Critical Assessment of the Theory and Empirical Studies of the Bank Lending Channel: Special Reference to Transition Economies

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Abstract:

This paper provides a critical assessment of the bank lending channel theory established by Bernanke and Blinder (1988 a, b). It also investigates several weaknesses and few additional modifications of the model found in the literature. Related to the empirical literature for the bank lending channel, this paper presents the most commonly used model by Ehrmann et al. (2001), which is designed as a simplified version of Bernanke and Blinder (1988 a, b) model. In addition, this paper critically surveys the empirical studies that explore the major determinants of the bank lending channel in transition economies from Central and South Eastern Europe (CSEE). According to the results presented in various empirical studies, bank lending channel is operational in majority of the transition economies from CSEE. Even though the surveyed empirical studies have some shortcomings, overall they provide solid results consistent with the bank lending channel theory.

Keywords: Bank Lending Channel, Banks' Financial Characteristics, Monetary Policy, Transition Economies.

1. Introduction

The research aims of this paper are to analyse and critically assess the theoretical basis of the bank lending channel and to examine the empirical evidence of whether it is being operational in different transition

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economies of Central and South Eastern Europe (CSEE). The value addition to this paper is that it provides a comprehensive critical survey of the theoretical foundations about the bank lending channel as well as critical assessment of the empirical studies that investigate the functioning of the bank lending channel in the aforementioned economies.

The main underlying theoretical model that describes the bank lending channel is that of Bernanke and Blinder (1988 a, b). This was the first formal model that modified the "traditional" IS-LM model by analysing not only the role of money in the monetary transmission mechanism and income determination, but also the role of loans in the economy. Moreover, this analysis critically assesses some of the weaknesses of this model and reviews some additional explanations and amendments of the model found in the literature. Related to the empirical analyses, this paper examines the econometric model put forward by Ehrmann et al. (2001), which is a simplified and modified version of Bernanke and Blinder (1988 a,b) model. This model is the most frequently used in the empirical studies. Additionally, various methods employed in different empirical studies that examine the bank lending channel in different economies are surveyed and critically assessed.

This paper is structured as follows: section 2 explains Bernanke and Blinder (1988 a, b) model. section 3 provides a critical appraisal and examines some amendments to the model. section 4 describes and criticises the econometric model designed by Ehrmann et al. (2001). Section 5 surveys various empirical studies that investigate the bank lending channel and provides a critical assessment. The final section concludes the assessment of theory and empirical evidence.

2. The Theoretical Basis of the Bank Lending Channel

The theoretical background of the bank lending channel was initially developed by Bernanke and Blinder (1988 a, b)[1]. They modify the traditional IS-LM model by relaxing some of its basic assumptions. Their starting argument is that although the traditional IS-LM model can explain the money

[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 a, b).

and interest rate channel of monetary transmission quite well, one of its main weaknesses is that it analyses the influence of various shocks in the economy only through the money function, giving a negligible role to the other financial instruments i.e. loans and bonds. More precisely, the IS-LM model treats asymmetrically banks' assets and liabilities by assigning a special role to money as a bank liability in determining aggregate demand. On the other hand, it treats loans and bonds equally as perfect substitutes for each other and where both markets are suppressed by Walras' Law. In that respect, the main innovations of Bernanke and Blinder model are the abandonment of the assumptions of perfect substitutability of loans and bonds and that financial markets clear only through price. They argue that loans should have a different treatment in the economy as compared to other financial instruments because they are provided by intermediary institutions, which are specialised in screening and monitoring borrowers in the presence of asymmetric information. These institutions can have an important impact on the monetary transmission mechanism in the economy where market clearance can be achieved not only by changes in the interest rates but also by the quantity of loans supplied, i.e. credit-rationing. Another argument why loans should have a different treatment from the other financial assets is associated with the periods of financial deregulation and integration of financial systems that induce higher capital mobility. Both of these factors, accompanied by financial innovations that can create similar instruments to money, may destabilise the money demand function.

Thus, Bernanke and Blinder (1988 a, b) amend the IS-LM model by substituting the IS curve with the credit-commodity curve (CC)[2]. The model is based on three equations. The first is the credit market curve (CM) representing the equilibrium on the credit market. The second is the LM curve representing the equilibrium on the money market and the third is the IS curve, representing the equilibrium on the goods market. Derivation of the model, under the assumptions of given prices, constant expected inflation and given information asymmetry, is presented below[3]:

The CM curve is derived on the following basis:

[2] Henceforth, we will also refer to the Bernanke and Blinder (1988 a, b) model as the CC-LM model.
[3] The derivation and explanation of the model is based on Bernanke and Blinder (1988 a, b) and Kierzenkowski (2005 and 2007).

The simplified bank balance sheet that ignores net worth is shown in equation 1.

$$R + B + L = D \qquad (1)$$

Banks' total assets are composed of reserves (R), bonds (B) and loans (L), which equal total liabilities that for simplicity are assumed to consist only of deposits (D). As total bank reserves (R) are composed of required reserves (τD) plus excess reserves (E), where τ is the reserve requirement coefficient; the banks' adding up constraint is:

$$B + L + E = D(1-\tau) \qquad (2)$$

Since cash is ignored in the model and it is assumed that the loan interest rate does not have any impact on the excess reserves function, therefore, banks' excess reserves depend negatively on the bond rate (i):

$$E = f(i)\, D(1-\tau) \qquad (3)$$

By assuming that the desired portfolio structure of banks is determined by the interest rates on loans and bonds, banks' loan supply function (L^s) is:

$$L^s = -\gamma_b i + \gamma_l \rho + D \qquad (4)$$

which is negatively related to interest rates on bonds (i) and positively to interest rates on loans (ρ), plus the amount of deposits. Coefficients γ_l and γ_b refer to the loan and bond interest rate elasticities of loan supply, respectively. Henceforth, following the approach of Kierzenkowski (2005 and 2007), all variables in the model (including the equation 4) are expressed in natural logarithms and are shown as deviations from their steady state trend, i.e. $x = \log \frac{x}{x_0}$

The loan demand function of the private sector (L^d):

$$L^d = \lambda_b i + \lambda_y y - \lambda_l \rho \qquad (5)$$

is determined positively by the interest rates on bonds (i), income (y) that captures the transactions demand for loans, which according to Bernanke and Blinder may arise from working capital or liquidity considerations and is also negatively related to the interest rate on loans (ρ). The coefficients λ_l and λ_b indicate the bond and loan interest rate elasticities of loan demand respectively, while λ_y refers to income elasticity of loan demand. Accordingly, equilibrium in the loan market that actually represents the CM curve is presented by:

$$\lambda_b i + \lambda_y y - \lambda_l \rho = -\gamma_b i + \gamma_l \rho + D \qquad (6)$$

The left hand side of the equation represents the loan demand function (see expression 5), while the right hand side shows the loan supply function (see expression 4).

Similarly, the money market equation (the LM curve) is derived by taking the deposit supply and demand functions. The deposit supply function is the sum of the money multiplier m(i) and the bank reserves given as below:

$$D^s = m(i) + R \qquad (7)$$

Whereas, the money multiplier m(i) is a positive function of interest rate of bonds due to the opportunity costs to banks of holding excess reserves (see equation 3). [4]

$$m(i) = [f(i)(1-\tau) + \tau]^{-1} \qquad (8)$$

The demand for deposits function is negatively related to the interest rate on bonds and positively related to income (representing the transactions motive) and net wealth.

$$D^d = -\beta_b i + \beta_y y \qquad (9)$$

[4] This function is expressed in levels not in logs as the most of the functions in this section, so the interpretation is different.

Net wealth in the model is assumed to be constant and therefore it is suppressed throughout the model. However this assumption may be too strong and may not apply in the medium and long run because there may be fluctuations in the net wealth. Thus, this may not be applicable for the transition economies as there can be noticeable fluctuations of the net wealth even in the short run. The coefficients β_b and β_y represent the bond interest rate and income elasticities of deposit demand, respectively.

Therefore, the equilibrium of the money market, representing the LM curve, is shown below:

$$-\beta_b i + \beta_y y = m(i) + R \qquad (10)$$

where the left hand side of the above equation is the deposit demand function (equation 9) and the right hand side represents the deposit supply function (equation 7).

The IS curve, indicating the equilibrium on the goods market, is a negative function of both bond (θ_b) and loan (θ_l) interest rate elasticities of output demand, which is shown below:

$$y = -\theta_l \rho - \theta_b i \qquad (11)$$

Regarding the equations presented so far, the "traditional" IS-LM model can be expressed with the following two equations, referring to the IS and LM curves respectively:

$$\begin{aligned} &\text{(IS curve):} && y = -\theta_l \rho - \theta_b i \\ &\text{(LM curve):} && -\beta_b i + \beta_y y = m(i) + R \end{aligned} \qquad (12)$$

The major contribution of Bernanke and Blinder's model is that they amend the IS-LM model by adding another equation that represents the credit market (CM curve), which is presented as follows:

$$\begin{aligned} &\text{(IS curve):} && y = -\theta_l \rho - \theta_b i \\ &\text{(LM curve):} && -\beta_b i + \beta_y y = m(i) + R \\ &\text{(CM curve):} && \lambda_b i + \lambda_y y - \lambda_l \rho = -\gamma_b i + \gamma_l \rho + D \end{aligned} \qquad (13)$$

By substituting the deposits (D) variable, as it is defined with equation 7, in the CM equation (13); we derive the following CM curve:

$$\lambda_b i + \lambda_y y - \lambda_l \rho = -\gamma_b i + \gamma_l \rho + m(i) + R \qquad (14)$$

Solving the equation 14 for interest rate on loans (ρ), expressed as a function of interest rate of bonds, income and bank reserves (i, y, R, respectively); we get the following equation:

$$\rho = \frac{\lambda_b i + \lambda_y y + \gamma_b i - m(i) - R}{\lambda_l + \gamma_l} \qquad (15)$$

By substituting the loan interest rate (ρ), as it is defined by equation 15, in the IS curve (equation 11), we get the following equilibrium relationship:

$$y = \frac{-i[\theta_l(\lambda_b + \gamma_b) + \theta_l(\lambda_l + \gamma_l)] + \theta_l m(i) - \theta_l R}{\lambda_l + \gamma_l + \lambda_y \theta_l} \qquad (16)$$

Equation (16) is referred to as the Bernanke and Blinder Credit Commodity curve (CC) that shows simultaneous equilibrium in both commodities and credit markets.

In the CC-LM model, the CC curve is negatively sloped as is the IS curve. The CC-LM model will become equivalent to the IS-LM model if loans and bonds are perceived as perfect substitutes either by lenders or borrowers, i.e. when the interest rate elasticities of loan supply or demand converge to plus and minus infinity respectively, ($\gamma_l \rightarrow \sim$; or $\lambda_l \rightarrow -\sim$); or when the income elasticity of loan demand becomes insensitive to loan interest rate, i.e. equals to zero ($\lambda_y = 0$). The point where both curves intersect indicates the equilibrium of money market as well as equilibrium in the credit and commodity markets.

Except in the extreme cases explained above, the main difference in the CC-LM model from the IS-LM model is that now changes in the level of

bank reserves not only affects the LM curve, but also affect the CC curve (equation 16) that ultimately makes monetary policy more effective.[5] For instance, an increase/decrease in bank reserves will not only shift the LM curve outward/inward but will also shift the CC curve in the same direction through changes in the quantity of loan supply. More precisely, an increase in bank reserves affects the LM curve by increasing the quantity of deposit (money) supply by the banks. At the same time, it will also have an impact on the CC curve by increasing the loan supply by banks that shifts the CC curve in the same direction as the LM curve. Furthermore, this increase in bank reserves will also have an impact on the size of the interest rate spread between the public bonds and loans because according to this model, changes in monetary policy have a higher impact on loan interest rates than the bond interest rate. More specifically, monetary policy tightening should increase the interest rate spread between loan and bond interest rates and vice versa. This is further explained by Bernanke and Blinder (1993) and Kierzenkowski (2005). However, in the derivation of the model, related to bank reserves, no account is taken of possible heterogeneous responses among banks with different financial characteristics in their loan supply that is induced by changes in monetary policy. This extension is covered in the version of the model developed by Ehrmann et al. (2001), (section 4). For instance, more liquid banks that keep higher level of excess reserves in case they face an unexpected withdrawal of deposits, may react differently in reducing their loan supply in periods of restrictive monetary policy compared to less liquid banks.

The other noteworthy difference between the CC-LM and IS-LM models is that shocks to credit supply or demand may affect the CC curve, which is not the case with the IS curve. However, in practice it is difficult to identify the demand side shocks because it is difficult to disentangle whether the loan demand side is affected by purely demand side shocks or it is affected by other macroeconomic factors. Therefore, usually in the literature the functioning of the bank lending channel is examined through the loan supply side factors. For example, a perceived lower riskiness of loans by the intermediary institutions may increase the loan supply that consequently, will shift the CC curve outward. The aforementioned factors that may induce

[5] The key monetary policy instrument of the central bank in the model is control over the base money through open market operations that directly affect the level of bank reserves.

shifts in the CC curve actually represent the bank lending channel that, according to the authors, enhance the effectiveness of the interest rate channel.

These predictions of Bernanke and Blinder model on the bank lending channel are supported by empirical evidence. For instance, estimations of the correlation between the growth rates of GNP and money and credit aggregates in the USA for the period 1953-1985, have indicated a higher correlation between the growth of GNP and credit after 1980, compared to the correlation between the growth of GNP and money[6]. Furthermore, the estimates of money and credit demand functions have suggested a higher parameter stability of the credit demand function from the 1980s, implying that the credit demand function may be a better predictor of the movements of GNP[7]. Another empirical finding is that the lending channel can significantly affect the size of the interest rate spread between bond and loan interest rates. This argument of the authors is based on the results from the credit demand function where credit aggregates are regressed on GNP, bonds and loans interest rates and the GNP deflator. According to the results, in periods of monetary policy tightening when bank reserves are reduced, the size of the interest rate spread between loans and bonds will increase and vice versa. However, the aforementioned results should be taken with caution because the significance level of the correlation coefficients are not provided while the regression results may be unreliable due to the relatively short time span of the data. Furthermore, the authors do not discuss the stability of the model and diagnostic tests. Additionally, considering their use of time series data, current practice suggests the need to consider the stationarity of the data and the application of co-integration methods.

Bernanke and Blinder (1992) argue that if the bank lending channel exists, then bank balance sheet items should exhibit systematic movements from a monetary policy shock. More precisely, monetary policy tightening is expected to affect both banks' assets and liabilities in such a way that the reduction of deposits should be offset by a reduction of loan supply. Accordingly, results from the impulse response analysis conducted for the

[6] Even though Bernanke and Blinder (1988 a,b) model is based on real terms, the correlation coefficients are estimated in both real and nominal terms respectively, and provide consistent findings.
[7] The GNP is in real terms while the rest of the regressors are in nominal terms. However, the price level is controlled in the regression model by inclusion of the GDP deflator.

USA for the period 1959-1978 based on macroeconomic data, have indicated that a monetary policy tightening (an increase in Federal Funds Rate), leads to an immediate decline in bank deposits.[8] After the shock , bank securities decline in the first six months and then start to rise. In contrast, bank loans remain unaffected immediately after the shock and begin to decline with a delay of 6 to 8 months. Consequently, the authors argue that these changes in bank portfolio structure show systematic movements because banks in order to maintain the level of loan supply after the policy shock offset the decline of deposits by the sale of securities. Later on, banks do not continue to offset the decline in deposits by selling securities and therefore they start to reduce the level of loan supply by lowering the quantity of new loans and/or by terminating the old ones and begin to rebuild their level of securities. According to the authors' arguments, this is an indication for the existence of the bank lending channel.

Nevertheless, this interpretation of empirical findings, based on macroeconomic data, should be taken with caution as there may be an identification problem. More specifically, the decline in loans may not only arise from supply side factors (reduced loan supply, resulting from decline in deposits), but also from demand side factors because, an increase in the interest rate may lead to lower investment and consumption by firms and households that may result in a reduced loan demand. Furthermore, confidence intervals from the impulse response analysis are not provided, and thus the significance of the findings is unclear. Overall, the main contribution of Bernanke and Blinder model is that it indicates that bank loans as well as money can have an important role in the monetary transmission in the economy.

3. Critical Assessment and Further Modifications of the Model

Although Bernanke and Blinder model was the first formal model that refers to the importance of loans in monetary transmission, however, this model has been criticised in the literature mainly in relation to some weaknesses arising from its basic assumptions. As a consequence, this model has undergone several developments and additional explanations that attempt

[8] In this example, a tightening of monetary policy refers to sale of bills by the FED that drains banks' reserves and increases the Federal Funds Rate.

to alleviate some of its problems. A critique of the model and its main amendments are presented in this section.

One of the main criticisms of Bernanke and Blinder (1988 a, b) model is that it assumes that the credit market is in equilibrium, which may not always hold in practice, especially when the economy is hit by various external or internal shocks. Furthermore, in the model it is assumed that the central bank controls base money in the economy through open market operations that affect bank reserves. This monetary policy framework is consistent with a money supply targeting regime, but nowadays, since many central banks have adopted the regime of inflation targeting, the main policy instrument is the key interest rate (this issue is tackled by Kierzenkowski 2007, see below). Moreover, Bernanke and Blinder argue that the bank lending channel makes monetary policy more effective and consequently, it complements the interest rate channel, which may not always be the case (see Kierzenkowski, 2005 and Kashyap and Stein, 1993; explained later in this section). Additionally, the model does not control for differences in the financial structure of the banks that may induce heterogeneous responses to monetary policy changes because banks may not cut/expand the quantity of loans supply proportionately (Ehrmann et al., 2001). These aspects are explored in more detail in sections 4 and 5.

Another criticism of Bernanke and Blinder model is that it does not take into account the impact of foreign direct investment (FDI) and foreign bank ownership, which may reduce the strength of the lending channel. For instance, in the case of monetary tightening it may become "cheaper" for the foreign owned firms to use trade credit from their parent company as a source of finance and that may reduce firms' dependency on domestic banks' loans (Corricelli et al., 2006 and Juks, 2004). This may be especially important in some transition economies with large FDI flows and a large presence of foreign banks.

Regarding the foreign-owned banks (takeovers and greenfields), there is empirical evidence indicating that they may respond less strongly to changes in the domestic policy rate than domestically owned banks (Schmitz, 2004 and Arena et al., 2007). Furthermore, the study by De Haas and

Lelyveld (2006) conducted for a sample of 10 CSEE economies[9] indicated that foreign-owned banks, especially greenfield banks, reduce their loan supply less during crisis periods. One of the reasons for such a response by foreign-owned banks is that they may use internal capital markets in order to get financial resources from their "parent" bank (De Haas and Naaborg, 2005)[10].

Additional factor that may also reduce the strength of the bank lending channel, which is not considered in the model, may be the close interbank relationships. For instance, depending on the structure of the banking system, some small banks may use their interbank relationship in order to get sources of funds (interbank deposits) in periods of monetary tightening, as it is the case in Germany and Italy (Worms, 2001 and Gambacorta, 2005). Another factor that may reduce the effectiveness of the bank lending channel are the relationships between the bank and the borrower, the so-called "hausebank" (Ehrmann et al., 2001 and Weth, 2002). For instance, the "hausebank" phenomenon refers to maintaining a relationship between a bank and some borrowers[11] that may lead to disconnection of the link between the monetary policy and loan supply. Moreover, government involvement in the banking sector through ownership and/or state loan guarantees may additionally reduce the effect of informational asymmetries in the credit market that may ultimately reduce the strength of the lending channel (Ehrmann et al. 2001 and Corricelli et al. 2006).

An additional shortcoming of the original Bernanke and Blinder model was that it lacks clear microeconomic foundations. Kashyap and Stein (1993) provide microfoundations for the two basic assumptions of the CC-LM model: a) the imperfect substitutability between loans and bonds and b) that changes in bank reserves affect the quantity of loans supplied by the banks. The microeconomic rationale for the first assumption is that loans

[9] The 10 economies from CSEE are: Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia and the three Baltic States.

[10] The study is conducted for a sample of eight CSEE economies: Czech Republic, Hungary, Poland, Slovakia, Slovenia and the three Baltic States.

[11] This is typical for small banks who are quite well familiarized with the financial strength and condition of the borrowers. Therefore, these banks in order to maintain those borrowers usually avoid cutting loan supply when monetary policy tightens.

provided by intermediary institutions have a special role in the economy because they are specialised in screening and monitoring borrowers which reduces the asymmetric information in financial markets between lenders and borrowers. This is not the case in the bond market because here lenders are not so specialised in monitoring the borrowers. Accordingly, borrowers in the bond market may exhibit moral hazard and may cause high deadweight costs for lenders, which is one of the major differences between these two financial instruments. An additional argument explaining why bank loans are different from bonds is that loan costs (interest rates that are usually associated with the costs of reserve requirement), are lower compared to the costs (interest rate set) on bonds. Furthermore, repeated transactions between the borrowers and lenders may result in the so-called "locked-in" relationship, implying that after establishing a relationship between the borrowers and lenders, it may become costly for the borrowers to change lenders or the financial instrument. More precisely, the borrower will be faced with transaction costs in searching for the new lender and learning costs that arise from learning the new conditions by which the borrower may get a loan.

Related to the second assumption, Kashyap and Stein (1993) argue that if banks dominate the credit market, then the central bank can affect the quantity of loan supply by controlling the level of bank reserves. According to the statistical data provided, banks in the USA have a dominant share of the loan supply market. However, their analysed time period was up to 1991, and in some periods after 1991 and in some economies, the market share of banks in the credit market may have changed. For example, in measuring banks' market share on the credit market, the results may depend on the legal definition of banks as entities and what kind of activities they are doing because through time, banks' legal definition and their carrying out of activities may change.

An additional argument that provides microfoundations for the second assumption of the CC-LM model, according to Kashyap and Stein (1993), is that banks are not indifferent to their portfolio structure because when their reserves are reduced, they respond by cutting the loan supply instead of selling some of their security holdings or issuing new Certificate of Deposits (CDs). The rationale why banks do not fully compensate for the

withdrawal of deposits by selling their security holdings is that securities are seen as liquid assets in the bank's portfolio structure that act as a shield in case of any unexpected withdrawal of deposits. Similarly, banks do not fully compensate the reserve reduction by issuing CDs as a tradable instrument because the marginal costs of additional issuance of CDs rise substantially. More precisely, due to asymmetric information, investors in CDs may suspect the quality of a bank that issues a high amount of CDs, particularly if it is a small bank, and may therefore require a high rate of return. Ultimately, this reduces the spread between the interest rates of loans and CDs and subsequently loan profitability. This argument was developed for the US economy where CDs are tradable financial instrument, whereas in other economies, especially with still relatively underdeveloped financial systems (transition economies), time deposits as an alternative instrument to CDs may not necessarily be tradable. This may make the bank lending channel even more pronounced.

Further microeconomic foundations for the bank lending channel are provided by Bernanke and Gertler (1995), where the functioning of the lending channel is related to changes in the external finance premium that borrowers face. The external finance premium is defined as the spread between the costs of external funds that have to be raised for financing their investment activities (loans or issuing equity) and the opportunity costs of their internal funds for financing (retained earnings). Thus, the authors argue that during a monetary policy tightening, informational frictions in the credit market worsen and therefore, the costs of intermediary loan supply institutions rise because they have to do more intensive screening, evaluation and monitoring of borrowers as well as additional activities related to contract enforcement and repayment of loans. Consequently, these activities result in an increase in costs (interest rates) of loans that lead to an increase in the external finance premium for the borrowers, which eventually may reduce the level of their borrowing. Another explanation is that in a period of restrictive monetary policy, when bank reserves decline and subsequently banks reduce the quantity of loan supply, the borrowers may be forced to find another lender (bank), which incurs additional costs that will be reflected in an increase of their external finance premium.

Bernanke and Gertler (1995) did not make a clear distinction between the functioning of the bank lending channel and the balance sheet channel, which are related and may both affect the external finance premium. Respectively, the balance sheet channel represents the effects of changes in the net worth of borrowers, defined as the value of assets minus liabilities, which are induced by the changes in monetary policy. For example, the authors explain that an increase in interest rates induced by monetary policy tightening may worsen the financial position of borrowers. More precisely, on one side, an increase in interest rates will increase the interest expense of borrowers and therefore, will reduce their cash flow. On the other side, it may affect the value of their collateral provided composed of assets holdings because the increase in interest rates is correlated with a decline in asset prices. Consequently, due to the worsening of the financial position of borrowers, banks may increase the interest rates of loans in order to compensate for a potential drop in debt repayments or cut back their loan supply. Both cases affect the external finance premium of borrowers.

Kierzenkowski (2007) further amends the CC-LM model by relaxing the implicit assumption of Bernanke and Blinder that the loan interest rates are more responsive to changes in monetary policy than bond interest rates and therefore, the lending channel makes monetary policy more effective. Regarding this issue, Kierzenkowski (2007) argues that the bank lending channel does not always enhance the effectiveness of monetary policy and in some circumstances it may even reduce it. This depends on the factors that determine the slope and scale of shifts in the CC curve. For example, the slope of the CC curve is mainly determined by loan and bond interest rate elasticities of loan supply (γ_l and γ_b respectively, see equation 16), loan and bond interest rate elasticities of loan demand (λ_l and λ_b respectively, see equation 16) and the income elasticity of loan demand (λ_y, see equation 16). Consequently, when the loan supply is more responsive to changes in loan interest rates than bond rates ($\gamma_l > \gamma_b$) and/or when loan demand is more responsive to changes in loan rates than bond rates ($\lambda_l > \lambda_b$) and when income elasticity of loan demand is relatively high (λy); then the response of loan interest rate to changes in monetary policy will be smaller than the bond interest rate. In this case, when the slope of the CC curve is steeper than the IS curve, it implies that the bank lending channel reduces the interest rate channel, which ultimately may weaken the strength of monetary policy.

The finding of Kierzenkowski (2007) that the bank lending channel may weaken the effectiveness of monetary policy does not only depend on the slope of the CC curve compared to the IS curve, but also on the scale of shift of the CC curve, is the major breakthrough of the author. Nevertheless, the major weakness is that the factors that induce the shift of the CC curve are not examined in detail in this model. In other words, it is not precisely specified which factors and in what circumstances have the most influential impact on the scale of shift of the CC curve. Furthermore, this model of Kierzenkowski (2007) has not been a subject of empirical investigation.

Additionally, Kashyap and Stein (1993) also argue that in some cases, the bank lending channel may reduce the strength of monetary policy. This may occur during an expansionary monetary policy when some banks cannot further extend the quantity of loan supply due to a binding capital constraint because of the legal capital requirement provisions regulating the banking sector.

A further amendment of Bernanke and Blinder model is proposed by Kierzenkowski (2005). He amends the CC-LM model by substituting the main monetary policy instrument of the model (control over the bank reserves through open market operations) with the policy instrument of control over the key central bank interest rate. The same conditions for amplification and attenuation regime of the bank lending channel apply as in Kierzenkowski (2007) except that now the direction of interest rate spread is analysed between the loan rate and key policy rate. This model modification is empirically tested for the case of Poland. The results pointed to an attenuation effect of the lending channel under the fixed exchange rate regime during the period 1996-1998; while after 1998 when the exchange rate has become flexible, the results suggest a neutral effect of the bank lending channel over the monetary transmission. However, the main shortcoming of this analysis is that it lacks a more comprehensive investigation of the monetary transmission channels in Poland because, the reasons why the functioning of the bank lending channel has changed are not explained in detail. It is only stressed that it coincides with the switch of the exchange rate regime from fixed to flexible one, without examining the inter-connection between the bank lending channel and exchange rate channel.

4. Explanation of the Conventional Model used in Empirical Work

Associated with the empirical analysis examining the effectiveness of the bank lending channel, a model that is most frequently used in various empirical studies was designed by Kashyap and Stein (1995) and later on amended by Ehrmann et al. (2001). This model investigates banks' heterogeneous loan supply function conditional on banks' specific financial characteristics, induced by changes in the monetary policy rate. The amended model developed by Ehrmann et al. (2001) attempts to correct for one of the weaknesses of Bernanke and Blinder model, i.e. not taking into account banks' financial characteristics as a determinant of banks' loan supply reaction function (as considered in Section 3). Ehrmann et al. (2001) model is based on a simplified mathematical model of Bernanke and Blinder (1988 a, b) model. Its derivation with the variables in natural logarithms is as follows[12]: Deposits (D) are assumed to equal money (M) and both are negatively determined by the monetary policy interest rate (r) with a constant (β), presented below:

$$M = D = -\psi r + \beta \qquad (17)$$

The loan demand function, shown below, depends negatively on the loan interest rate (ρ) and positively on income (y) and the price level (P).

$$L^d = \varphi_1 y + \varphi_2 P - \varphi_3 \rho \qquad (18)$$

The loan supply function, expression 19, is positively associated with the amount of deposits (D) and the interest rate on loans (ρ) and negatively with the monetary policy rate (r). The rationale why loan supply is a negative function of monetary policy rate is because the latter refers to opportunity costs of banks when they borrow in the money market to finance their loan supply.

$$L^s = \mu D + \varphi_4 \rho - \varphi_5 r \qquad (19)$$

[12] The source for derivation of the model is Ehrmann et al. (2001).

The major contribution of the Ehrmann et al. (2001) model is that the amount of deposits is also determined by banks' specific characteristics. More precisely, changes in the level of banks' deposits will be negatively related to their size, liquidity and capitalisation ratio as presented below:

$$\mu = \mu_0 - \mu_1 x \qquad (20)$$

where, (μ) refers to changes in deposits by banks and (x) represents one of the aforementioned bank specific characteristic.

The clearing of the loan market equation, calculated as a reduced form of the model, is as follows:

$$Ls = \frac{\varphi_1\varphi_4 y + \varphi_2\varphi_4 P - (\varphi_5 + \mu_0\psi)\varphi_3 r + \mu_1\psi\varphi_3 rx + \mu_0\varphi_3\beta - \mu_1\varphi_3\beta x}{\varphi_3 + \varphi_4} \qquad (21)$$

Equation 21 can be presented in a simplified version, such as:

$$Ls = \beta_0 + \beta_1 y + \beta_2 P - \beta_3 r + \beta_4 rx + \beta_5 x; \text{ where } \beta_4 = \frac{\mu_1\psi\varphi_3}{\varphi_3 + \varphi_4} \qquad (22)$$

The coefficient β_4 is the coefficient of the interaction term between the policy interest rate and banks' specific characteristics and shows the reaction of different banks with different financial characteristics in changing the quantity of loan supply induced by changes in the monetary policy rate.

However, one of the weaknesses of this model is its basic assumption of an equal interest rate elasticity of loan demand among the borrowers. This assumption may not hold in practice because small and large firms may respond differently to changes in the interest rate on loans. Additionally, this assumption excludes the so-called "locked-in" relationship[13], where some borrowers do not want to change their lender or the financial instrument when the loan interest rate is rising due to high costs incurred by changing the lenders or the financial instruments. This may result

[13] For details see Kashyap and Stein (1993), explained further in section 3.

in different interest rate elasticities of loan demand among the borrowers that violates the main assumption of Ehrmann et al. (2001) model. However, in the empirical studies of Worms (2001) and Martinez-Pegas and Hernando (2001), in which they control for this factor, the estimated results were broadly in line as with the assumption of homogenous loan demand function among borrowers.

The econometric specification of the model, based on equation 22, is as follows:

$$\Delta\log(Ls_{it})=\beta_{0i}+\sum_{j=1}^{l}\beta_1\Delta\log(Ls_{it-1})+\sum_{j=0}^{l}\beta_2\Delta r_{t-j}+\sum_{j=0}^{l}\beta_3\Delta\log(GDP_{t-j})+\sum_{j=0}^{l}\beta_4 P_{t-j}$$
$$+\beta_5 X_{it-1}+\sum_{j=0}^{l}\beta_6 X_{it-1}\Delta r_{t-j}+\sum_{j=0}^{l}\beta_7 X_{it-1}\Delta\log(GDP_{t-j})+\sum_{j=0}^{l}\beta_8 X_{it-1}P_{t-j}+\varepsilon_{it} \qquad (23)$$

(where β_{0i} is bank-specific intercept term; Ls=loan supply by banks to non-financial private sector; GDP=Gross Domestic Product; r=policy interest rate; P=price level (inflation); X=bank-specific financial characteristics; i,t=cross-section and time-specific subscripts, respectively; l=number of lags).

The model is set as a Panel Data Model estimated in first differences. The included macroeconomic variables (GDP and CPI inflation) control for the homogeneous loan demand factors. Related to the supply side factors, a statistically significant coefficient β_2 indicates that changes in monetary policy have a significant impact on the banks' loan supply function, indicating the existence of a bank lending channel. The coefficient β_6 is the coefficient on the interaction term between the bank specific characteristic and the changes in monetary policy interest rate that coincides with the coefficient β_4 in equation 22. A statistically significant coefficient β_{6j} implies that changes in monetary policy, conditional on bank specific characteristics, have different distributive impact on the banks' loan supply function. Hence, this model does not only examine the distributive effects of the quantity of loan supply among banks due to changes in the policy rate, but also examines the distributive effects of loan supply among banks, conditional on their

specific financial characteristics such as: level of liquidity and capitalization, income structure etc.

Overall, the main originality of the amended model by Ehrmann et al. (2001) is that it incorporates bank specific characteristics as an influential factor in determining banks' heterogeneous loan supply reaction function to changes in monetary policy. Consequently, investigating these distributive effects on loan supply among banks, especially when they are determined by their specific financial characteristics, may provide useful information about the informational frictions on the credit market.

5. Survey of the Empirical Evidence

This section surveys empirical studies that examine the existence of a bank lending channel and the determinants of banks' heterogeneous loan supply reaction function, conditional on their specific financial characteristics. The common characteristic of all the surveyed studies is that they are based on microeconomic bank level data. The rationale for the use of bank level data is because it is better in identifying the loan supply side of banks, representing the bank lending channel, which is not the case with the empirical studies that use macroeconomic data. More precisely, studies purely based on macroeconomic data aim to investigate the loan demand side factors, nevertheless they are not able to disentangle clearly whether the changes in the aggregate amount of loans in the economy is induced by purely demand side factors or some other macroeconomic factors. In other words, those studies cannot identify if changes in banks' loan supply are determined purely by the loan supply side, loan demand or both the factors simultaneously.

There are several studies that empirically investigate the existence of the bank lending channel at aggregate level for the eight new EU member states from CSEE[14] as well as at the individual country level. The main characteristic of most of these studies is that they augment the model specification (23) with some specific characteristics of these transition economies. More precisely, some studies (Schmitz, 2004; Havrylchyk and

[14] The economies considered under the eight new EU member states are: Czech Republic, Hungary, Poland, Slovakia, Slovenia and the three Baltic states (Estonia, Latvia and Lithuania).

Jurzyk, 2005; Chmielewski, 2006; Golodniuk, 2006), include in the model the real effective exchange rate (REER) as another important macroeconomic control variable due to the relatively high openness of these economies and consequently, its importance for the monetary policy regime[15]. Other studies (Schmitz, 2004; Kohler et al., 2006; Horvath et al. 2006; Juks, 2004), investigate the loan supply reaction function to changes not only to the domestic policy rate but also to the 3-month EURIBOR rate. Moreover, majority of the studies additionally augment the model with a foreign ownership dummy variable (Schmitz, 2004; Matousek and Sarantis, 2009; Kohler et al., 2006; Havrylchyk and Jurzyk, 2005; Chmielewski, 2006; Pruteanu-Podpiera, 2007; Horvath et al. 2006; Brooks, 2007 and Arena et al., 2007). The reasons for using the EURIBOR rate as a reference rate and controlling for the foreign ownership are explained by the relatively high proportion of foreign currency loans and foreign currency indexed loans relative to total loans, as well as the relatively high proportion of the foreign ownership of total banking capital. It is perceived that foreign owned banks react differently to changes in domestic monetary policy rate compared to domestically owned banks. For example, because of those differences they are expected to react more strongly to changes in the EURIBOR rate than to changes in the domestic policy rate.

Another variable that is added in the model specification (23) is the ratio of non-performing loans to total loans (the NPL ratio) and its interaction term with the policy rate (Chmielewski, 2006 and Pruteanu-Podpiera, 2007). The rationale for including this variable is for the reason that the NPL ratio may have increased sharply during the transition process in the CSEE economies that incurs additional costs to the banks, alters their risk preferences and worsens their asset portfolio structure (for details see section 2). Accordingly, this variable may play an important role over banks' lending decisions in the transition economies.

One of the first analysis that attempts to explore the functioning of the bank lending channel jointly for the eight new EU member states from CSEE is done by Schmitz (2004). The results based on model specification 23 augmented with the REER, foreign ownership and EURIBOR rate

[15] This is especially important given the currency board regime of the three Baltic States.

indicate that the bank lending channel is operational, mainly through changes in the EURIBOR rate but not through changes in the respective domestic policy rates. Related to the banks' specific characteristics (size, liquidity, capitalisation and ownership structure), the ownership structure turns out to be the most significant determinant of the loan supply function. More precisely, foreign-owned banks are more sensitive to adjusting the quantity of loan supply to changes in the EURIBOR rate than domestic banks. Regarding the rest of the bank specific characteristics, none of them turned out to have a significant influence on the bank lending channel. There is a weak evidence that size of the banks may have an impact on the loan supply function, but the results are not robust to different model specifications and different sample periods. Nevertheless, the main shortcoming of this research is that it is conducted for eight different economies from CSEE with different monetary policy regimes. For example some economies i.e. the Baltic States have currency board while other economies i.e. Czech Republic, Poland, Hungary etc., have inflation targeting regime. Furthermore, some of the economies in the sample have undergone through switch of the monetary policy regime i.e. from fixed exchange rate to inflation targeting (Czech Republic) and this is not controlled for in the regressions.

In a similar vein, Matousek and Sarantis (2009) explore the bank lending channel for the same group of transition economies on individual basis. The results based on the augmented model specification 23 for the ownership structure indicate that, apart from Slovenia and partially in Poland, changes in domestic policy rates do not have any significant impact on the loan supply function, consistent with Schmitz's (2004) findings. Related to the bank specific characteristics, size and liquidity indicators were the most influential factors over the loan supply function in most of the sample economies, which is contrary to Schmitz. Overall, there is ambiguous evidence for the existence of the bank lending channel. However, the main pitfall of this analysis is that it does not take into account the influence of the EURIBOR rate as a reference rate, which according to Schmitz (2004) is the key variable in determining the bank lending channel. Another pitfall, similar as in Schmitz (2004), is that the model does not control for the switch of the monetary policy regime as it was the case in most of the sample economies that may bias the results.

Kohler et al. (2006) investigate the bank lending channel jointly for the three Baltic States. The rationale for this, according to the authors, is due to the similar monetary policy and exchange rate regimes, financial structure, and the comprehensiveness of the data sets. Accordingly, by amending the model specification 23 for the EURIBOR rate as a reference rate and the foreign ownership, the estimated results have shown that the lending channel works mainly through the changes in the EURIBOR rate, but not through changes in the domestic policy rates. This finding is as expected and consistent with Schmitz's (2004) findings because, having in mind the currency board regime and consequently, the loss of the monetary independence, changes in domestic policy rate would have no impact on the economy. The main determinants of the banks' loan supply function turned out to be banks' liquidity, capitalisation and the ownership structure, while banks' size did not enter significantly into the equations.

Analysing the bank lending channel at individual country level, there are several studies that provide mixed evidence for Poland. For example, Wrobel and Pawlowska (2002), Havrylchyk and Jurzyk (2005) and Chmielewski (2006) find that bank lending channel operates in Poland through changes in domestic policy rate which is in contrast to the findings of Schmitz (2004) and Matousek and Sarantis (2009). Regarding the bank specific characteristics, all three studies provide evidence that liquidity has a significant impact over the bank lending channel, but with the opposite sign from what is predicted by economic theory. This is explained by the structural excess liquidity of the Polish banking system that may bias the results. Related to the other bank specific characteristics, the results of Wrobel and Pawlowska (2002) based on model specification 23 imply that banks' heterogeneous loan supply function is mainly determined by their size and capitalisation ratio. In contrast, the estimates of Havrylchyk and Jurzyk (2005) and Chmielewski (2006), based on model specification 23 augmented for the REER and the foreign ownership indicate that an important determinant of the banks' loan supply decisions is the ownership structure. The main breakthrough of the empirical model of Chmielewski (2006) is that he augments the model by the NPL ratio that turned out to be the major determinant of banks' loan supply function. Additionally, Havrylchyk and Jurzyk (2005) show that banks' deposits do not respond significantly either to changes in the domestic policy rate or banks' financial characteristics,

inferring that one of the main preconditions for the existence of the lending channel is not fulfilled. The main shortcoming of these analyses is that they do not test for the sensitivity of loan supply to changes in the EURIBOR rate, which may be an important determinant of the lending channel in Poland.

In the Czech Republic, Pruteanu-Podpiera (2007) investigates the bank lending channel for the two subperiods 1996-1998 and 1999-2001[16]. The results based on model specification 23, augmented for foreign ownership of banks and the NPL ratio, show a significant reaction of the banks' loan supply function to changes in domestic monetary policy rate for the two subperiods being stronger for the second subperiod. These results are contrary to the findings of Schmitz (2004) and Matousek and Sarantis (2009). Analysing the role of banks' specific characteristics, liquidity and capitalisation were seen to be the major determinants of the heterogeneous bank reaction function in the first subperiod, but not in the second. Size and foreign ownership variables had a significant impact over the banks' loan supply function but with contrary signs from what is expected from economic theory. The NPL ratio had opposite signs between the two subperiods (positive for the first and negative for the second subperiod). The interaction term between the NPL ratio and the policy rate entered with a positive sign in the two sub-periods, which is in contrast to what was expected. The reason for this, according to the author, may be due to the policy of soft budget constraints by the banks. However, this is not supported by any additional explanation or empirical evidence. In summary, this analysis provides some evidence for the existence of the bank lending channel in Czech Republic. Nevertheless, the main pitfall is that it lacks explanation as to why foreign-owned banks react more strongly to changes in domestic policy rate. Moreover, the EURIBOR, as a reference rate, as well as the REER variables are not included in the model, which may also be important determinants of the lending channel in the Czech Republic.

In the case of Hungary, Horvath et al. (2006) determined the existence of the bank lending channel. The estimates, based on the amended model specification (23) includes the EURIBOR rate, nominal exchange rate

[16] The reason for dividing the sample into two subperiods according to the author is due to the rapid changes in monetary policy during the second subperiod, characterised by a continual reduction in the monetary policy rate and the reserve requirement.

and the foreign ownership, indicate that banks significantly alter the quantity of loan supply to changes in the domestic policy rate. In contrast, changes in the EURIBOR rate did not have any significant influence over the loan supply function, which is contrary to the findings of Schmitz (2004). The most significant determinants of the heterogeneous loan supply function are foreign ownership of the Hungarian banks, size and capitalisation ratios. Liquidity had an insignificant impact, explained by the structural excess liquidity of the banking system. The robustness of these findings is tested by disaggregating the total loans by their sectoral as well as currency structure.

In Estonia, the analysis conducted by Juks (2004) provides little evidence in favour of the existence of the bank lending channel. The author investigates the responses of banks' deposits and loans to changes in the policy rate (the EURIBOR rate is taken as a policy rate due to the currency board regime). The estimates based on model specification (23) indicate that changes in the EURIBOR rate had significant but positive impact over time deposits, which is contrary to the bank lending channel theory. Related to banks' loans, changes in the EURIBOR rate did not have any significant influence over the loan supply function, suggesting the absence of an operational bank lending channel. The reasons for this, according to the author, are related to many non-monetary and non-economic factors associated with the transition process. Regarding the bank specific characteristics, capitalisation and liquidity turned out to be significant factors in the bank heterogeneous loan supply function. However, the significant influence of these two characteristics cannot be taken as evidence for the existence of the bank lending channel mainly because the quantity of loan supply is not responsive to changes in the policy rate. The main weakness of this analysis is that it does not take into account other factors that may have impact over the lending channel in Estonia such as, the REER and foreign ownership variable, having in mind the currency board regime.

Golodniuk (2006) explores the determinants of the bank lending channel in Ukraine. The estimates based on model specification (23) estimated in both nominal and real terms (the latter being additionally augmented for the REER), imply the existence of a bank lending channel. Changes in the monetary policy rate do have significant influence over the loan supply, being stronger for the loans to household sector and for the

model estimated in real terms. Regarding banks' financial characteristics, the capitalisation ratio is seen as a major determinant of the heterogeneous loan supply function. However, the impact of capitalisation over the loan supply function may not be robust due to its sensitivity to different ways of measurement. In summary, the results of this study provide evidence for the functioning of the bank lending channel in Ukraine, even if the results for the impact of balance sheet characteristics are sensitive to the way of measurement chosen.

Outside the CSEE economies, Brooks (2007) investigates whether the bank lending channel is functional in Turkey after the financial turmoil in 2006[17]. By using a different model specification and controlling for foreign ownership, the results indicate that the bank lending channel is driven mainly through the liquidity of the banks. The rest of the bank specific characteristics (size, capitalisation and foreign ownership) did not significantly affect the bank lending channel. Nevertheless, the coefficient of the monetary policy rate is neither reported in the paper and nor is the estimation method, robustness and stability of the system discussed. An additional weakness is the short time span ranging from June 2006 till March 2007. Arena et al. (2007) determine the existence of the bank lending channel in a set of emerging economies from Latin America and Asia. By using different model specification than 23 and controlling for foreign ownership, the results indicate that changes in monetary policy do have a significant impact on banks' deposit and loan supply. The main determinants of the lending channel are liquidity, capitalisation and the foreign ownership of the banks. Nevertheless, the main shortcoming of this research is that the loan demand side in the model did not control for the main macroeconomic factors such as, GDP and CPI, which in other studies are seen as important factors of the loans supply function.

Overall, it seems that bank lending channel is operational in the afore-mentioned transition economies, mainly through changes in the EURIBOR rate and foreign ownership. The explanation for this is because in these economies, substantial part of banks' capital is foreign owned.

[17] The period from May to June 2006 was characterised by sharp increase of the interest rates (one-year money market rate, overnight lending policy rate and overnight borrowing policy rate), accompanied by sharp movements of the exchange rate (Brooks, 2007).

Therefore, it is expected that the foreign owned banks are sensitive to adjusting their loan supply to changes in the EURIBOR rate than to changes in the domestic policy rate. Moreover, most of the foreign-owned banks keep their foreign currency deposits in accounts at their parent banks or other banks in the euro-zone. These factors may influence banks' lending decisions that may make the EURIBOR rate more relevant factor in determining their loan supply function. However, these studies have some pitfalls that are mentioned in the next subsection. A summary of the above mentioned studies is presented in the Annexure.

5.1. Critical Assessment of the Reviewed Studies

A general shortcoming of most of the above mentioned empirical studies is that they do not examine the reaction function of banks' deposits to changes in the monetary policy rate. The negative relationship between the two is one of the main preconditions for the existence of the bank lending channel. Namely, according to Bernanke and Blinder (1988 a, b) model, in order for the bank lending channel to become operational, monetary policy tightening should drain banks' deposits that ultimately should result in a reduction of loan supply. Some studies such as, Havrylchyk and Jurzyk (2005) and Juks (2004) have tackled this issue by testing the response of deposits to changes in the policy rate. However, the main pitfall of these two studies is that they specify almost the same model as that used for the loan supply function when examining the deposit market. The deposit market is influenced by other factors and it should not be expected that exactly the same factors and same bank specific characteristics determine banks deposits. For example, according to Bernanke and Blinder model, the deposit market is mainly determined by banks' reserves and money market multiplier (see section 2). Accordingly, results related to banks' deposit function in the afore-mentioned studies, should be interpreted with caution due to the inadequate model specification.

Regarding data selection, the main weakness of majority of the studies is that they are based on different data sets constructed according to different methodologies, which are not unified across the analysed economies. Schmitz (2004), Matousek and Sarantis (2009), Kohler et al.

(2006), Arena et al. (2007), attempted to solve this problem by using the BankScope data set[18]. Another reason for using the BankScope data set is because this was the only available data set for some of the analysed economies. However this data source has been criticised in the literature (Ehrmann et al., 2001; Kohler et al., 2006 and Arena et al., 2007) because it does not represent the whole banking population. For example, it is biased towards large banks. Moreover, the level of liquidity is provided only to some but not all banks.

The assessed empirical studies differ in the selection of the data series. For instance, they differ whether chained or annual rate of changes[19] of GDP and CPI are taken. For example, Juks (2004) uses annual rate of changes of both the afore-mentioned variables; whereas Schmitz (2004) and Matousek and Sarantis (2009) use chained rate of changes. An argument for using the chained rate of change is for the sake of consistency in the interpretation of the results because the rate of change of all the other variables in the model (including the dependent variable) is chained, not annual. Moreover, chained rate of changes reflect more the current conditions in the economy such as, large fluctuations in oil prices. On the other hand, the rationale for using the annual rate of change of the two variables, mainly for those studies that use quarterly and monthly frequency of the data, is because it clears the series from seasonal effects. Nevertheless, the seasonality effect from the data may be taken out by seasonal adjustment of the series or by including seasonal dummies in the model.

Regarding the model specification, a possible weakness of the majority of these studies is that they are based on model specification 23. This suffers from the inappropriateness of one of its basic assumptions: a homogeneous loan demand function across the borrowers[20] (see sections 2 and 4). Another possible weakness of the surveyed empirical studies, especially those conducted on individual EU economies, is that they do not

[18] This data base is provided by Bureau van Dijks and FITCH IBCA.
[19] Chained rate of change refers to the rate of change of the current period versus the previous period i.e. this month (quarter) versus the previous month (quarter). The annual rate of change refers to the rate of change of this period versus the same period from last year, i.e. this month (quarter) versus the same month (quarter) from the previous year.
[20] Worms (2001) and Martinez-Pages (2001) control for a heterogeneous demand function, but the results were in line with the results obtained by model 23.

include the REER variable, as it is done in many empirical analyses conducted for the transition economies. This may be an important determinant of the lending channel in the EMU economies, having in mind the importance of the exchange rate during the pre-accession period and the fluctuation margins defined in the ERM II. Moreover, regarding the model used in the studies for CSEE economies, the potential pitfall of most of them, excepting Chmielewski (2006) and Pruteanu-Podpiera (2007), is that they do not take into account the NPL ratio that may be an important determinant of bank loan supply.

Another problem associated with the model specification is whether the model should be estimated in real or nominal terms. The theoretical model by Bernanke and Blinder assumes constant inflation, and inflation expectations are suppressed throughout the model. However, in the empirical studies analysed in the previous two subsections there is inconsistency related to this issue and no clear cut preferred specification is evident. For example, Schmitz (2004) estimate the model with some variables in real terms (loans, deposits and GDP) and some variables in nominal terms (policy rate and bank financial characteristics). Kohler et al. (2006), estimate the model in nominal terms without considering the effect of inflation. In many studies such as, Wrobel and Pawlowska (2002), Havrylchyk and Jurzyk (2005), Pruteanu-Podpiera (2007) and Juks (2004), the model is estimated largely in nominal terms and whilst it is made clear that GDP is in real terms, it is not discussed whether loans are in real or nominal terms. Other studies, Matousek and Sarantis (2009), Chmielewski (2006) and Horvath et al. (2006), estimate the model in nominal terms controlling for the effect of inflation, but nevertheless fail to state if GDP is in real or nominal terms.

A further issue related to model specification in these empirical studies is whether the macroeconomic variables (GDP and CPI) and the policy rate should be treated as exogenous, predetermined or endogenous. In some studies this issue is not discussed (Horvath et al. 2006; Golodniuk, 2006; Pruteanu-Podpiera, 2007 and Matousek and Sarantis, 2009). Moreover, all of the studies mentioned below lack an explanation as to why those variables are taken as exogenous, predetermined or endogenous. For example, some studies such as, Juks (2004) treat them as endogenous. In

contrast, Havrylchyk and Jurzyk (2005), Chmielewski (2006) treat them as strictly exogenous.

Another possible weakness of some of these studies arises from the estimation technique applied, given the endogenous nature of the model. More precisely, some studies such as, Schmitz (2004), Kohler et al. (2006) and Wrobel and Pawlowska (2002), are specified as fixed effects panel data models, estimated with OLS/GLS method(s) (see table 1). Given that these regressions include a lagged dependent variable on the right hand side, these methods are inefficient and biased. Namely, the lagged dependent variable is correlated with the error term and this gives rise to an endogeneity problem. Dynamic panel estimation by GMM is a technique that appropriately deals with this problem and this is the most frequently used method in majority of the assessed studies (see table 1).

There has been a rapid development in econometrics techniques in dynamic panel analysis in recent years (Arellano and Bover, 1995; Blundell and Bond, 1998 and Roodman, 2006). Given these developments, the use of "differenced" GMM by majority of these studies does not now seem to be the most appropriate estimator. "System" GMM may be more appropriate in the presence of unit root process with better properties when estimating such data series is a major advantage of using system GMM over differenced GMM (see section 4). This is applicable to the estimation of models of loans because the data series are non-stationary data, i.e. data that contain near unit root process.

GMM estimators are designed for samples with short time series data (small T) and large cross sectional units (large N). However, some studies like Horvath et al. (2006) and especially Juks (2004), are conducted for a sample of only five banks and have much greater T compared to N (see table 1). This creates the problem of "too many" instruments for predetermined and/or endogenous variables and as the literature on dynamic panel analysis has developed, it has become clear that this may weaken the power of the Sargan and/or Hansen test for validity of the instruments (see section 4). In particular it may lead to a value of one or close to one and lead inappropriately to the non-rejection of the null that all the instruments are valid. Many of the studies, i.e. Matousek and Sarantis (2009), Havrylchyk

and Jurzyk (2005), Chmielewski (2006) and Juks (2004), report a p-value of Sargan test in majority of the regressions that equals 1 or close to 1. What is surprising is that in some studies, the p-value of Sargan test equals 1 or close to 1 even though they are conducted for a sample with much greater N than T. For instance, the sample for banks comprises 67 banks (Havrylchyk and Jurzyk, 2005). In other studies, i.e. Golodniuk (2006), the Sargan/Hansen test is not reported; whereas in Pruteanu-Podpiera (2007) the p-value of Sargan test in some of the regressions reported is less than 0.05, leading to rejection of the null hypothesis of the validity of all the instruments.

In respect of the reported results, there is a large variation in the estimated coefficients regarding their signs and magnitude in different model specifications within individual papers. This is especially the case with studies conducted for CSEE economies. For instance, in Pruteanu-Podpiera (2007) there is variation in the sign of the estimates for CPI and considerable variation in magnitude of the estimates for GDP. In Chmielewski (2006) and Matousek and Sarantis (2009), there is variation in both sign and magnitude of the estimates for inflation, GDP and the policy rate. However, in many of the studies reviewed in section 5 nothing is discussed of the robustness of the models and their sensitivity to different sample periods, variables included and to different estimation methods.

Overall, these studies provide interesting investigation of the existence of bank lending channel and its determinants. However, their major weakness is related to the use of differenced GMM instead of system GMM estimator. It should be borne in mind that at the time when these studies were conducted, the tools and econometric software for applying system GMM estimator in practise were not as developed as today. This may be one of the reasons for not using this method in the empirical investigation.

6. Summary

The aim of this paper was to explain in detail and to critically assess the underlying theoretical model of the bank lending channel. Furthermore, this paper has investigated its main modifications that were found in the literature and has explained the simplified econometric model that is commonly used in the empirical studies. Additionally, this paper has

critically surveyed the empirical studies that explore the major determinants of the bank lending channel in transition economies from CSEE.

The first formal model for the bank lending channel was developed by Bernanke and Blinder (1988 a, b). Accordingly, by abandonment of the assumption of perfect substitutability between loans and bonds of the IS-LM model, the authors argue that loans should have a different treatment in macroeconomic models. Consequently, the authors replace the IS curve in the IS-LM model by the credit commodities (CC) curve. Accordingly, changes in monetary policy rate do not have an impact only on the money market but also on the credit and commodities markets, making the monetary policy more effective. However, this paper has reported several weaknesses of the model.

The main criticisms of Bernanke and Blinder (1988 a, b) model are the following: first, the postulation that the main monetary policy of the central bank is control over the base money; second, it lacks microeconomic foundations; third, the claim that bank lending channel makes the monetary policy more effective, it neglects some factors that may work in the reverse direction and fourth, it does not take into account banks' financial characteristics and the degree of competitiveness in the banking sector as determinants of loan supply reaction function to changes in the monetary policy. Consequently, by following the afore-mentioned criticism of the model, the main modifications are as follows:

Related to the first criticism, Kierzenkowski (2005) amends the model by substituting the policy instrument – control over the base money, with the instrument – control over the key policy interest rate. Related to the second weakness, Kashyap and Stein (1993) further explain the model by providing microeconomic foundations. Regarding the third weakness, Kierzenkowski (2007) and Kashyap and Stein (1993) argue that the bank lending channel in some circumstances may reduce the strength of the monetary policy. Finally, in response to the fourth criticism, Ehrmann et al. (2001) amend the model by including some bank specific characteristics that are seen as determinants of heterogeneous loan supply reaction function.

Regarding the empirical research, the most commonly used specification is a simplified version of Bernanke and Blinder (1988 a, b) model developed by Ehrmann et al. (2001). There is evidence that bank lending channel exists in majority transition economies from CSEE. Even though the surveyed empirical studies have some shortcomings, overall they provide solid results consistent with the bank lending channel theory.

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Annexure - Table 1: Summary of presented studies for the transition economies from SCEE and some other emerging economies.

Country / Area	Study by:	Time period	Frequency of the data	Data source	Method of estimation	Size of N and T	Balanced / unbalanced panel	Macroeconomic control variables used	Evidence of the existence of bank lending channel	Significant determinants of bank lending channel
Eight new EU member states	Schmitz (2004)	1990 - 2001	Annual	BankScope	Panel data with fixed effects	N=261; T=1990-2001	Unbalanced	Real GDP, CPI, REER, foreign ownership	YES, through EURIBOR	Ownership, size weakly
	Matousek and Sarantis (2008)	1994 - 2003	Annual	BankScope	Panel data by differemced GMM estimator	N depends from the economy; T=1994-2003	/	Real GDP, CPI	Weak evidence	Size, liquidity
Baltic States	Kohler et al. (2006)	1997 - 2004	Annual	BankScope	Panel data by OLS	N=36; T=1997-2004	Unbalanced	Nominal GDP	YES, through EURIBOR	Liquidity, capitalisation, ownership
Poland	Wrobel and Pawlowska (2002)	1997 Q1 - 2001 Q4	Quarterly	Central bank	Panel data with fixed effects, estimated with GLS method	N=648; T=1997Q1-2001Q4	/	Real GDP, CPI	YES	Capitalisation and size
	Havrylchyk and Jurzyk (2005)	1995 Q1 - 2002 Q4	Quarterly	Central bank	Panel data by differemced GMM estimator	N=67; T=1995-2004	Unbalanced	Real GDP, CPI, REER, foreign ownership	YES, weak evidence	Foreign ownership
	Chmielewski (2006)	1997 Q1 - 2004 Q4	Quarterly	Central bank	Panel data by differemced GMM estimator	N=N/A; T=1997-2004	/	Real GDP, CPI, REER, foreign ownership	YES	Foreign ownership and NPL ratio
Czech Republic	Prutenau-Podpiera (2007)	1996 Q1 - 1998 Q4; 1999 Q1 - 2001 Q4	Quarterly	Central bank	Panel data by differemced GMM estimator	N=33; T=1996-2001	/	Real GDP, CPI, foreign ownership	YES	Capitalisation, liquidity
Hungary	Horvath-Judit and Naszodi (2006)	1995 Q1 - 2004 Q3	Quarterly	Central bank	Panel data by differemced GMM estimator	N=25; 1995-2004	/	GDP, CPI, nominal exchange rate, foreign ownership	YES	Size, capitalisation, foreign ownership
Estonia	Juks (2004)	1996 Q4 - 2004 Q1	Quarterly	Central bank	Panel data by differemced GMM estimator	N=5; T=1997-2004	/	Real GDP, CPI	NO	Liquidity, capitalisation
Ukraine	Golodniuk (2006)	1998 - 2003	Annual	Central bank	Panel data by differemced GMM estimator	N=149; T=1998-2003	/	Real GDP, CPI, REER	YES	Capitalisation
Turkey	Brooks (2007)	June 2006 - March 2007	Quarterly	Bank Association of Turkey	Panel data model with "difference to difference" approach by using least absolute deviations method	N=33; T=2006Q2-2007Q1	/	/	YES	Liquidity
Emerging economies from Latin America and Asia	Arena et al. (2007)	1989 - 2001	Annual	BankScope	Panel data with fixed effects, estimated with GLS method	N=1565; T=1989-2001	Unbalanced	Foreign ownership	YES	Liquidity, capitalisation, foreign ownership

Source: various studies mentioned in section 5