing loans in columns (4) – (6). For variable definitions and sources, see table 1. Unbalanced panel, sample period 1997 – 2011. Estimation method is panel fixed effects IV with endogenous interest rate, instrumented with the relevant euro area interest rate, and robust standard errors clustered by bank. A full set of time dummies is included in all regressions. *z*-statistics are reported in parentheses. One (*), two (**) and three (***) asterisks denote significance at respectively the 10%, 5% and 1% level.

Table 5. Russian Federation – Dynamic panel fixed effects IV estimation

	Risk assets			Non-performing loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable	0.261*** (7.104)	0.236*** (6.440)	0.271*** (7.360)	0.256*** (2.943)	0.281*** (3.388)	0.348*** (3.784)
Size	0.023*** (3.281)	0.013** (2.063)	0.010 (1.593)	-0.030*** (-6.181)	-0.014*** (-4.389)	-0.008** (-2.294)
Capitalization	-0.061** (-2.306)	-0.076*** (-3.006)	-0.101*** (-3.934)	0.049* (1.752)	0.069*** (2.639)	0.111*** (4.172)
Profitability $_{t-1}$	0.095 (1.299)	0.043 (0.710)	0.159** (2.054)	-0.236** (-2.032)	-0.179* (-1.918)	-0.334*** (-2.728)
Efficiency	0.015*** (2.643)	0.013** (2.493)	0.027*** (5.028)	-0.007 (-1.119)	-0.004 (-0.788)	-0.025*** (-4.298)
Growth	0.081*** (3.687)	0.337*** (7.372)	0.109** (2.569)	-0.138*** (-7.568)	-0.550*** (-11.997)	-0.192*** (-4.310)
Central bank interest rate	0.805*** (8.118)			-1.291*** (-11.245)		
Short term rate		0.689*** (7.863)			-1.099*** (-11.748)	
Long term rate			0.542** (2.511)			-0.911*** (-3.688)
Diagnostics						
Wald test	11.437	12.490	7.603	17.272	18.443	7.067
# of Obs.	4,337	4,346	4,337	4,141	4,150	4,141
# of Cross-sections	875	878	875	850	853	850
LM stat (underidentification test)	265.54	455.76	20.86	267.22	413.89	17.00
F stat (weak identification test)	567.58	1335.75	29.80	589.77	1163.38	23.23

Notes: Dependent variable is risk assets in columns (1) – (3) and non-performing loans in columns (4) – (6). For variable definitions and sources, see table 1. Unbalanced panel, sample period 1997 – 2011. Estimation method is panel fixed effects IV with endogenous interest rate, instrumented with the relevant euro area interest rate, and robust standard errors clustered by bank. A full set of time dummies is included in all regressions. *z*-statistics are reported in parentheses. One (*), two (**) and three (***) asterisks denote significance at respectively the 10%, 5% and 1% level.

Table 6. All countries except Russian Federation – Dynamic panel fixed effects IV estimation

	Risk assets			Non-performing loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable	0.370***	0.358***	0.218**	0.501***	0.462***	0.388***
	(4.118)	(4.232)	(2.517)	(7.326)	(7.404)	(4.548)
Size	0.000	0.000	-0.004	-0.006	-0.013*	-0.004
	(0.026)	(0.039)	(-0.412)	(-0.806)	(-1.919)	(-0.718)
Capitalization	-0.046	-0.031	-0.002	-0.053	-0.072	-0.076
	(-0.597)	(-0.422)	(-0.044)	(-0.651)	(-0.758)	(-0.935)
Profitability $_{t-1}$	-0.050	-0.068	-0.239	-0.751**	-0.410	-0.123
	(-0.392)	(-0.488)	(-1.604)	(-2.128)	(-1.021)	(-0.430)
Efficiency	0.002	-0.001	-0.001	0.012	-0.006	0.011
	(0.141)	(-0.038)	(-0.100)	(0.938)	(-0.243)	(0.673)
Growth	-0.086	-0.098	-0.095	-0.199***	-0.200***	-0.060
	(-1.224)	(-1.491)	(-0.951)	(-5.589)	(-4.502)	(-0.857)
Central bank interest rate	0.028			0.217		
	(0.236)			(1.547)		
Short term rate		-0.026			0.043	
		(-0.320)			(0.288)	
Long term rate			-0.053			0.722*
			(-0.166)			(1.957)
Diagnostics						
Wald test	5.819	4.584	1.833	77.249	31.477	7.622
# of Obs.	998	1,059	826	590	621	494
# of Cross-sections	139	146	125	85	91	77
LM stat (underidentification test)	51.08	39.51	59.05	32.78	17.41	37.69
F stat (weak identification test)	116.53	80.10	321.07	62.51	29.16	178.23

Notes: Dependent variable is risk assets in columns (1) – (3) and non-performing loans in columns (4) – (6). For variable definitions and sources, see table 1. Unbalanced panel, sample period 1997 – 2011. Estimation method is panel fixed effects IV with endogenous interest rate, instrumented with the relevant euro area interest rate, and robust standard errors clustered by bank. A full set of time dummies is included in all regressions. *z*-statistics are reported in parentheses. One (*), two (**) and three (***) asterisks denote significance at respectively the 10%, 5% and 1% level.

Table 7. Whole sample – Variables in Differences
Dynamic panel fixed effects IV estimation

	(Δ)Risk assets			(Δ)Non-performing loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable	-0.394***	-0.402***	-0.400***	-0.378***	-0.371***	-0.370***
	(-10.926)	(-11.306)	(-10.750)	(-6.717)	(-6.541)	(-6.182)
(Δ)Size	0.013	0.012	0.011	-0.043***	-0.041***	-0.043***
	(1.039)	(0.990)	(0.881)	(-8.108)	(-7.849)	(-7.799)
(Δ)Capitalization	-0.101***	-0.094***	-0.099***	0.013	0.003	0.003
	(-3.757)	(-3.708)	(-3.832)	(0.576)	(0.127)	(0.142)
(Δ)Profitability $_{t-1}$	-0.033	-0.027	-0.024	-0.108	-0.101	-0.131
	(-0.690)	(-0.557)	(-0.457)	(-1.137)	(-1.134)	(-1.333)
(Δ)Efficiency	0.012**	0.014**	0.012**	0.009	0.007	0.006
	(2.001)	(2.264)	(2.025)	(1.344)	(0.985)	(0.907)
Growth	0.044	0.117***	0.119**	0.035	-0.080***	-0.095**
	(1.247)	(3.747)	(2.431)	(1.040)	(-3.484)	(-2.023)
(Δ)Central bank interest rate	0.207			0.133		
	(0.682)			(0.422)		
(Δ)Short term rate		0.281***			-0.306***	
		(7.295)			(-9.243)	
(Δ)Long term rate			0.447**			-0.616***
			(2.262)			(-3.117)
Diagnostics						
Wald test	9.003	11.303	8.787	10.317	14.177	8.199
# of Obs.	4,210	4,263	4,061	3,682	3,706	3,600
# of Cross-sections	946	950	939	871	873	866
LM stat (underidentification test)	120.28	723.25	137.43	128.31	673.32	135.60
F stat (weak identification test)	117.98	4230.87	152.71	99.824	6142.67	149.24

Notes: Dependent variable is the change in risk assets from previous period (year) in columns (1) – (3) and the change in non-performing loans from previous period (year) in columns (4) – (6). For variable definitions and sources, see table 1. Unbalanced panel, sample period 1997 – 2011. Estimation method is panel fixed effects IV with endogenous change in interest rate, instrumented with the relevant change in euro area interest rate, and robust standard errors clustered by bank. A full set of time dummies is included in all regressions. *z*-statistics are reported in parentheses. One (*), two (**) and three

(***) asterisks denote significance at respectively the 10%, 5% and 1% level.

Table 8. Russian Federation – Variables in Differences
Dynamic panel fixed effects IV estimation

	(Δ)Risk assets			(Δ)Non-performing loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable	-0.382***	-0.399***	-0.381***	-0.412***	-0.426***	-0.414***
	(-10.292)	(-10.879)	(-10.211)	(-7.212)	(-8.050)	(-7.416)
(Δ)Size	0.012	0.011	0.011	-0.044***	-0.043***	-0.043***
	(0.840)	(0.775)	(0.808)	(-7.943)	(-7.809)	(-7.707)
(Δ)Capitalization	-0.109***	-0.097***	-0.104***	0.004	-0.001	0.002
	(-4.032)	(-3.738)	(-3.906)	(0.152)	(-0.039)	(0.093)
(Δ)Profitability $_{t-1}$	-0.048	-0.067	-0.030	-0.090	-0.064	-0.104
	(-0.917)	(-1.277)	(-0.567)	(-0.914)	(-0.709)	(-1.060)
(Δ)Efficiency	0.012**	0.012**	0.013**	0.009	0.010	0.008
	(2.025)	(2.047)	(2.131)	(1.318)	(1.306)	(1.147)
Growth	0.053	0.176***	0.164***	0.002	-0.092***	-0.119**
	(1.273)	(5.047)	(2.966)	(0.056)	(-3.641)	(-2.230)
(Δ)Central bank interest rate	0.063			-0.367		
	(0.225)			(-1.100)		
(Δ)Short term rate		0.341***			-0.341***	
		(8.799)			(-10.381)	
(Δ)Long term rate			0.550***			-0.749***
			(2.578)			(-3.490)
Diagnostics						
Wald test	8.304	11.258	8.112	11.903	20.170	10.726
# of Obs.	3,383	3,386	3,383	3,200	3,203	3,200
# of Cross-sections	828	828	828	801	801	801
LM stat (underidentification test)	161.91	657.82	103.11	162.10	632.07	117.28
F stat (weak identification test)	328.41	14173.01	115.47	308.37	17958.81	135.29

Notes: Dependent variable is the change in risk assets from previous period (year) in columns (1) – (3) and the change in non-performing loans from previous period (year) in columns (4) – (6). For variable definitions and sources, see table 1. Unbalanced panel, sample period 1997 – 2011. Estimation method is panel fixed effects IV with endogenous change in interest rate, instrumented with the relevant change in euro area interest rate, and robust standard errors clustered by bank. A full set of time dummies is included in all regressions. *z*-statistics are reported in parentheses. One (*), two (**) and three (***) asterisks denote significance at respectively the 10%, 5% and 1% level.

Table 9. All countries except Russian Federation – Variables in Differences
- Dynamic panel fixed effects IV estimation

	(Δ)Risk assets			(Δ)Non-performing loans		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged dependent variable	-0.448***	-0.410***	-0.481***	-0.220*	-0.114*	-0.062
	(-4.858)	(-4.820)	(-4.935)	(-1.856)	(-1.865)	(-0.966)
(Δ)Size	0.028	0.032	0.025	-0.027	-0.036**	-0.036
	(1.002)	(1.149)	(0.763)	(-1.395)	(-1.986)	(-1.524)
(Δ)Capitalization	0.013	0.024	0.085	-0.088	-0.138	-0.132
	(0.119)	(0.206)	(0.869)	(-0.483)	(-0.788)	(-0.616)
(Δ)Profitability $_{t-1}$	0.025	0.125	0.133	-0.199	-0.130	-0.387
	(0.181)	(0.857)	(0.671)	(-1.121)	(-0.825)	(-1.087)
(Δ)Efficiency	-0.007	-0.012	-0.015	0.012	0.002	0.013
	(-0.541)	(-0.769)	(-0.916)	(0.544)	(0.093)	(0.690)
Growth	-0.131	-0.063	-0.183**	-0.290**	-0.116*	0.072
	(-1.257)	(-0.855)	(-2.560)	(-2.279)	(-1.907)	(0.619)
(Δ)Central bank interest rate	0.070			1.474**		
	(0.138)			(2.062)		
(Δ)Short term rate		-0.389			0.272	
		(-1.442)			(1.276)	
(Δ)Long term rate			-0.493			1.253*
			(-1.033)			(1.802)
Diagnostics						
Wald test	5.919	3.948	3.432	3.653	4.437	2175.829
# of Obs.	827	877	678	482	503	400
# of Cross-sections	118	122	111	70	72	65
LM stat (underidentification test)	39.32	42.26	50.50	19.17	20.91	23.95
F stat (weak identification test)	76.798	85.200	110.94	34.25	32.74	41.80

Notes: Dependent variable is the change in risk assets from previous period (year) in columns (1) – (3) and the change in non-performing loans from previous period (year) in columns (4) – (6). For variable definitions and sources, see table 1. Unbalanced panel, sample period 1997 – 2011. Estimation method is panel fixed effects IV with endogenous change in interest rate, instrumented with the relevant change in euro area interest rate, and robust standard errors clustered by bank. A full set of time dummies is included in all regressions. *z*-statistics are reported in parentheses. One (*), two (**) and three (***) asterisks denote significance at respectively the 10%, 5% and 1% level.