Regular Article

What Drives Bank Lending in Domestic and Foreign Currency Loans in a Small Open Transition Economy with Fixed Exchange Rate? The Case of Macedonia

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This paper investigates two different bank loan supply functions and their determinants according to the currency of bank loans in the Republic of Macedonia. There is robust statistical evidence in favour of the existence of a bank lending channel through foreign currency loans and the foreign reference interest rate. This suggests that the impact of domestic monetary policy over the bank lending channel is limited. The most significant bank-specific characteristic for the foreign currency loan supply function is bank size, whereas for the domestic currency loans no bank-specific variable plays a significant role.

Comparative Economic Studies (2011) **53**, 307–331. doi:10.1057/ces.2011.2;
published online 10 March 2011

Keywords: bank lending channel, monetary policy, ‘system’ GMM, foreign currency loans

JEL Classifications: C13, C23, E40, E50

INTRODUCTION

The main research aims of this paper are to empirically investigate the existence of the bank lending channel and its determinants in Macedonia. We estimate two different loan supply functions by disaggregating the loans by currency, in denars and in foreign currency (mainly in euros). The rationale for examining the two loan supply functions separately is the relatively high

Figure 1: Stock of total bank loans and stock of loans in denars to non-financial private sector, in millions of denars

Source: NBRM (<http://www.nbrm.mk/?ItemID=A55FFC32FC478E4A89444507A6C02C45>)

share of foreign currency loans in the total loans in the Macedonian banking sector (see Figure 1), which is typical of many transition economies, and the belief that such loans may respond to variables different from those affecting loans in domestic currency (Kohler *et al.*, 2005).

Hence, Macedonia's fixed exchange rate, banks' dependence on foreign financing and the level of currency substitution through the presence of foreign currency loans may thus weaken the impact of domestic monetary policy. According to the 'impossible trinity', a country's independent monetary policy setting under a fixed exchange rate and relatively high openness is very limited (Mundell, 1963; Fleming, 1962). This may also be the case in Macedonia. Hence, with this research we investigate whether changes in the domestic reference rate really matter for banks in Macedonia or whether changes in the foreign reference rate are more important in determining their loan supply decisions.

LITERATURE REVIEW

The theoretical background of the bank lending channel was initially developed by Bernanke and Blinder (1988).¹ Empirical investigations of the

¹ There are previous attempts in the literature that tackle the issue of existence of bank lending channel, but formally the first model that depicts the lending channel is that of Bernanke and Blinder (1988).

bank lending channel for transition economies usually augment the standard model with some additional variables specific to transition economies. Those variables usually are: the real effective exchange rate (*REER*), a foreign ownership variable and a foreign interest rate, typically the 3-month EURIBOR rate. The rationale for including the *REER* variable is, according to Schmitz (2004), to capture the effect of changes in the price competitiveness of these economies on banks' assets and their lending potential. A change in price competitiveness may affect the trade balance and the inflow and outflow of funds through the capital account. The latter may in turn directly affect banks' assets and change their lending potential. For example, according to Schmitz (2004), appreciation of the *REER* will worsen the price competitiveness of domestic products, resulting in a deterioration of the trade balance.² Consequently, net capital inflows will have to increase raising banks' assets and their lending potential and *vice versa*.

The foreign ownership variable is used to capture the impact of foreign capital in the banking sector on the loan supply. Foreign-owned banks thus react differently from domestically-owned banks in adjusting the quantity of loan supply when the reference rate changes due to the existence of internal capital markets within the foreign-owned banks (De Haas and Van Lelyveld, 2006). The inclusion of the foreign reference rate in the models is due to the high dependence of banks on foreign financing, as well as to the high share of foreign currency loans in total loans (Schmitz, 2004; Kohler *et al.*, 2005).

A summary of empirical studies of the bank lending channel in transition economies that are most relevant to this paper are provided in Table 1.

These studies can be mainly divided into two groups depending on whether they augment the standard model by including both, the foreign and domestic interest rates or only the domestic rate. The common finding of the studies that include both interest rates, Schmitz (2004) for the eight new EU member states and Kohler *et al.* (2005) for the Baltic States, is that the bank lending channel works through changes in the foreign interest rate but not through the domestic rate. The common finding of the studies that include only the domestic interest rate in the model is that either they find weak evidence for its significant impact on the loan supply function (Matousek and Sarantis, 2009; Havrylchyk and Jurzyk, 2005), or the impact of the domestic interest rate on the loan supply function is much lower (Wrobel and Pawlowska, 2002; Chmielewski, 2006; Pruteanu-Podpiera, 2007

²Appreciation refers to worsening of the price competitiveness of domestic products. Appreciation of the REER of Macedonian denar is indicated by downward movement of the index.

Table 1: Summary of the empirical studies that investigate the bank lending channel in transition economies

Country/area	Study by:	Time period	Frequency of the data	Method of estimation	Size of <i>N</i> and <i>T</i>	Macroeconomic control variables used	Evidence of the existence of bank lending channel	Significant determinants of bank lending channel
Eight/ten new EU member states	Schmitz (2004)	1990–2001	Annual	Static Panel data with fixed effects	<i>N</i> =261; <i>T</i> =1990–2001	Real GDP, CPI, REER, foreign ownership	YES, through EURIBOR	Foreign ownership, size weakly
	Matousek and Sarantis (2009)	1994–2003	Annual	Dynamic Panel data by 'difference' from the economy; GMM estimator	<i>N</i> depends <i>T</i> =1994–2003	Real GDP, CPI	Weak evidence through domestic interest rate	Liquidity and size weakly
Baltic States	Kohler <i>et al.</i> (2005)	1997–2004	Annual	Static Panel data by OLS	<i>N</i> =36; <i>T</i> =1997–2004	Nominal GDP	YES, through EURIBOR	Foreign ownership, capitalisation, liquidity
Poland	Wrobel and Pawlowska (2002)	1997 Q1 –2001 Q4	Quarterly	Dynamic Panel data with fixed effects, estimated with Generalized Least Squares method	<i>N</i> =648; <i>T</i> =1997Q1–2001Q4	Real GDP, CPI	YES	Capitalisation, liquidity and size weakly
Czech Republic	Havrychyk and Jurzyk (2005)	1995 Q1 –2002 Q4	Quarterly	Dynamic Panel data by 'difference' GMM estimator	<i>N</i> =67; <i>T</i> =1995–2004	Real GDP, CPI, REER, foreign ownership	Weak evidence through domestic interest rate	Foreign ownership
	Chmielewski (2006)	1997 Q1 –2004 Q4	Quarterly	Dynamic Panel data by 'difference' GMM estimator	<i>N</i> = <i>N</i> / <i>A</i> ; <i>T</i> =1997–2004	Real GDP, CPI, REER, foreign ownership	YES	Foreign ownership and liquidity
	Pruteanu-Podpiera (2007)	1996 Q1–1998 Q4; 1999 Q1–2001 Q4	Quarterly	Dynamic Panel data by 'difference' GMM estimator	<i>N</i> =33; <i>T</i> =1996–2001	Real GDP, CPI, foreign ownership	YES	Capitalisation
Ukraine	Golodniuk (2006)	1998–2003	Annual	Dynamic Panel data by 'difference' GMM estimator	<i>N</i> =149; <i>T</i> =1998–2003	Real GDP, CPI, REER	YES	Capitalisation

and Golodniuk, 2006) compared to the impact of the foreign interest rate in the studies that include both interest rates.

Regarding the bank-specific characteristics, the major similarity of the empirical analyses is that the most influential characteristic on bank lending decisions is the foreign-ownership variable, implying that foreign owned-banks reduce the quantity of loan supply proportionally less than the domestically owned banks when the interest rate increases (Schmitz, 2004; Kohler *et al.*, 2005; Havrylchyk and Jurzyk, 2005 and Chmielewski, 2006). Another bank-specific characteristic that is commonly estimated to have a significant influence on the loan supply function is bank capital, suggesting that better capitalised banks cut the quantity of loans proportionally less than poorly capitalised banks when the interest rate increases (Kohler *et al.*, 2005; Wrobel and Pawlowska, 2002; Pruteanu-Podpiera, 2007 and Golodniuk, 2006). The results in regard to the liquidity variable imply that, in the banking systems that have structural excess liquidity such as the Baltic States (Kohler *et al.*, 2005) and Poland (Matousek and Sarantis, 2009; Wrobel and Pawlowska, 2002 and Chmielewski, 2006), its sign is opposite to what theory would predict. The results in respect of the asset size of the banks are mixed. The estimates indicate that it has either an insignificant impact (Kohler *et al.*, 2005; Havrylchyk and Jurzyk, 2005; Chmielewski, 2006; Pruteanu-Podpiera, 2007 and Golodniuk, 2006), or where it is significant, the results are sensitive to model specifications (Matousek and Sarantis, 2009; Schmitz, 2004 and Wrobel and Pawlowska, 2002).

The estimates of the parameters of the macroeconomic control variables, *GDP*, *CPI* and *REER*, are controversial. The *GDP* and *REER* variables are estimated as statistically significant (Schmitz, 2004; Havrylchyk and Jurzyk, 2005 and Golodniuk, 2006), but the sign of these two variables is not consistent among the studies. The significance of the price level differs among the studies and depends upon the model specification and the country considered.

A major weakness in the majority of these studies is the estimation technique applied. Given the endogeneity of some of the independent variables in the model such as the lagged dependent variable, bank balance sheet items and the *GDP* and *CPI*, the majority of these studies use dynamic panel estimated with difference Generalized Method of Moments (GMM) (see Table 1). This estimation technique was seen as being able to deal with the endogeneity of the independent variables in these models most appropriately. However, there has been rapid development in the techniques used in dynamic panel analysis in recent years (Arellano and Bover, 1995; Blundell and Bond, 1998 and Roodman, 2006). Given these developments, the use of difference GMM does not now seem to be the most appropriate estimator due to the non-stationarity of the data. A system GMM estimator is more

appropriate in the presence of a unit root process because it is more efficient and has better statistical properties. Therefore, we use the system GMM in estimating the bank lending channel in Macedonia.

An additional weakness of many of the aforementioned studies, apart from Schmitz (2004) and Kohler *et al.* (2005), is that they only include the domestic interest rate as a determinant of the loan supply function and do not consider the impact of the foreign interest rate, which is estimated to have a significant impact on bank lending. Moreover, the cited studies examine the functioning of the bank lending channel by using only the total stock of loans in all currency denominations. This may bias the results because it cannot distinguish to what extent and to which reference rate banks are more responsive, the domestic or the foreign.

STYLISTED FACTS ABOUT MONETARY DEVELOPMENTS AND THE BANKING SYSTEM IN MACEDONIA

Since gaining its monetary independence in 1992, the National Bank of the Republic of Macedonia (NBRM) has changed its monetary policy regime once. From the initial period of transition until the end of 1995, the monetary policy regime was oriented towards money supply targeting (for details see Trajkovic, 2006). At the end of 1995, policy makers switched to a fixed exchange rate by pegging the domestic currency to the German mark and later on to the euro (Trajkovic, 2006).

From the pegging of the exchange rate to the German Mark at the end of 1995 to 1999, the banking system lacked liquid assets. Consequently, the NBRM had to maintain the stability of the nominal exchange rate by injecting liquid assets into the banking system by auctioning bank credits. Since 2000, the liquidity of the Macedonian banking system has improved to the point where it is characterised by excess liquidity. Accordingly, the NBRM had to change its main monetary policy instrument and began to auction Central Bank (CB) Bills with maturity of 28 days to banks and the key policy rate was thus the respective CB Bills rate. This interest rate actually serves as an alternative investment for the banks, because banks can participate in the CB Bills auctions that are conducted exclusively on the primary market and for which no secondary market exists. The market for treasury bills (T-bills) is developing. The CB Bills share in banks' securities portfolio in 2008 equaled 60.4%, whereas the share of the T-bills was around 12%.

As in other transition economies, Macedonia's banking sector is dependent on foreign financing. The share of foreign liabilities in the

Figure 2: Movements of the MBKS rate, the lending rate in denars and foreign currency and the 3-month EURIBOR rate, in %

Source: NBRM (<http://www.nbrm.mk/?ItemID=A55FFC32FC478E4A89444507A6C02C45>) and EUROSTAT (<http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home>)

structure of total banks' liabilities ranges from 8.5 % in 2004 to 10.5 % in 2008 (Source: NBRM, 2009, p. 20). There is also a relatively high proportion of foreign currency and foreign currency indexed loans. The average share of these loans has grown, reaching 56 % of all bank loans in 2008.

The key policy rate (CB Bills rate) and the money market rate (MBKS) declined during the period 2000–2008 (see Figure 2).

The lending rates of loans denominated in domestic and foreign currency have also declined over time. However, their level has been higher compared to the MBKS rate and especially the 3-month EURIBOR. This may suggest that banks may be borrowing abroad to engage in a form of interest arbitrage.

THE MODEL

The specification used in this analysis is a stock-adjustment model, and is a modified version of that developed by Ehrmann *et al.* (2001) and Kierzenkowski (2005) for an economy with a fixed exchange rate that has a relatively high level of currency substitution. Hence, the modified version of the model presented here allows for the existence of two types of loans and deposits, domestic and foreign currency, in the portfolio structure of the banks. The model is derived as a simplified version of Bernanke and Blinder's (1988) model by incorporating bank-specific characteristics as determinants of the banks' heterogeneous loan supply functions.

The model is based on three basic equations that model banks' deposits, banks' loan demand and loan supply, respectively. The derivation of the model is as follows³:

Banks' deposits (D) are assumed to equal money (M) and are composed of domestic (D_d) and foreign currency deposits (D_f) that are negatively determined by the domestic and foreign reference rates as an alternative risk free assets, r_d and r_f , respectively, (Ehrmann *et al.*, 2003) and a constant (β):

$$M = D = D_d + D_f = -\Psi_d r_d - \Psi_f r_f + \beta \quad (1)$$

In the model, there are also two loan demand and loan supply functions according to the currency denomination of the loans. The domestic currency loan demand function (equation 2), is positively determined by the real income (y) and the price level (P) as macroeconomic control variables, negatively by the interest rate on loans denominated in domestic currency (ρ_d) and positively by the interest rate on loans denominated in foreign currency (ρ_f).

$$L_d^d = \varphi_1 y + \varphi_2 P - \gamma_1 \rho_d + \gamma_2 \rho_f \quad (2)$$

The negative association between the demand for domestic currency loans and their interest rate is due to increasing borrowers' costs of taking a domestic currency loan when the domestic currency loan interest rate increases. However, the borrowers' decision for taking a domestic currency loan is also affected by the interest rate on foreign currency loans. When the interest rate on foreign currency loans increases, *ceteris paribus*, then the differences between the cost of taking the domestic currency loans compared to the foreign currency loans have decreased, affecting borrowers' decision in favour of the domestic currency loan. In a simplified framework, this may actually represent the interest rate spread between the interest rate of loans denominated in domestic and foreign currency adjusted for risk. Hence, equation 2 can be simplified by introducing the interest rate spread between the interest rate of loans denominated in domestic and foreign currency adjusted by risk (S) (Kierzenkowski, 2005):

$$L_d^d = \varphi_1 y + \varphi_2 P - \varphi_3 S \quad (3)$$

Analogous reasoning can be used to derive the demand for foreign currency loans where, apart from their positive association with real income and price level, they are negatively influenced by the interest rate of loans

³ The source for derivation of the model is Ehrmann *et al.* (2001) and Kierzenkowski (2005).

denominated in foreign currency and positively by the interest rate of loans denominated in domestic currency:

$$L_f^d = \varphi_4 y + \varphi_5 P - \gamma_3 \rho_f + \gamma_4 \rho_d \quad (4)$$

By introducing the interest rate spread (S), defined in the same way as previously, equation 4 can be simplified to:

$$L_f^d = \varphi_4 y + \varphi_5 P + \varphi_6 S \quad (5)$$

Banks' decisions to supply domestic currency loans are positively associated with the amount of total banks' deposits (D) as a source of financing their lending activities and the interest rate on loans denominated in domestic currency (ρ_d) as a rate of return and negatively with the interest rate on loans denominated in foreign currency (ρ_f) and domestic and foreign reference rates (r_d and r_f , respectively).

$$L_d^s = \mu(D) + \gamma_5 \rho_d - \gamma_6 \rho_f - \varphi_8 r_d - \varphi_9 r_f \quad (6)$$

The supply of domestic currency loans is related to the interest rate on foreign currency loans because the latter represents an opportunity cost for the banks. When the interest rate on foreign currency loans increases, then the opportunity cost for the banks of placing their funds as domestic currency loans instead of foreign currency loans will increase as well. The supply of domestic currency loans is a negative function of domestic and foreign reference rates because these rates are the opportunity costs of banks when they borrow in the money market in order to finance their loan supply. The different loan supply reaction to interest rates of loans in domestic and foreign currency denominated loans may be again simplified by the interest rate spread between these two interest rates. Hence, by using the interest rate spread (S) as previously defined, the domestic currency loan supply (equation 6) can be presented as follows:

$$L_d^s = \mu(D) + \varphi_7 S - \varphi_8 r_d - \varphi_9 r_f \quad (7)$$

A similar specification describes the foreign currency loan supply function.

$$L_f^s = \mu(D) + \gamma_7 \rho_f - \gamma_8 \rho_d - \varphi_{11} r_d - \varphi_{12} r_f \quad (8)$$

By introducing the interest rate spread as defined previously, equation 8 can be written as:

$$L_f^s = \mu(D) - \varphi_{10} S - \varphi_{11} r_d - \varphi_{12} r_f \quad (9)$$

A major contribution of Ehrmann *et al.* (2001) is that the impact of banks' deposits on the quantity of loans supplied is inversely related to other banks' balance sheet characteristics such as size, liquidity and capital. The rationale for this is that when the size of these balance sheet items is larger, then banks are seen to be less dependent on banks' deposits as a source of financing their lending activities. Thus, banks may use one of the other balance sheet items to finance their lending activities or raise non-deposit funding. Consequently, the impact of these variables on the loan supply function is incorporated through the following equation:

$$\mu = \mu_0 - \mu_1 x \quad (10)$$

where μ refers to changes in banks' deposits and x represents one of the aforementioned bank-specific characteristics.

The equilibrium of the market for domestic currency loans, calculated as a reduced form of the model, is:

$$L_d = \frac{\varphi_1 \varphi_7 y + \varphi_2 \varphi_7 P - (\mu_0 \psi_d + \varphi_8) \varphi_3 r_d - (\mu_0 \psi_f + \varphi_8) \varphi_3 r_f + \mu_1 \psi_d \varphi_3 r_d x + \mu_1 \psi_f \varphi_3 r_f x + \mu_0 \varphi_3 \beta - \mu_1 \varphi_3 \beta x}{\varphi_3 + \varphi_7} \quad (11)$$

The equilibrium of the market for foreign currency loans, calculated as a reduced form of the model, is:

$$L_f = \frac{\varphi_4 \varphi_{10} y + \varphi_5 \varphi_{10} P - (\mu_0 \psi_d + \varphi_{11}) \varphi_6 r_d - (\mu_0 \psi_f + \varphi_{12}) \varphi_6 r_f + \mu_1 \psi_d \varphi_6 r_d x + \mu_1 \psi_f \varphi_6 r_f x + \mu_0 \varphi_6 \beta - \mu_1 \varphi_6 \beta x}{\varphi_6 + \varphi_{10}} \quad (12)$$

Equations 11 and 12 can be simplified so that:

$$L_d = \beta_0 + \beta_1 y + \beta_2 P - \beta_3 r_d - \beta_4 r_f + \beta_5 r_d x + \beta_6 r_f x + \beta_7 x \quad (13)$$

where $\beta_5 = \frac{\mu_1 \psi_d \varphi_3}{\varphi_3 + \varphi_7}$ and $\beta_6 = \frac{\mu_1 \psi_f \varphi_3}{\varphi_3 + \varphi_7}$ from equation 11; and

$$L_f = \alpha_0 + \alpha_1 y + \alpha_2 P - \alpha_3 r_d - \alpha_4 r_f + \alpha_5 r_d x + \alpha_6 r_f x + \alpha_7 x \quad (14)$$

where $\alpha_5 = \frac{\mu_1 \psi_d \varphi_6}{\varphi_6 + \varphi_{10}}$ and $\alpha_6 = \frac{\mu_1 \psi_f \varphi_6}{\varphi_6 + \varphi_{10}}$ from equation 12.

The coefficients β_5 and β_6 from equation 13 and coefficients α_5 and α_6 from equation 14 are the coefficients of the interaction terms between the domestic and foreign reference interest rate and banks' specific characteristics. They show the asymmetric reaction of different banks with different financial characteristics in changing the quantity of loan supply induced by changes in the respective reference rates.

On the basis of the foregoing discussion, the basic stock-adjustment model used in this paper is augmented by the explanatory variables *REER* and foreign ownership, which are seen to be specific for the case of transition economies.

The general unrestricted model by each bank has the following specification:

$$\begin{aligned}
 \log(\text{Loans}_{i,t}) = & \beta_0 + \beta_1 \log(\text{Loans}_{i,t-1}) + \beta_2 \text{MPID}_t \\
 & + \beta_3 \text{MPIF}_t + \beta_4 \log(\text{GDP}_t) \\
 & + \beta_5 \log \text{CPI}_t + \beta_6 \log \text{REER}_t \\
 & + \beta_7 X_{i,t} + \beta_8 X_{i,t} \text{MPID}_t + \beta_9 X_{i,t} \text{MPIF}_t \\
 & + \beta_{10} \text{ForOwnDum}_{i,t} + \beta_{11} \text{MPID}_t \text{ForOwnDum}_{i,t} \\
 & + \beta_{12} \text{MPID}_t \text{ForOwnDum}_{i,t} + \varepsilon_{i,t}
 \end{aligned} \tag{15}$$

Where: β_0 is the intercept term of the regression; $\text{Loans}_{i,t-1}$ is the stock of loan by bank i in year $t-1$ in domestic currency and foreign currency, respectively; MPID_t is the domestic interest rate in year t ; MPIF_t is the foreign interest rate in year t ; GDP_t is the gross domestic product in real terms in year t ; CPI_t is the consumer price index in year t ; REER_t is the real effective exchange rate of Macedonian denar in year t ; $X_{i,t}$ is bank-specific characteristic such as liquidity, size and capitalisation ratio by bank i in year t ; $X_{i,t} \text{MPID}_t$ and $X_{i,t} \text{MPIF}_t$ are interaction terms between each of the aforementioned bank-specific characteristic and the domestic and foreign reference rates by bank i in year t , respectively; $\text{ForOwnDum}_{i,t}$ is the foreign ownership dummy variable by bank i in year t . We assign value of 1 if the bank is foreign-owned and 0 otherwise. Foreign-owned bank is defined as bank where the foreign capital combines more than 50% of total shareholders capital; $\text{MPID}_t \text{ForOwnDum}_{i,t}$ and $\text{MPIF}_t \text{ForOwnDum}_{i,t}$ are interaction terms between foreign ownership dummy variable and the domestic and foreign reference rates by bank i in year t , respectively; $\varepsilon_{i,t}$ is the error term composed of v_i – group specific time-invariant unobservable bank-specific effect plus $u_{i,t}$ – i.i.d error term by bank i in year t ; i and t are bank and time specific subscripts; $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}$ and β_{12} are parameters to be estimated in the model.

Bernanke and Blinder (1988) assume that inflation and inflationary expectations are constant. However, in empirical studies this assumption cannot be made and there is some inconsistency in its treatment in previous studies. In our model, we include all variables, except *GDP* and *REER*, in

nominal terms. The argument for including these exceptions in real terms is that we are interested in examining how aggregate demand (*GDP*) affects credit growth. Accordingly, if we include nominal *GDP* we cannot establish whether changes in loan growth are caused by the real output changes or inflation.

The reason for the lagged dependent variable in the model, as argued by Bernanke and Blinder (1988), is because the model is designed as a stock-adjustment model allowing for some inertia in the adjustment of the stock of loans, that is, the current value may be determined by its own past value. The sign of the parameter is expected to be positive.

The interest rates are included to indicate if there is direct response of loans to their changes. The expected sign of both rates is negative. As representative domestic interest rate we have selected the domestic MBKS, whereas for representative foreign interest rate we chosen the 3-month EURIBOR.

GDP and *CPI* control for demand side effects and the business cycle in the economy. However, the estimated impact of these two variables should be viewed with caution because, in the transition economies, these variables may also capture some other non-economic factors that may influence the loan demand. Particularly in the case of Macedonia, the loan demand may be affected by the transition process that was characterised by a wave of bank failures in the initial period of transition and a wave of failures of savings houses later.

The rationale for adding the *REER* as a measure of the price competitiveness of domestic products was explained in the Section 'Literature review'. However, for the inclusion of this variable in the case of the Macedonian economy have to be taken with caution because the trade balance deterioration caused by appreciation of the *REER* is not fully covered by capital inflows. It is largely covered by other sources, such as private transfers that in 2008 accounted around 14% of the nominal *GDP*.

The impact of each of the three bank-specific characteristics, size, liquidity and capitalisation, and their interaction terms with the MBKS was explained in the model presented in the beginning of this section. Hence, according to equations 13 and 14, the signs of the single terms of these three balance sheet items and their interaction terms with the reference rate are expected to be positive.

A foreign ownership dummy variable and its interaction term with the policy rate aim to control for the effect of foreign ownership in the banking sector explained in Section 'Literature review'. The signs of both parameters are expected to be positive. However, in the case of Macedonia there may be a divergence between the legal definition of foreign-owned banks (*de jure*)

and the one in practice (*de facto*) that may bias the results (Bogoev, 2010). Accordingly, it is not clear that the foreign-ownership variable will have a significant impact on the bank lending channel.

DATA ISSUES AND SUMMARY STATISTICS

We use bank balance sheet data obtained from Banking Supervision Department of the NBRM, which is not publicly available (for details see Appendix). We work with quarterly data with a sample period from 2000 to 2008. The sample is restricted to this time span because the balance sheet items for each individual bank over this period were constructed according to the same accounting methodology with only minor modifications. The balance sheet data before 2000 were not available for all banks and complied according to a different accounting methodology. At the end of 2008, an important methodological change in to the classification of the balance sheet items was implemented and, therefore, later data are not comparable.

The original unbalanced data set that comprises all banks in Macedonia includes 24 banks. However, the sample was adjusted for mergers and acquisitions among banks by backward aggregation of the balance sheet items. Although this is the most commonly used approach in the literature (Ehrmann *et al.*, 2001; Worms, 2001; Gambacorta, 2005; Farinha and Marques, 2003; De Haan, 2001; Havrylchuk and Jurzyk, 2005 and Pruteanu-Podpiera, 2007), this may bias the data because changes in the management of the merged bank and the know-how of the staff are not controlled for. After the adjustment of the sample for the mergers between two banks that occurred in 2001 and 2006 and two acquisitions in 2001 respectively, over the whole sample period we work with an unbalanced set of 20 banks. Detailed description of each data series used in the model is presented in Appendix.

Following the approach of Ehrmann *et al.* (2001), the bank-specific characteristics are transformed as follows:

$$Size_{i,t} = \log A_{i,t} - \frac{1}{N_t} \sum_i \log A_{i,t} \quad (16)$$

$$Liq_{i,t} = \frac{L_{i,t}}{A_{i,t}} - \frac{1}{T} \sum_t \left(\frac{1}{N_t} \sum_i \frac{L_{i,t}}{A_{i,t}} \right) \quad (17)$$

$$Cap_{i,t} = \frac{C_{i,t}}{A_{i,t}} - \frac{1}{T} \sum_t \left(\frac{1}{N_t} \sum_i \frac{C_{i,t}}{A_{i,t}} \right) \quad (18)$$

Where: $A_{i,t}$, $L_{i,t}$, and $C_{i,t}$ = assets, liquidity and size by bank i in year t , respectively; N and T = the size and the time length of the sample respectively; i and t = bank and time specific subscripts.

The main reason for this normalisation is that the average of the interaction term $X_{it}MPID_t$ and $X_{it}MPIF_t$ from the equation 15 is zero and consequently, the coefficients β_8 and β_9 are interpreted as the direct impact of domestic and foreign reference rates on banks' loans respectively, conditional on these bank financial characteristics (Ehrmann *et al.*, 2001; Gambacorta, 2005). Another reason for the normalisation is that in this way any disturbances caused by minor methodological changes in the balance sheet data can be reduced (Chmielewski, 2006).

ESTIMATION RESULTS

In interpreting the results, we will focus on both short-run estimates (Tables 2 and 3) and long-run estimates (Table 4).⁴ By estimating the model with system GMM, in order to circumvent the problem of creation of too many instruments N , we restrict and collapse the instrument set with the `xtabond2` command (Roodman, 2006). Thus, the total number of instruments created was reduced considerably and ranges from 23 for regressions 1–3 in Table 2 and regression 2 in Table 3 to 30 for regressions 1 and 3 in Table 3. In selecting the most parsimonious model, we assess a battery of diagnostic tests such as the Arellano-Bond test for the second-order serial correlation and the Hansen test for the joint validity of the instrument sets. Additionally, we performed the difference-in-Hansen test that may be used to test whether the system GMM is better than the difference GMM. As suggested by Sarafidis *et al.* (2006), this may be used as a proxy indicator for the presence of cross-sectional dependence.

The final model specifications are variants of the general form presented in equation 15. The initial investigation started from this as reflecting the underlying theory and variables found to be important elsewhere in the transition environment. However, in our specification search we were aware of the need to specify as restricted a model as possible, given the need to keep the number of instruments relatively low.

⁴ The overall long-run effect is calculated with the following formula: $\sum_t \beta_t / (1 - \sum_{l=1} y_{t-l})$, where β is the coefficient(s) of the independent variable, y is the coefficient(s) of the lagged dependent variable, t is the time subscript and l indicates the number of lags. In STATA 10, we use the `nlcom` command for calculating the long-run coefficients and their statistical significance.

Table 2: Short-run estimates of outstanding loans in domestic currency

Variables	Regression 1	Regression 2	Regression 3
	Controlling for size	Controlling for liquidity2	Controlling for capital
L.LoansDen	0.816***	0.841***	0.842***
W-C S.E.	0.089	0.070	0.104
MBKS	-0.021**	-0.023***	-0.014**
W-C S.E.	0.010	0.006	0.006
EUR	0.012	0.015	0.010
W-C S.E.	0.012	0.012	0.017
LCPI1	1.564*	0.623	0.029
W-C S.E.	0.767	0.580	0.560
IGDPr	-0.493*	-0.443**	-0.518*
W-C S.E.	0.271	0.207	0.273
SizeNorm	0.061	—	—
W-C S.E.	0.086	—	—
SizeNormMBKS	0.002	—	—
W-C S.E.	0.005	—	—
SizeNormEUR	0.028	—	—
W-C S.E.	0.025	—	—
Liquid2Norm	—	-0.728	—
W-C S.E.	—	1.050	—
Liquid2normMBKS	—	0.035	—
W-C S.E.	—	0.065	—
Liquid2normEUR	—	0.143	—
W-C S.E.	—	0.155	—
CapitalNorm	—	—	0.315
W-C S.E.	—	—	0.541
CapitalnormMBKS	—	—	-0.038
W-C S.E.	—	—	0.046
CapitalnormEUR	—	—	-0.203
W-C S.E.	—	—	0.207
Constant	0.981	3.030	6.445**
W-C S.E.	2.722	2.207	3.045
Number of observations	635	635	635
Number of banks	20	20	20
Number of instruments	23	23	23
F-test for the significance of the whole regression (<i>p</i> -value)	<i>F</i> (8, 19)=925.35 (0.00)	<i>F</i> (8, 19)=1096.21 (0.00)	<i>F</i> (8, 19)=309.57 (0.00)
AR(1)/(<i>p</i> -value)	-2.41 (0.02)	-2.53 (0.01)	-2.74 (0.01)
AR(2)/(<i>p</i> -value)	0.06 (0.95)	-0.20 (0.85)	-0.49 (0.62)
Hansen (<i>p</i> -value)	0.87	0.82	0.48
Difference in Hansen 'system' (<i>p</i> -value)	0.96	0.50	0.76
Difference in Hansen cross-sectional correlation (<i>p</i> -value)	0.49	0.90	0.23
Estimates of L.LoansDen with FE	0.67	0.75	0.74
Estimates of L.LoansDen with OLS	0.86	0.92	0.89

Dependent variable: log of the stock of loans denominated in domestic currency.

Notes: Estimated by two-step 'system' GMM estimator with Windmeijer (2005) corrected standard errors, by restricting and collapsing the instrument set with the command `xtabond2`.

***/**/* denote significance at 1%, 5% and 10% level of significance, respectively.

Windmeijer (2005) corrected standard errors in parenthesis.

Computations have been done in STATA 10.

Table 3: Short-run estimates of outstanding loans in foreign currency (mainly in euros)

Variables	Regression 1	Regression 2	Regression 3
	Controlling for size	Controlling for liquidity2	Controlling for capital
L.LoansFX	0.627***	0.596***	0.546***
W-C S.E.	0.149	0.065	0.033
MBKS	-0.005	-0.007	-0.002
W-C S.E.	0.032	0.016	0.011
EUR	-0.196**	-0.109**	-0.177***
W-C S.E.	0.075	0.052	0.029
LCPI1	-1.332	-3.114	0.372
W-C S.E.	1.641	3.211	1.299
IGDPr	1.789*	1.741***	1.281**
W-C S.E.	0.866	0.553	0.534
SizeNorm	-0.362	—	—
W-C S.E.	0.409	—	—
SizeNormMBKS	0.006	—	—
W-C S.E.	0.026	—	—
SizeNormEUR	0.219**	—	—
W-C S.E.	0.094	—	—
Liquid2Norm	—	-5.584**	—
W-C S.E.	—	2.181	—
Liquid2normMBKS	—	0.093	—
W-C S.E.	—	0.105	—
Liquid2normEUR	—	0.42	—
W-C S.E.	—	0.490	—
CapitalNorm	—	—	4.240***
W-C S.E.	—	—	1.627
CapitalnormMBKS	—	—	0.064
W-C S.E.	—	—	0.049
CapitalnormEUR	—	—	-1.132
W-C S.E.	—	—	1.350
Constant	-6.979	2.075	-8.072
W-C S.E.	7.342	7.360	6.030
Number of observations	478	478	478
Number of banks	18	18	18
Number of instruments	30	23	30
F-test for the significance of the whole regression (<i>p</i> -value)	<i>F</i> (8, 17)=26.44 (0.00)	<i>F</i> (8, 17)=1023.19 (0.00)	<i>F</i> (8, 17)=6646.16 (0.00)
AR(1)/(<i>p</i> -value)	-1.32 (0.19)	-1.40 (0.16)	-1.34 (0.18)
AR(2)/(<i>p</i> -value)	-0.70 (0.49)	-0.77 (0.44)	-0.80 (0.42)
Hansen (<i>p</i> -value)	0.89	0.66	0.87
Difference in Hansen 'system' (<i>p</i> -value)	0.80	0.65	0.73
Difference in Hansen cross-sectional correlation (<i>p</i> -value)	0.95	0.51	0.98
Estimates of L.LoansFX with Fixed Effects (FE)	0.61	0.55	0.53
Estimates of L.LoansFX with Ordinary Least Squares (OLS)	0.78	0.81	0.76

Dependent variable: log of the stock of loans denominated in foreign currency.

Notes: Estimated by two-step 'system' GMM estimator with Windmeijer (2005) corrected standard errors, by restricting and collapsing the instrument set with the command `xtabond2`.

***/**/* denote significance at 1%, 5% and 10% level of significance, respectively.

Windmeijer (2005) corrected standard errors in parenthesis.

Computations have been done in STATA 10.

Table 4: Long-run estimates of outstanding loans in domestic and foreign currency (mainly in euros), respectively

	Estimates of the long-run relationship among the variables for the domestic currency loans based on the short-run estimates from table 2	Long-run relationship among the variables for the foreign currency loans based on the short-run estimates from table 3
<i>Regression 1 – model with size</i>		
MBKS	–0.115*	–0.011
EUR	0.063	–0.414***
LCPI	8.515***	–2.814
IGDPr	–2.687	3.781**
SizeNorm	0.331	–0.765
SizeNormMBKS	0.009	0.012
SizeNormEUR	0.153	0.463***
<i>Regression 2 – model with liquidity</i>		
MBKS	–0.282	–0.014
EUR	0.161	–0.287***
LCPI	9.61	–6.18
IGDPr	–5.553	3.456***
Liquid2Norm	–10.400	–11.085**
Liquid2normMBKS	0.088	0.184
Liquid2normEUR	1.442	0.833
<i>Regression 3 – model with capital</i>		
MBKS	–0.145*	–0.002
EUR	0.148	–0.321***
LCPI	0.509	0.672
IGDPr	–8.947**	2.313**
CapitalNorm	5.438	7.656**
CapitalnormMBKS	–0.66	0.114
CapitalnormEUR	–2.512	–2.043

***/**/* denotes significance at 1%, 5% and 10% level of significance, respectively.
Computations have been done in STATA 10.

Starting with the most general model presented in equation 15, for both domestic and foreign currency loans we started by assessing the impact and the statistical significance of the *REER* variable. The results from both models for domestic and foreign currency loans indicated that this variable is statistically insignificant at the 10% level.⁵ Thus, given the economic arguments that in the case of Macedonia this variable may *a priori* have an ambiguous impact and its statistical insignificance, we decided to exclude it from the model. We next assessed the statistical significance of the foreign ownership variable and its interaction term with the MBKS. The results

⁵ The results are available from the author upon request.

indicated that in all model specifications both terms are jointly insignificant at the 10% level. Moreover, even using some insider information from the Banking Supervision department from the NBRM in order to clearly distinguish which banks are *de facto* foreign-owned and which only *de jure* in defining the dummy variable, the foreign ownership remained statistically insignificant.⁶ The results of the more restricted model are discussed in the following subsection.

Interpretation of the results of the most parsimonious model

The two-step results with Windmeijer (2005)-corrected standard errors for the short-run relationship among the variables for the currency disaggregated loans are presented in Tables 2 and 3, whereas the estimates for the long-run relationship among the variables are presented in Table 4. The regressions are classified according to the interaction term of each bank-specific characteristic.

As can be seen from the results, all model specifications satisfy the criteria of no second-order serial correlation in the residuals. The null hypothesis of the Arellano-Bond test cannot be rejected at a 10% level of significance (Tables 2 and 3). The results of Hansen test point to non-rejection of the null hypothesis of validity of the over-identifying restrictions at the 10% level of significance (Tables 2 and 3). By restricting and collapsing the instrument sets, we managed to substantially reduce the number of instruments. Accordingly, we were able to reduce the *p*-value of Hansen test much below 1 so that it ranges from 0.48 to 0.89.

As an additional specification test, we conducted the difference-in-Hansen test for the joint validity of the differenced instruments used for the levels equation. The results indicated that at a 10% level of significance we cannot reject the null hypothesis of their joint validity, supporting the choice of system over difference GMM (Tables 2 and 3). Moreover, as a rough test for the presence of cross-sectional dependence in the model, we conducted the difference-in-Hansen test for the validity of the instruments for the two lagged values of the dependent variable (Sarafidis *et al.*, 2006; Pugh *et al.*, 2010). At a 10% level of significance, we cannot reject the null hypothesis for the joint validity of the instruments for the lagged values of the dependent variable (Tables 2 and 3).

The lagged value of the log of outstanding loans for both denar and foreign currency loans is, as expected, highly significant and has a positive sign. For lagged denar loans, the coefficient is around 0.8 (Table 2) and for the lagged foreign currency loans is around 0.6 (Table 3). These results imply

⁶These results are available from the author upon request.

relatively high inertia in the adjustment process of the stock of both domestic and foreign currency loans, although higher for domestic currency loans, which might be due to the higher share of long-term loans in domestic currency loans compared to the foreign currency loans.

For domestic currency loans, the coefficient for the domestic MBKS is negative and significant in all regressions, whereas the foreign reference rate (EURIBOR) is insignificant in all regressions for both short- and long-run estimates. The size of the short-run estimates is quite low and ranges between -1.4% and -2.3% (Table 2), for a 1% point increase in MBKS. For the long-run estimates, this coefficient is statistically significant in two out of the three regressions and ranges between -12% and -15% (Table 4). Thus, the evidence suggests that domestic currency loans react significantly to changes in the domestic MBKS in the short- and long-run but not to the foreign reference rate. However, this reaction is quite sluggish, which may imply that domestic monetary policy is relatively ineffective and the possibility for independent interest rate setting is quite limited.

Regarding the sensitivity of foreign currency loans, the results imply the reverse. More precisely, the foreign currency loans in both, short- and long-run react significantly to changes in the foreign reference rate. However, they do not react significantly to changes in the domestic reference rate. The short-run reactions range from -11% to around -20% (Table 3), whereas the long-run estimates range from -29% up to -41% (Table 4). This suggests that banks adjust their foreign currency loans in response to changes in the foreign reference rate in both, short and long run but not to the changes in the domestic reference rate. Furthermore, by comparing the size of the coefficients, we see that banks' foreign currency loan supply function is much more sensitive in the interest rates than is the domestic loan supply function. These findings imply that in small open transition economies, especially in those that have a fixed exchange rate regime, the domestic monetary policy may be quite ineffective and its impact over the banks' loan supply function is quite limited, consistent with the concept of 'impossible trinity'.

Regarding the macroeconomic control variables, the price level (*CPI*) enters positively as expected for both, short- and long-run estimates but it is statistically significant only in the model controlling for the size of the banks. Regarding the size of the short-run estimates, where significant, the price elasticity of loan supply is 1.6 (Table 2), whereas the long-run estimate, where significant, is 8.5 (Table 4). In the regressions for foreign currency loans, the price level does not enter significantly in any of the three models for the short- and long-run relationship (Tables 3 and 4). This may be explained by the possibility that banks in granting foreign currency loans believe they

are hedged from the possible risks of an unstable macroeconomic environment and higher inflation, and the risks of possible depreciation of the nominal exchange rate are transmitted to the borrowers. These results suggest that the price level matters only for banks' loans in the domestic currency loan due to the possible risk of currency depreciation or price instability.

The other macroeconomic control variable (*GDP*) in both domestic and foreign currency loan supply functions enters significantly in both short- and long-run estimates (Tables 2, 3 and 4, respectively). For domestic currency loans, the coefficient is negative. The cases where *GDP* has an insignificant impact are consistent with the findings of Matousek and Sarantis (2009). However, *GDP* enters significantly and with a correct (positive) sign in the short- and long-run estimates for the foreign currency loan supply function, indicating that as economic activity intensifies, banks supply more foreign currency loans.

Regarding the single and the interaction terms of the bank-specific characteristics, the results for the domestic currency loans suggest that none of the single and interaction terms enter significantly in the short- and long-run relationship. Thus, bank characteristics do not play significant role in banks domestic currency decisions.

With the foreign currency loans, the single terms of liquidity and capital enter significantly in the loan supply function for both short- and long-run estimates. Nonetheless, the sign of the single term in respect of liquidity is contrary to the theoretical predictions, probably due to the structural excess liquidity of the banking system that may bias the results. Nonetheless, these results are in line with Wrobel and Pawlowska (2002), Matousek and Sarantis (2009) and Chmielewski (2006) for the case of Poland and Kohler *et al.* (2005) for the Baltic States whose banking systems are also characterised with structural excess liquidity.

Regarding the interaction terms, size is statistically significant with a positive sign in both the short- and long-run horizon. This indicates that bank size is a significant determinant of the heterogeneous loan supply function in respect of foreign currency loans among Macedonian banks, implying that larger banks reduce the quantity of loan supply by proportionately less when the foreign reference rate tightens than do smaller banks.

Robustness check⁷

The robustness of the results has been checked by using different GMM estimators. More precisely, we have re-estimated the same model

⁷ All the results discussed in this section are available from the author upon request.

specifications with a one-step system GMM estimator with robust standard errors by restricting and collapsing the number of instrument sets, using the `xtabond2` command. We have also re-run the same model specifications with the two-step system GMM estimator with Windmeijer (2005) corrected standard errors by only restricting the number of instruments used for the endogenous variables using the STATA default command `xtdpd`. An additional informal robustness check of the estimates, suggested by Roodman (2006) and Bond (2002), is to verify if the estimates of the lagged dependent variable lie between the estimates using Fixed Effects (FE) and Ordinary Least Squares (OLS) (see Tables 2 and 3). The first method tends to bias the estimates downwards, while the second method tends to bias the estimates upwards.

In re-estimating the same regressions by one-step system GMM with robust standard errors and reducing and collapsing the instrument sets, the results indicate that all model specifications again satisfy all diagnostic criteria mentioned in Section 'Interpretation of the results of the most parsimonious model'. Regarding the sign and size of the coefficients, the results in general are similar to the ones discussed previously. The only exception is the size of the lagged coefficients of the foreign currency loans and domestic currency loans, which now are a bit higher suggesting a higher inertia in the stock of loan adjustment. Regarding the significance of the coefficients, the major difference in respect of the domestic currency loans is that now the price level enters statistically insignificant in the regression controlling for bank size.

In re-estimating the same model specifications by only restricting the number of instruments with the two-step system GMM estimator with Windmeijer (2005) corrected standard errors, the total number of instruments created increased to more than 100 instruments, depending on the model specification. According to the estimates, again all model specifications fulfil the criteria of no second-order serial correlation, as indicated by Arellano-Bond test. However, although the results of Sargan test indicate that the null hypothesis could not be rejected at a 10% level of significance, the *p*-value of this test in all regressions equals 1. Hence, this implies that the regressions suffer from the problem of too many instruments (Roodman, 2006, 2008). This weakens the power of the Sargan test and the estimates should be treated with caution. Regarding the sign and magnitude of the coefficients, they are broadly consistent with the two-step estimates reported in the previous subsection.

CONCLUSIONS

The aim of this paper is to investigate the bank lending channel and its determinants in Macedonia and to draw a conclusion about the effectiveness of the domestic monetary policy through the bank lending channel. We

investigate two different loan supply reaction functions according to the currency of the loans.

The short- and long-run estimates indicate to the existence of a lending channel mainly through the foreign currency loan supply function, which significantly reacts only to changes in the foreign reference rate that is beyond the scope of domestic monetary policy makers. The loan supply function of domestic currency loans reacts only to the changes in the domestic reference rate, but the reaction of the latter is quite weak. This implies that the bank lending channel mainly works through the foreign currency loans and foreign reference rate and the impact of the domestic reference rate is quite limited, consistent with the concept of 'impossible trinity'. Moreover, if the increasing trend of the share of foreign currency loans in the total loans in Macedonia continues (see Figure 1), then it may reduce the effectiveness of the domestic monetary policy through the bank lending channel even more in future. The findings presented in this paper are robust to different model specifications and different estimation methods.

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APPENDIX

Data description and construction of the variables used in the model

- **LoansDen** is the natural logarithm of the nominal value of the stock of outstanding loans to non-financial private sector denominated in denars for each bank individually. Source: author's own calculations upon the data from the Banking Supervision Department of the NBRM. The data is not publicly available.
- **LoansFX** is the natural logarithm of the nominal value of the stock of outstanding loans to non-financial private sector denominated in foreign currency (mainly in euros) for each bank individually. Source: author's own calculations upon the data from the Banking Supervision Department of the NBRM. The data is not publicly available.
- **MBKS** is the weighted average interbank interest rate in nominal terms, in %. Source: NBRM (<http://www.nbrm.mk/default.asp?ItemID=9A4CA3589A2C094A92E4C4EE74B8934C>).
- **EUR** is 3-month EURIBOR in nominal terms, in %. Source: EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/page/portal/interest_rates/introduction).
- **GDP_r** is the natural logarithm of the gross domestic product of the Republic of Macedonia in denars and exchange rate from 1997. Source: author's own calculations upon the data from the State Statistical Office of Macedonia (<http://www.stat.gov.mk/statistiki.asp?ss=09.01&rbs=0>).
- **CPI₁** is the natural logarithm of the consumer price index of the Republic of Macedonia with base year: 2000 = 100. Source: author's own calculations upon the data from the State Statistical Office of Macedonia (<http://www.stat.gov.mk/statistiki.asp?ss=08.01&rbs=0>).
- **REER** is the natural logarithm of the real effective exchange rate of Macedonia with base: 2003 = 100. Source: author's own calculations upon the data from the Research Department from the NBRM. The data is not publicly available.
- **Size** is the natural logarithm of the asset size of each bank individually. In nominal terms normalised according to equation 16. Source: author's own calculations upon the data from the Banking Supervision Department of the NBRM. The data is not publicly available.
- **Liquid₂** is the ratio of liquid over total assets, both in nominal terms for each bank individually. The liquidity includes: cash in vault at the NBRM + short term deposits in accounts in banks abroad + CB bills and T-bills with maturity up to 1 year + cheques and overdrafts + short-term restricted deposits in accounts in banks abroad + short-term security holdings issued by banks and saving houses + short-term bonds issued by the state + short-term credits

granted to banks abroad. Source: author's own calculations upon the data from the Banking Supervision Department of the NBRM. The data is not publicly available.

- Capital is the ratio of equity + reserves over total assets, in nominal terms, for each bank individually. Source: author's own calculations upon the data from the Banking Supervision Department of the NBRM. The data is not publicly available.
- ForOwn is the foreign ownership dummy variable for each bank individually. Value of 1 if the bank is foreign owned and 0 otherwise. Foreign owned-bank is defined as bank where minimum 50% of shareholders capital is foreign owned. Source: Banking Regulation Department of the NBRM. The data is not publicly available.