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The risk-taking channel of monetary policy in Macedonia: evidence from credit registry data[1]

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[1] This paper was prepared for the meeting. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

The Risk-Taking Channel of Monetary Policy in Macedonia: Evidence from Credit Registry Data

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Abstract

This paper is the first effort to empirically investigate the potential existence of the monetary policy risk-taking channel in Macedonia. For this purpose we use a rather unique and confidential database of corporate loans, taken from the Credit Registry of the National bank, which is complemented with data from banks' balance sheets. By using pooled OLS on semi-annual data for the 2010-2017 period, our study points to an inverse relationship between the policy rate and the ex-ante risk rating assigned by the banks, a finding that is supportive to the existence of the risk-taking channel. The results prove to be robust after controlling for several bank, loan and time specific variables. We also test for possible difference in the risk-taking by banks conditioned on the leverage level, but the results do not point to a significant difference in the reaction.

Keywords: Monetary policy, risk-taking, ex-ante credit risk, leverage, POLS

JEL classification: E43, E44, E52, G21

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Contents

1. Introduction

The latest global crisis revisited many of the previously conventional economic paradigms, including those related to monetary policy transmission. The main "novelty" in this area was the increasing focus on the link between policy rates and the quality of the credits extended by banks, and hence the risk undertaken. In a low interest rate environment, the incentive of banks to assume more risk in their balance sheets rises. They lax their lending standards or start a yield searching path, thus shifting from safe to riskier assets.

Borio and Zhu (2008) noted that prior to the crisis not sufficient emphasize was put on understanding the link "between monetary policy and perceptions and pricing of risk by economic agents", what they mark as monetary policy "risk-taking channel". They argue that the central bank through the changes in its policy reaction can affect risk-taking, by imposing changes on risk perceptions and tolerance to risk.

In this paper, we attempt to explore the risk-taking channel of monetary policy in Macedonia. For this purpose, we employ micro data on individual corporate loans, utilizing the confidential database from the Credit Registry of the Central bank. We study the linkage between the effective interest rate of the central bank and the so-called ex-ante risk-taking by the banks, while controlling for several loan, bank and time specific variables. To our best knowledge, this is a first attempt to estimate the risk-taking monetary police channel for Macedonia, and a first attempt to use the rich data set from the Credit Registry for a more comprehensive empirical investigation. Hence the paper has two important contributions, the first one related to the specifics of the topic, which has not been explored before, and the second related to the first-time utilisation of a unique database.

The paper is organised as follows. Section 2 briefly discusses the literature on risk-taking monetary policy channel, with focus on the empirical literature on the issue, only. Section 3 reflects on the model specification, while Section 4 explains the data used. Section 5 refers to the chosen empirical methodology and discusses the main findings. Section 6 presents the results of several robustness checks, and finally, Section 7 concludes.

2. Related literature

Despite the rising policy interest on the risk-taking channel, the empirical literature on the issue is rather new and scant. It does not come as surprise, given the fact that the discussion on the monetary policy risk-taking channel, particularly came to the fore after the outburst of the global crisis. In addition, the estimate of this channel often requires granular micro, or survey data, which has not been easily and readily available across countries.

Gaggl et al. (2010) explored the risk-taking channel in Austria, using a unique dataset that matches lenders and borrowers, accounting for a major part of Austrian business lending. Data is taken from the annual balance sheets and income statements of companies, as well as from the Credit Registry in the Austrian central bank. The research does support the risk-taking channel for the Austrian case.

López et al. (2010) estimate the monetary policy risk-taking channel on the case of Columbia, using database with a quarterly frequency for more than two million loans for the period 2000-2008. By using a duration model they find a significant link between low interest rates and banks' risk-taking based on evidence from Colombia. Lower interest rates raise the probability of default on new loans, but reduce that on outstanding loans.

Dell'Ariccia et al. (2013), which our paper is closely related to, study the link between the short term interest rate and risk-taking, using confidential data on individual U.S. banks' loan rating from the Federal Reserve's Survey of Terms of Business lending. In the paper, the authors explore the link between the ex-ante risk rating of the banks and the short-term policy rate. They employ panel estimate on a loan level data, on a stratified sample of about 400 banks, over the 1997-2011 period, with a quarterly frequency. They reveal a negative relation between risk rating and the interest rate, providing strong evidence that low short-term interest rate environment increases bank risk-taking. They also provide evidence that this effect is strongly dependant on the level of bank's capitalization, with the effect of risk-taking being more pronounced for well capitalized banks.

Bonfim and Soares (2013) use the data on loans to non-financial corporations from the Portuguese Credit Register for the 1999-2007 period. Credit registry data is used, and firm-bank relationship in a given quarter is the main unit of observation. The authors use discrete choice models to assess the probability of borrowers with bad credit history or no credit history being granted loans. The approach also allows to test whether banks grant more loans to risky borrowers, when interest rates are lower. The results from the discrete choice models show that lower interest rates increase the probability of bank granting a loan to a borrower with recent bad credit history, and the risk-taking is more evident in smaller banks. While ex-ante risk is higher, the survival analysis does not confirm the increase in risk-taking ex-post, i.e. over the life of the loan.

Jiménez et al. (2014) explore the existence of the monetary policy risk-taking in Spain by using a comprehensive database from the credit registry of Spain. The authors assess the monthly information on loan application, from 2002 until 2009, matched with the resulting granting loans and the main bank and firm-level information. They use a two-stage model, in which they explain the monthly granting in the first stage and the actual outcome in the second stage, while controlling for both observed and unobserved, time varying, firm and bank heterogeneity. They infer that a lower overnight interest rate induces banks that are less capitalized to grant more loans to ex-ante risky firms and to extend larger loan volumes with less of collateral, but with a higher ex-post probability of default.

Karapetyan A. (2016) explores the risk-taking channel in Norway, by using a unique dataset of corporate borrowers. Within the model, data on newly extended loans or the change in the total credit exposure between the bank and the firm is used as dependant variable, while the risk rating of the firm, policy rate and several bank specific and macro variables are employed as control variables. The paper finds that a lower benchmark interest rate induces the bank to grant more loans to risky firms.

3. Model specification

In the paper, we follow the model of Dell'Ariccia et al., where authors argue that the policy rate affects banks' deposit rates and bank motivation for risk-taking through two different channels. First, the so-called pass-through effect exists, when the increase of the policy rate affects deposit rates, and then lending rates. Hence, if the bank is successful in managing the credit portfolio, the reward for the success is higher. Therefore, it is highly motivated to monitor the quality of the credit portfolio closely and to maximize the return on it. The second channel is the classical risk-shifting, when due to the increase of the policy rate, costs of funding increase as well, reducing banks' profit margins (other things equal) in case of success and hence reduces its incentive to monitor its portfolio. They also emphasize that the relative size of the two channels is conditioned on the bank leverage, or in other words on bank's capitalization. The risk-shifting effect is high for fully leveraged banks, and it descends to zero for a bank fully funded with capital. In the model that they use, the first effect prevails, and the main expected outcome of the model is to find a negative relationship between banks' risk-taking and the policy rate of the central bank. When the policy rate is low or declining, banks assume more ex-ante credit risk, and vice versa. Another important, but a very strong assumption in the model is that monetary policy changes, i.e. changes in the policy rate, are fully exogenous to the banks' risk-taking.

Following Dell'Ariccia et al., our main empirical model specification takes the following form:

$$LRR_{kit}=\lambda_i+\beta r_t+\eta K_{it}+\mu L_{kit}+\Omega B_{it}+\varepsilon_{kit}$$

where, LRR_{kit} is the loan risk rating of loan k, extended by bank i during the semester t, and this is the measure used in the model specification to gauge the ex-ante risk rating that the bank assigns to the specific loan party. λ_i are bank-specific effects, r_t is the Central bank's effective interest rate, K_{it} refers to a measure of bank's capitalisation at the end of time t, L_{kit} embeds a set of loan specific variables (size, maturity, indicator of collateral backing), and B_{it} refers to a set of bank specific variables at the end of time, other than capitalisation (in essence it includes total assets, as a measure of bank's size). The main coefficient of interest, which is the essence of our research question, is the β coefficient, which is expected to be negative and hence, indicative for a presence of risk-taking channel in Macedonia.

Furthermore, we proceed with the second block of estimation, where an interaction term between policy rate and the capitalisation measure is employed. The inclusion of the interaction term aims to test the hypothesis that low interest rates do increase banks' risk-taking, especially for banks with relatively high capital, i.e. low leverage. To support this notion the expected sign of the coefficient ν in front of the interaction terms is expected to be negative.

$$LRR_{kit}=\lambda_i+\beta r_t+\eta K_{it}+\nu K_{it}r_t+\mu L_{kit}+\Omega B_{it}+\varepsilon_{kit}$$

4. Data

4.1. Credit Registry of the National Bank of the Republic of Macedonia

Given that the Credit Registry of the National bank is the main data source, in the paper we provide a separate section on its main features. The National Bank of the Republic of Macedonia is legally obliged to establish and maintain a Credit Registry of domestically founded banks' and saving houses' credit exposures to legal entities and individuals. This Credit Registry constitutes an electronic base of data and information on the credit exposures of deposit-taking financial institutions to their clients[3], the main purpose of which is to contribute to improvement in the loan quality and the maintenance of the stability of the banking system.

The Credit Registry of the National Bank was established in 1998. Ever since its establishment, the Credit Registry has undergone several changes, with some more substantial improvements taking place in 2008/2009. Hence, when performing any data series analysis, 2009/2010 is usually taken as a starting point, as for consistency of data employed to be ensured. Since 2009, deposit-taking financial institutions are obliged to submit data to Credit Registry for any individual contract made with clients (legal entities and individuals), that is (even potentially[4]) generating exposure to credit risk, with a monthly frequency. Some minimum thresholds in the amount of individual credit contracts are imposed when submitting data to Credit Registry.

4.2. Dataset and definition of variables

The dataset used in our empirical model covers the seven largest banks in the country (out of 15[5]), with a market share on the corporate credit segment, varying between 87-89%. We use data with a semi-annual frequency over the period 2010H1-2017H1.

Loan specific variables

We use data on individual new loans[6] extended to non-financial companies during each half-year of the time period covered. New loans extended in a process of restructuring of previously approved loans (when replacing old loan with a new one) are also included in the study. Due to the huge number of loans extended in relatively small amounts, we have reduced our sample, focusing only on loans with individual amounts exceeding the mean value calculated for each analysed period.

[3] Banks and saving houses are the only functional (and allowed by Law) deposit-taking financial institutions in the Republic of Macedonia.

[4] Off-balance sheet activities, e.g. irrevocable credit commitments and overdrafts, uncovered guarantees and letters of credit, etc.

[5] There were 18 banks in 2010.

[6] For the sake of simplicity, we will be using the term "loan" throughout the remaining of the paper. However, besides classical agreements for loans, data on newly concluded leasing contracts and factoring and forfaiting agreements made with banks' clients are covered as well (although having negligibly small amounts), as such data is also reported by our banks. Additionally, off-balance sheet activities with non-financial companies, which could potentially generate credit risk to the bank, are also taken into account.

Risk rating is the risk category assigned[7] by the bank to a given loan, as reported in the Credit Registry of the National Bank of the Republic of Macedonia. According to regulation, when classifying any credit exposure to a certain risk category, the bank should take into account the creditworthiness of the client, its regularity in debts repayment and the collateral provided for the particular credit exposure. Thus, the loan is classified in one of the five risk categories, as prescribed in the regulation, from A (having the lowest level of riskiness) up to E (having the highest level of riskiness). For the purpose of our study, the risk categories are translated into corresponding numerical values, thus obtaining a discrete index that increases with higher perceived risk (A=1, B=2, C=3, D=4 and E=5)[8]. The risk categories assigned to loans extended in each half-year period covered in the analysis refer to loans classification made as of the end of the respective half-year period. As such, these risk categories might be considered as proper ex-ante risk ratings assigned by the bank to a given new loan.

We also consider several control variables, pertaining to some of the basic loan characteristics: the size of the loan (measured in logs), the original maturity of the loan (in years), and dummy variable on whether or not the loan is secured by collateral (takes value 1 for secured loans, and 0 otherwise). For the purpose of our study, loans with co-credit borrower or where endorser is appointed and/or are secured by a bill of exchange only (and none of the other types of collateral) are considered as unsecured.

Bank specific variables

We complement data from the Credit Registry with balance sheet information[9] on banks' total assets (measured in logs) and their capital positions. As for the latter, regulatory capital ratio is employed (the Tier 1 ratio), calculated as a share of banks' Tier 1 regulatory capital in risk weighted assets[10]. Alternatively, in some of the specifications, the capitalization ratio is used- calculated as a share of banks' equity and reserves in total assets.

[7] More precisely, banks do not report the risk category of a particular loan, but the percentage of impairment losses determined for that particular loan. Depending on the reported percentage of impairment losses, the risk category of each particular loan can be obtained (from A to E), as prescribed in the regulation on credit risk management.

[8] According to our regulation, loans classified in D and E are considered as non-performing, as well as loans classified in risk category C, which, on any basis, have not been collected in more than 90 days from the date of maturity. Potentially useful information with reference to our study is the fact that banks are obliged to classify restructured loans, at least, in risk category C, or even higher (D or E). The regulation on credit risk management provides a list of criteria upon which, individual credit exposures should be classified by banks, in the respective risk category (Decision on credit risk management, available at: http://www.nbrm.mk/ns-newsarticle-decision_credit_risk_2013.nspx.

[9] As reported by banks according to Decision on submitting data on the accounts balances and value entries in banks' general ledger and financial statements (Official Gazette of the Republic of Macedonia No. 126/11), available at (in Macedonian only): http://www.nbrm.mk/ns-newsarticle-odluka_za_dostavuvanjie_podatotsi_za_sostojbata_i_promietot_na_smietkitie_od_smietkovniot_plan_na_bankitie_i_finansiskitie_izvieshtai.nspx.

[10] As reported by banks according to Decision on the methodology for determining the capital adequacy (Official Gazette of the Republic of Macedonia No. 47/12, 50/13, 71/14, 223/15, 218/16), available at: http://www.nbrm.mk/ns-newsarticle-decision_capital_adequacy_2012.nspx.

Time specific variables

Within the study, the main policy rate of the central bank should be used as a relevant short-term rate in the economy. In the Macedonian case, the interest rate on the one-month Central Bank bills (CB bills) is the key rate, which reflects the monetary policy stance. Yet, in April 2012, the portfolio of monetary instruments was enriched with the introduction of the overnight deposits and seven-day deposits that are also relevant for banks' decisions. Hence, for the purpose of the study, until April 2012 we do use the CB bills rate, but as of April 2012 we calculate an effective interest rate. It is a volume-weighted average of the interest rates on all three instruments.

In some of the specifications we also try to control for the specifics of the economy, throughout the time horizon used in the estimates. For this purpose we use a variable which should broadly capture these effects, i.e. the real GDP growth.

5. Methodology and empirical results

In this section we present the methodology used for the estimation and the empirical findings from the estimated model. Our main interest is focused on the reaction of the ex-ante credit rating of newly granted loans to the changes in the key policy rate. This will allow us to draw conclusions on whether a new, risk-taking channel of monetary policy exists in Macedonia, apart from the more traditional channels.

In the search for the appropriate estimator we have to take into account the specifics of our sample. Namely, as mentioned previously, we are dealing with a dataset which consists of time-specific, bank-specific and loan-specific variables. Although the time and bank-specific variables can be dynamically tracked, this is not the case with the loan-specific variables (including most importantly the dependent variable) because each new loan occurs only once, at the date of approval and is not followed afterwards. By construction, this means that there are many loans per period, per bank, which makes our dataset non-longitudinal, so typical panel analysis exploiting the time dimension, cannot be conducted. However, given that the research question that we try to address does not require use of any time series operators or autoregressive panel models, we can still use static panel models even on the series of cross-sections in our sample. The reason why we opt to follow this approach is in order to control for the bank-level fixed effects and thus to alleviate the potential omitted variable bias. Namely, it is presumable that there are some fixed effects, specific to each individual bank that impact the bank's risk behaviour, and which are not captured in the fully unrestricted model. This is also known as unobserved heterogeneity, which is one of the many sources of endogeneity. However, by applying this estimator, the diagnostics tests show that the model suffers from considerable heteroscedasticity which influences the inference. Due to the fact that our number of clusters is very small (in our case we have only 7 banks and 15 separate time periods), we cannot use cluster robust standard errors to correct for the problem of heteroscedasticity of the error structure. Namely, in the case of few clusters, cluster-robust standard errors are no longer valid, as their derivation relies on asymptotic results. Not just that this would not be an improvement over the non-robust standard errors, in fact it might make matters worse. For that reason, we opt to using the pooled OLS

(POLS) estimator as an alternative approach, with heteroscedasticity-consistent standard errors. In addition, mimicking the fixed effects estimator, a full set of bank dummy variables is also included in the model to control for the unobserved bank-level heterogeneity. We expect this to capture some of the effects from omitted variables that vary across banks, but not time. The inclusion of bank dummy variables is also supported by the joint significance of the fixed effects in the standard fixed-effects model and by the significance of the general F-test in the OLS regressions.

Loan risk ratings, the CB bills rate and bank and loan characteristics

Dependent variable: risk rating of individual loans Table 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CB bills rate	-0.015***	-0.012***	-0.012***	-0.012***	-0.012***	-0.013***	-0.011**
	[0.002]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Tier 1 capital ratio		0.266**	0.264**	0.264**	0.253**	0.246**	0.316**
		[0.123]	[0.123]	[0.123]	[0.123]	[0.123]	[0.127]
Bank size		0.014	0.014	0.014	0.013	0.011	0.023
		[0.023]	[0.023]	[0.023]	[0.023]	[0.023]	[0.023]
Loan size			0.003			-0.002	-0.002
			[0.003]			[0.003]	[0.003]
Dummy for loans with collateral				-0.004		-0.012**	-0.011*
				[0.006]		[0.006]	[0.006]
Loan maturity					0.010***	0.010***	0.010***
					[0.001]	[0.001]	[0.001]
GDP growth							0.007***
							[0.001]
Constant	1.185***	0.874**	0.865**	0.894**	0.888**	0.957**	0.693
	[0.010]	[0.438]	[0.438]	[0.437]	[0.439]	[0.437]	[0.448]
Observations	29,074	29,074	29,074	29,074	29,074	29,074	29,074
Number of banks	7	7	7	7	7	7	7
Bank dummy variables	YES	YES	YES	YES	YES	YES	YES
R-squared	0.137	0.137	0.137	0.137	0.140	0.140	0.140

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

In line with the expectations, the results show that the short-term interest rate has a negative and significant effect on ex-ante bank risk-taking, which is a finding akin to studies in other countries (Dell'Ariccia et al. (2013), Ioannidou et al. (2014), Jimenez et al. (2014)). This provides evidence of a potential risk-taking channel of the monetary policy in Macedonia, indicating that monetary policy actions may affect not only the quantity, but also the quality of banks' lending. As it can be seen from the table, the interest rate maintains its significant negative effect even after controlling for bank-specific (column 2) and loan-specific variables (columns 3-6). Moreover, the coefficient on interest rate is fairly stable in magnitude and varies between -0.011 and -0.015. The estimation results in column 2, where we control for the different bank characteristics suggest that a reduction of the interest rate of one standard deviation (1.025) is associated with an increase in loan risk ratings of 0.012. However, compared with the standard deviation of loan risk ratings of 0.46, albeit statistically significant, this appears to be a very small economic effect.

In order to extend the analysis of the relationship between monetary policy and bank risk-taking, in columns 3-6 we control for the distinct loan characteristics that are most likely to affect risk ratings, such as loan amount, maturity and collateral, by including them first successively, and then jointly in the estimation. The results show that the economic and statistical significance of the interest rate in the specification using the full set of independent variables (column 6) is very similar to the estimation which controlled only for the bank-specific variables. The effect of the other bank-specific variables on the risk rating is also similar. Namely, we find that the coefficient on Tier 1 capital ratio is positive and significant in all regressions, implying that the increase in the level of capitalization of banks leads to increase in their risk appetite. The literature offers contradictory results as to the effects of bank capital on banks' risk appetite. On the one hand, some authors find that better capitalized banks are safer and have a lower risk exposure (Dell'Ariccia et al., 2013), while other authors report opposite results (Ioannidou et al., 2014, Bonfim and Soares, 2013). Our results are consistent with the latter line of research. One explanation might be that banks with higher capital might tolerate higher losses, and therefore take higher risk. Regarding the loan-specific variables, we find that although the amount of the loan has no significant implications for the credit rating, there is a positive and significant relationship between the rating and the loan maturity, meaning that loans with longer maturity tend to have poorer ex-ante credit ratings. Similarly, whether a loan is secured by collateral or not also plays a significant role for the ex-ante credit rating. However, this relationship is negative, with collateralized loans reducing banks' risk-taking, since ex ante they are assigned better credit ratings on average than non-collateralized loans. Also, when we include GDP growth in order to control for the effects of the macroeconomic environment on the demand for loans that might be related with the dependent variable, results remain broadly unaltered (column 7). Moreover, the relationship between GDP growth and risk-taking is positive, indicating a certain pro-cyclicality in the banks' risk behaviour. The explanation might be that higher growth rates lead to a rise in banks' optimism and tolerance to risk which, in turn, results in approval of ex-ante riskier loans.

Next, we test whether the strength of the interest rate effect on banks' risk-taking depends on their levels of capitalization. This hypothesis is developed in the simple model of Dell'Ariccia et al. (2013), according to which low interest rates increase banks' risk-taking, especially for banks with relatively high capital (low leverage). For that reason, in specification (2) of Table 2 we include the interaction term between the Central bank bills rate and the Tier 1 capital ratio, among the other regressors[11]. It is expected a priori the coefficient on the interaction term to be negative, which would indicate a stronger effect of interest rate cuts on risk-taking of highly capitalized banks (Dell'Ariccia et al., 2013).

[11] Similar estimation is also done by including the interaction term between the bank assets and the interest rate, to investigate whether there is a differential effect of bank size on the link between the interest rate and risk taking. However, the results show that both bank size and the interaction term are not statistically significant and for the sake of brevity they are not reported.

Loan risk ratings and the interaction between the CB bills rate and bank capital

Dependent variable: risk rating of individual loans — Table 2

	(1)	(2)	(3)
CB bills rate	-0.013***	-0.027***	-0.035***
	[0.004]	[0.007]	[0.008]
Tier 1 capital ratio	0.246**	-0.177	
	[0.123]	[0.240]	
Tier 1 capital ratio x CB bills rate		0.116***	
		[0.044]	
Equity-assets ratio			-0.220
			[0.384]
Equity-assets ratio x CB bills rate			0.277***
			[0.073]
Bank size	0.011	0.019	0.049**
	[0.023]	[0.022]	[0.021]
Loan size	-0.002	-0.002	-0.002
	[0.003]	[0.003]	[0.003]
Dummy for loans with collateral	-0.012**	-0.012**	-0.012*
	[0.006]	[0.006]	[0.006]
Loan maturity	0.010***	0.010***	0.010***
	[0.001]	[0.001]	[0.001]
Constant	0.957**	0.867**	0.283
	[0.437]	[0.431]	[0.407]
Observations	29,074	29,074	29,074
Number of banks	7	7	7
Bank dummy variables	YES	YES	YES
R-squared	0.140	0.140	0.141

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

The results from this specification confirm in general the ones without the interaction term[12]. As it can be seen, we again obtain a statistically significant, negative coefficient on the short-term interest rate, which appears to be somewhat larger in magnitude. However, opposite to the theoretical suggestions in Dell'Ariccia et al. (2013), we find that the coefficient on the interaction term between bank capital and the interest rate is positive and significant. Given the negative coefficient on the interest rate, the interpretation in the model with the interaction term is not straightforward, and requires an additional calculation of the marginal effect of the interest rate on risk rating, while holding the capital ratio constant at representative values. Indeed, the calculation points to a negative marginal effect, but with minimal economic significance. Namely, based on the estimation results presented in column 2 of Table 2, when evaluated at one standard deviation below the mean of

[12] Note that in this case the coefficient on Tier 1 capital ratio changes signs and becomes statistically not significant. However, the tests of the main effects in this model do not test the same hypotheses that they do when carried out in the model without interaction. Instead, when we test for the overall significance of Tier 1 ratio in the interaction model, we find that it statistically significant. This means that the main effects of the variables that are used to compute the interaction terms should still be included in the model, even if they are not significant. Otherwise, main effects and interaction effects can get confounded.

the Tier 1 capital ratio, a one standard deviation reduction in interest rates results in worsening of loan risk ratings by 0.02, which is a small effect taking into account that the standard deviation of the risk rating variable equals 0.46. The effect of a one standard deviation decrease in interest rates is even smaller when we hold the capital ratio constant at one standard deviation above the mean, amounting only to 0.01. This finding suggests that interest rate cuts encourage marginally larger risk-taking for banks with lower capital ratios, while the negative relationship for better capitalized banks is slightly weaker, given that the internal loan risk ratings assigned by these banks tend to worsen by a bit less than those assigned by lower capitalized banks. This goes against the aforementioned proposition that the effect of lower interest rates on bank risk-taking should be stronger for well-capitalized banks, compared to lower capitalized banks. However, similar result is also found in the research of Ioannidou et al. (2014) for the case of Bolivia, Jimenez et al. (2014) for the case of Spain, Özşuca and Akbostancı (2016) for the case of Turkey and Lopez et al. (2010) for the case of Colombia. The results in column 3, where we use a different proxy for bank capitalization, i.e. the equity-assets ratio, also broadly support these conclusions, albeit the economic relevance becomes even smaller, and the statistical significance actually disappears when evaluated at one standard deviation above the mean.

Table 3 reports the estimation results obtained by splitting the sample by bank capital. The evidence suggests that the interest rate has the same encouraging effect on risk-taking, regardless whether we analyse separately the banks with capital ratios higher or lower than the median.

Subsampling by bank capital

Dependent variable: risk rating of individual loans Table 3

	(1)	(2)
	Banks with Tier 1 capital ratio above median	Banks with Tier 1 capital ratio below median
CB bills rate	-0.016**	-0.010*
	[0.007]	[0.005]
Tier 1 capital ratio	-0.002	0.033***
	[0.001]	[0.004]
Bank size	-0.061**	0.093***
	[0.029]	[0.036]
Loan size	-0.007*	0.006
	[0.004]	[0.005]
Dummy for loans with collateral	0.024***	-0.049***
	[0.009]	[0.009]
Loan maturity	-0.004***	0.023***
	[0.001]	[0.002]
Constant	2.373***	-0.852
	[0.559]	[0.700]
Observations	14,299	14,775
Number of banks	7	7
Bank dummy variables	YES	YES
R-squared	0.015	0.213

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

6. Robustness checks

Table A in Annex 1 reports the results from the estimation when splitting the sample by different loan characteristics. In this case, the results are mixed. For example, we continue to find negative and significant relationship between the interest rate and the risk rating only for the loans with maturity longer than median and the loans that are secured by collateral. Opposite to this, the coefficient on the interest rate becomes positive in the subsamples of shorter-term and non-secured loans. This implies that in these cases other factors might be at play in the banks' decisions to undertake risk.

Table B in Annex 1 presents an alternative specification, in which we include time dummy variables in the model[13]. These variables should capture changes in economy-wide conditions that are not captured by the interest rate. In this case, the interest rate variable is dropped because it varies over time, but not across banks, and will therefore be captured with the time dummies. This will enable us to check the robustness of the estimated interaction between the interest rate and banks' capitalization levels. The comparison shows that the coefficients on the interaction term between the two proxies for bank capitalization and the interest rate are similar, which lends support to the robustness of the results in our main specification.

As an additional robustness check we include an interaction between the Central bank bills interest rate and the real growth of GDP in the model, in order to control directly for the potential dependence of risk ratings on the economy-wide conditions. As shown in Table C in the Annex, the results again support the conclusion that there is an increasing effect of lower interest rates on bank risk-taking. Furthermore, the coefficients on the interactions between the capital ratios and the short-term interest rate do not change very much in this specification of the model.

Finally, in order to examine the effect of past interest rate decisions on credit risk on the date of loan origination, we use the six-month lag of the interest rate as an explanatory variable. This might also help us to tackle the possible problem of reversed causality between interest rates and risk-taking. As shown in Table D in Annex 1, the results do not change the conclusions drawn so far in our analysis.

7. Conclusion

The monetary policy risk-taking channel became particularly topical issue after the outburst of the global financial crisis. The risk-taking approach, suggests that accommodative monetary policy impacts not only the quantity, but the quality of credits, as well, through its effect on banks' perceptions and risk pricing.

In the paper we made an effort to empirically test the presence of the risk-taking channel on the Macedonian case. For this purpose we followed an approach,

[13] The results from the F-test show that the time dummies are strongly statistically significant. However, in order to save space, we do not report them in the table.

commonly employed in the empirical literature on this matter, using micro, or individual data on newly extended loans. The database was extracted from the Credit Registry of the National bank, and covered the seven largest banks and their newly extended loans in the corporate credit portfolio for the 2010 -2017 period. We used the pooled OLS estimation to test the linkage between the policy rate and the ex-ante risk rating assigned by banks to each individual loan. Our study revealed inverse relationship between the two, supporting the existence of the risk-taking channel in Macedonia. The results proved to be robust after controlling for several bank, loan and time specific variables. Yet, the magnitude of the coefficient was rather small, indicative for small economic significance.

The findings of the paper are policy-relevant, as they are indicative for the presence of the risk-taking monetary policy channel in Macedonia and the need to take financial stability and banks' risk pricing into consideration when deciding on the policy rate, and/or on the need to complement it with targeted macro-prudential measures. The paper is also meaningful from the pure research perspective, since to the best knowledge of our knowledge it is the first effort to estimate this alternative monetary policy channel in the region, and the first effort to use the Credit Registry database for research purposes. Future research in this area might try to tackle more thoroughly the definition of the ex-ante risk rating, by compiling alternative indicators, and testing whether the risk-taking channel exists after controlling for the different risk measures. In addition, the risk-taking channel could be assessed on the household credit portfolio, as well.

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Annex 1

Subsampling by loan characteristics

Dependent variable: risk rating of individual loans — Table A

	(1)	(2)	(3)	(4)
	Loans with maturity longer than median	Loans with maturity shorter than median	Loans secured by collateral	Loans not secured by collateral
CB bills rate	-0.037***	0.010*	-0.025***	0.016*
	[0.006]	[0.006]	[0.005]	[0.009]
Tier 1 capital ratio	-0.005***	0.011***	0.003**	0.001
	[0.002]	[0.002]	[0.001]	[0.003]
Bank size	-0.154***	0.180***	-0.023	0.091*
	[0.031]	[0.033]	[0.025]	[0.049]
Constant	4.080***	-2.310***	1.601***	-0.609
	[0.592]	[0.640]	[0.481]	[0.941]
Observations	12,827	16,247	23,141	5,933
Number of banks	7	7	7	7
Bank dummy variables	YES	YES	YES	YES
R-squared	0.177	0.114	0.144	0.115

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Regressions including time dummy variables

Dependent variable: risk rating of individual loans — Table B

	(1)	(2)
Tier 1 capital ratio	-0.882***	
	[0.260]	
Tier 1 capital ratio x CB bills rate	0.158***	
	[0.046]	
Equity-assets ratio		-1.403***
		[0.411]
Equity-assets ratio x CB bills rate		0.352***
		[0.077]
Bank size	-0.118***	-0.059
	[0.044]	[0.038]
Loan size	-0.003	-0.003
	[0.003]	[0.003]
Dummy for loans with collateral	-0.015**	-0.013**
	[0.006]	[0.006]
Loan maturity	0.010***	0.010***
	[0.001]	[0.001]
Constant	3.236***	2.096***
	[0.810]	[0.702]
Observations	29,074	29,074
Number of banks	7	7
Bank dummy variables	YES	YES
Time dummy variables	YES	YES
R-squared	0.144	0.144

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Loan risk ratings, the CB bills rate, bank capital and GDP

Dependent variable: risk rating of individual loans — Table C

	(1)	(2)	(3)
CB bills rate	-0.038***	-0.056***	-0.063***
	[0.009]	[0.011]	[0.011]
CB bills rate x GDP growth	0.007***	0.007***	0.007***
	[0.002]	[0.002]	[0.002]
Tier 1 capital ratio	0.258**	-0.310	
	[0.126]	[0.239]	
Tier 1 capital ratio x CB bills rate		0.156***	
		[0.045]	
Equity-assets ratio			-0.406
			[0.382]
Equity-assets ratio x CB bills rate			0.327***
			[0.074]
Bank size	-0.000	0.010	0.040*
	[0.024]	[0.024]	[0.021]
Loan size	-0.002	-0.002	-0.002
	[0.003]	[0.003]	[0.003]
Dummy for loans with collateral	-0.010	-0.010	-0.010
	[0.006]	[0.006]	[0.006]
Loan maturity	0.010***	0.010***	0.010***
	[0.001]	[0.001]	[0.001]
GDP growth	-0.016**	-0.016**	-0.014**
	[0.007]	[0.007]	[0.007]
Constant	1.221***	1.098**	0.522
	[0.466]	[0.461]	[0.424]
Observations	29,074	29,074	29,074
Number of banks	7	7	7
Bank dummy variables	YES	YES	YES
R-squared	0.141	0.141	0.142

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Regressions with the lag of CB bills rate

Dependent variable: risk rating of individual loans — Table D

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CB bills rate (t-1)	-0.009***	-0.007***	-0.007***	-0.007***	-0.007***	-0.008***	-0.007***
	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Tier 1 capital ratio		0.275**	0.274**	0.272**	0.262**	0.255**	0.300**
		[0.129]	[0.129]	[0.129]	[0.129]	[0.129]	[0.131]
Bank size		0.018	0.017	0.017	0.017	0.015	0.021
		[0.023]	[0.023]	[0.023]	[0.023]	[0.023]	[0.024]
Loan size			0.003			-0.002	-0.002
			[0.003]			[0.003]	[0.003]
Dummy for loans with collateral				-0.004		-0.012*	-0.011*
				[0.006]		[0.006]	[0.006]
Loan maturity					0.010***	0.010***	0.010***
					[0.001]	[0.001]	[0.001]
GDP growth							0.007***
							[0.001]
Constant	1.170***	0.796*	0.784*	0.813*	0.806*	0.874*	0.736
	[0.008]	[0.449]	[0.448]	[0.448]	[0.449]	[0.448]	[0.453]
Observations	29,074	29,074	29,074	29,074	29,074	29,074	29,074
Number of banks	7	7	7	7	7	7	7
Bank dummy variables	YES	YES	YES	YES	YES	YES	YES
R-squared	0.137	0.137	0.137	0.137	0.140	0.140	0.141

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations.

Annex 2

List of input data in the Credit Registry of the National Bank of the Republic of Macedonia

No.	Data on clients identification and characteristics	Data on maturity and other dates related to the agreement	Data on the amounts of credit exposure	Data on the collateral (if any) provided by the client	Data on other characteristics of the credit agreement	Other data on the credit quality	Data on written-off claims
1.	Type of client (legal entity, individual, retailer, bank, etc.)	Date of the first cash outflow on the basis of the credit agreement	Total approved exposure amount	Type of collateral (residential or commercial real estate, automobile, guarantees, securities, endorser, co-borrower, etc.)	Number of credit agreement (according to bank own format)	Amount and percentage (as share in total credit exposure) of impairment losses and/or special reserves determined by the bank	Outstanding amount of written-off principal
2.	Residency status and name of country	Final maturity date of the credit agreement	Amount of undue principal of the credit agreement as of the end of the reporting month	Amount of collateral	Type of debt repayment (in annuities, bullet loans or credit cards/overdrafts)	Scope of the impairment losses determined by the bank (calculated for individual credit exposure or for group of exposures on aggregate basis)	Outstanding amount of written-off interest
3.	Code for unique identification in Macedonia	Date of first maturity of the credit agreement principal	Amount of due principal of the credit agreement as of the end of the reporting month	Lien over collateral (primary, secondary, etc.)	Interest rate type (fixed, variable or adjustable according to decision of authorized body in the bank)	Identification of credit agreements where restructuring or extension of the final maturity date was made	Outstanding amount of the other written-off claims
4.	Title of the legal entity and tax number for legal entities - residents	Date of restructuring or extension (if any) of the final maturity date	Amount of interest as of the end of the reporting month	Endorser/co-borrower information: - national ID - tax number - title of the legal entity - name of surname of the individual	Currency (EUR, USD, MKD, etc.)*	Number of restructurings / extensions of the final maturing date (if any)	
5.	Name and surname of the individual	New exposure maturity date (due to restructuring or extension of final maturity date)	Amount of non-performing principal of the credit agreement as of the end of the reporting month		Purpose of the foreign currency credit	Identification of credit agreements that are repayed by endorser or another entity due to default of original borrower	
6.	Municipality for residents from Macedonia		Amount of non-performing interest as of the end of the reporting month		Purpose of the credit approved to individuals (consumer loan, mortgage loan, automobile loans, etc.)	Maximum noted delay in repayment over entire duration of the agreement (in number of days)	
7.	Prevailing activity of legal entities		Amount of other claims according to the agreement as of the end of the reporting month		Agreed annual nominal interest rate	Amount to which the maximum noted delay in repayment pertains	
8.	Client with matched foreign currency position		Amount of off-balance sheet items (if any related to the agreement) as of the end of the reporting month				
9.			Total credit exposure deriving from the credit agreement as of the end of the reporting month				
10.			Annuity amount				
11.			Amount approved in the restructuring or extension (if any) of the final maturity date				

* Agreements in Denars with FX clause are separately identified by reporting the currency of the FX clause.

Source: Instructions for implementation of the Decision on the contents and the manner of functioning of the Credit Registry (Official Gazette of the Republic of Macedonia No. 14/14, 83/15 and 225/15), Available at: http://www.nbrm.mk/ns-newsarticle-instructions_credit_registry_n.nspx.

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The risk-taking channel of monetary policy in Macedonia: evidence from credit registry data[1]

Mite Miteski, Ana Mitreska and Mihajlo Vaskov,
National Bank of the Republic of Macedonia

[1] This presentation was prepared for the meeting. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, the IFC or the central banks and other institutions represented at the meeting.

The Risk-Taking Channel of Monetary Policy in Macedonia: Evidence from Credit Registry Data

Mite Miteski, Ana Mitreska and Mihajlo Vaskov
National Bank of the Republic of Macedonia

9th IFC Conference
Basel, 30-31 August 2018

Motivation

- Increasing interest on the link between monetary policy and banks' risk-taking in recent years
  - the "Great Recession" sawn by the low rates environment prior to its emergence
- The risk-taking channel: accommodative monetary policy impacts not only the quantity, but the quality of banks' credits as well, through its effect on banks' perceptions and risk pricing
- Research objectives:
  - to empirically test the presence of the risk-taking channel in Macedonia
  - to analyze the impact of banks' leverage on the risk-taking behavior
- Our contribution:
  - to the best of our knowledge, this is a first attempt to explore the risk-taking monetary police channel for Macedonia
  - also, first-time utilization of the confidential micro database from the Credit Registry of NBRM for research purposes

Econometric methodology

- Following the specification of Dell'Ariccia et al.:

(1) $$LRR_{kit} = \lambda_i + \beta r_t + \eta K_{it} + \mu L_{kit} + \Omega B_{it} + \varepsilon_{kit}$$

(2) $$LRR_{kit} = \lambda_i + \beta r_t + \eta K_{it} + \nu K_{it} r_t + \mu L_{kit} + \Omega B_{it} + \varepsilon_{kit}$$

where

LRR_{kit} is the risk rating of loan k, extended by bank i during the semester t
λ_i are bank-specific effects
r_t is the Central bank's effective interest rate
K_{it} is a measure of bank's capitalisation
L_{kit} is a set of loan specific variables
B_{it} is a measure of bank size
$K_{it}r_t$ is interaction term between interest rate and bank capital

- Estimation method: POLS with robust s.e. and bank dummy variables to control for the likely presence of unobserved heterogeneity (bank-level fixed effects related to banks' ownership, management, clients etc.)

Data description

- The Credit Registry of NBRM: electronic base of data and information on the credit exposures of deposit-taking financial institutions to their clients, the main purpose of which is to contribute to improvement of the credit risk management and the maintenance of the financial stability of Macedonia
- Biannual data on individual new loans extended to non-financial companies, for the period 2010:H1-2017:H1
- 7 largest banks, with market share of around 90%

<table>
<tr><th>Dependent variable</th><th>Loan specific variables</th><th>Bank specific variables</th><th>Time specific variables</th></tr>
<tr><td rowspan="3">Risk rating assigned by the bank to a given loan classified in one of the five risk categories (A=1, B=2, C=3, D=4 and E=5)</td><td>loan size (in log)</td><td>total assets (in log)</td><td>NBRM's effective interest rate</td></tr>
<tr><td>loan original maturity (in years)</td><td>Tier 1 capital ratio</td><td>real GDP growth</td></tr>
<tr><td>dummy variable for collateral (1 for secured loans, and 0 otherwise)</td><td>equity-total assets ratio (alt.)</td><td></td></tr>
<tr><td colspan="2">Source: Credit Registry of NBRM</td><td>Source: Banks' balance sheets</td><td>Source: NBRM, SSO</td></tr>
</table>

Main results

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CB bills rate	-0.015***	-0.012***	-0.012***	-0.012***	-0.012***	-0.013***	-0.011**
	[0.002]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Tier 1 capital ratio		0.266**	0.264**	0.264**	0.253**	0.246**	0.316**
		[0.123]	[0.123]	[0.123]	[0.123]	[0.123]	[0.127]
Bank size		0.014	0.014	0.014	0.013	0.011	0.023
		[0.023]	[0.023]	[0.023]	[0.023]	[0.023]	[0.023]
Loan size			0.003			-0.002	-0.002
			[0.003]			[0.003]	[0.003]
Dummy for loans with collateral				-0.004		-0.012**	-0.011*
				[0.006]		[0.006]	[0.006]
Loan maturity					0.010***	0.010***	0.010***
					[0.001]	[0.001]	[0.001]
GDP growth							0.007***
							[0.001]
Constant	1.185***	0.874**	0.865**	0.894**	0.888**	0.957**	0.693
	[0.010]	[0.438]	[0.438]	[0.437]	[0.439]	[0.437]	[0.448]
Observations	29,074	29,074	29,074	29,074	29,074	29,074	29,074
Number of banks	7	7	7	7	7	7	7
Bank dummy variables	YES	YES	YES	YES	YES	YES	YES
R-squared	0.137	0.137	0.137	0.137	0.140	0.140	0.140

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Main results

VARIABLES	(1)	(2)	(3)
CB bills rate	-0.013***	-0.027***	-0.035***
	[0.004]	[0.007]	[0.008]
Tier 1 capital ratio	0.246**	-0.177	
	[0.123]	[0.240]	
Tier 1 capital ratio x CB bills rate		0.116***	
		[0.044]	
Equity-assets ratio			-0.220
			[0.384]
Equity-assets ratio x CB bills rate			0.277***
			[0.073]
Bank size	0.011	0.019	0.049**
	[0.023]	[0.022]	[0.021]
Loan size	-0.002	-0.002	-0.002
	[0.003]	[0.003]	[0.003]
Dummy for loans with collateral	-0.012**	-0.012**	-0.012*
	[0.006]	[0.006]	[0.006]
Loan maturity	0.010***	0.010***	0.010***
	[0.001]	[0.001]	[0.001]
Constant	0.957**	0.867**	0.283
	[0.437]	[0.431]	[0.407]
Observations	29,074	29,074	29,074
Number of banks	7	7	7
Bank dummy variables	YES	YES	YES
R-squared	0.140	0.140	0.141

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Alternative specifications

- Subsampling by bank capital
- Subsampling by loan characteristics
- Regressions including time dummy variables
- Regressions with the interaction between Central bank bills interest rate and real GDP growth
- Regressions with the lag of CB bills rate

➢ The results broadly in line with the ones from the baseline specification

Conclusion

- Our study reveals inverse relationship between the policy rate and the ex-ante risk rating assigned by banks, supporting the existence of the risk-taking channel in Macedonia.
- The results prove to be robust after controlling for several bank, loan and time specific variables, but the economic significance is rather small.
- Regarding the impact of leverage on risk-taking, we find a lower risk-taking for better capitalized banks, although the degree of difference between banks with higher and lower capitalization is marginal.
- The findings of the paper are policy-relevant, as they are indicative for the presence of the risk-taking monetary policy channel in Macedonia and point to the need to take financial stability and banks' risk pricing into consideration when deciding on the policy rate.
- This is just a beginning - future research focused on assessment of the risk-taking channel in view of some alternative risk indicators, as well as on conducting a similar analysis for the household lending segment.