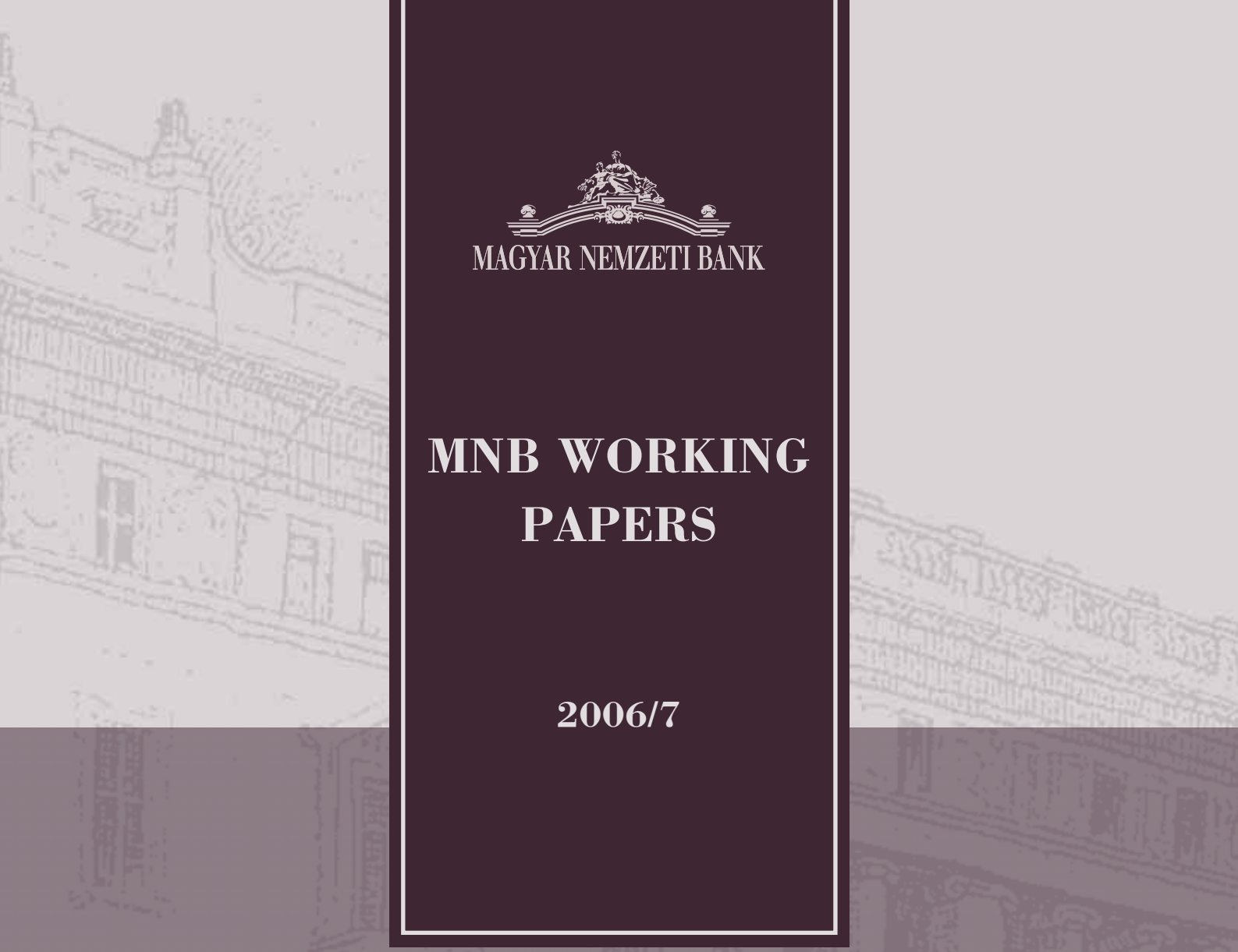

MAGYAR NEMZETI BANK

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2006/7

CSILLA HORVÁTH–JUDIT KREKÓ–ANNA NASZÓDI

Is there a bank lending channel in Hungary? Evidence from bank panel data

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May 2006

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MNB Working Papers 2006/7

Is there a bank lending channel in Hungary? Evidence from bank panel data*

(A bankhitelezési csatorna Magyarországon – Egy panel ökonometria elemzés eredményei)

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Contents

Abstract

In this paper we analyze the bank lending channel in Hungary. We provide a brief overview of the theory and the empirical approaches used to investigate the existence of bank lending channel. From the possible methods we use the generally applied approach suggested by Kahsyap and Stein (1995) which relies on discovering asymmetries in changes in the amount of loans to monetary actions in order to isolate supply and demand effects. We estimate an ARDL model where the asymmetric effects are captured by interaction-terms. We find significant asymmetric adjustment of loan quantities along certain bank characteristics. The existence of bank lending channel, and therefore loan supply decisions of banks, can explain these asymmetries. In addition, we do not find any sign for asymmetric loan demand adjustment along these variables. According to these findings, we cannot rule out the existence of the bank lending channel in Hungary.

JEL classification: C23, E44, E52, G21.
Keywords: monetary transmission, credit channel, bank lending channel, ARDL model.

Összefoglalás

A tanulmány a bankhitelezési csatorna jelenlétét elemzi magyar banki paneladatokon. Először röviden áttekintjük a bankhitelezési csatorna irodalmának elméleti és empirikus megközelítéseit. Majd az utóbbiak közül az általánosan bevett, Kahsyap és Stein (1995) által javasolt módszert alkalmazzuk. Ez a módszer az egyes bankok hitelállomány-változásának aszimmetriája alapján különíti el a hitelkeresleti és a -kínálati hatásokat. Egy olyan ARDL-modellt becslünk, amelyben az aszimmetrikus hatásokat a kamatlábváltozás és bizonyos banki jellemzők keresztszorzata képviseli. A keresztszorzat paraméterének szignifikanciáját a bankhitelezési csatorna működése, azaz a hitelkínálati hatások is magyarázhatják. A bankhitelezési csatorna működését valószínűsíti továbbá, hogy a keresztszorzatos tag paraméterének szignifikanciája nem tudható be a hitelkereslet aszimmetriájának. Mindezek alapján nem zárható ki a hazai bankhitelezési csatorna jelenléte.

1. Introduction

The bank lending channel emphasizes the behavior of financial intermediaries in effecting the quantity of loans and therefore the real economy. The theory of bank lending channel suggests that the state of financial sector may have a strong influence on the transmission of monetary policy. The implication of this theory on the euro zone is that a common monetary policy shock in the euro zone may induce asymmetric reactions in countries with different conditions on the financial market. Since the beginning of the EMU, a large body of empirical analysis had been devoted to the credit channel. These find weaker or stronger evidence of credit channel for the analyzed countries (see Table A. in the Appendix). The book edited by Angelioni et al. (2003) summarizes the main findings for the European countries. In this paper we investigate whether bank lending channel plays a role in the transmission mechanism in Hungary. We discuss and investigate whether and to what extent the conditions for the working of the bank lending channel are fulfilled, review the conditions of the Hungarian financial sector, outline the expected future tendencies based on some country- and region-specific characteristics. In the empirical examination of the bank lending channel we use the generally applied approach suggested by Kahsyap and Stein (1995) which relies on discovering asymmetries in changes in the amount of loans to monetary actions in order to isolate supply and demand effects. We estimate an ARDL model where the asymmetric effects are captured by interaction-terms.

According to this approach, however, asymmetries can only be attributed to supply decisions if loan demand is homogeneous across banks. A novelty of the paper is that we make an attempt to test whether demand of loans can be considered homogeneous across banks with respect to some bank-characteristics. Additionally, we also investigate an intermediate step in the process of the bank-lending channel. Namely, whether monetary tightening induces asymmetric increases in external financing, which is in line with the theory.

This approach tests the existence of bank lending channel only indirectly, but not directly. The most reliable and direct way to test this hypothesis in an environment of interest rate controlling monetary policy would be the comparison of bank lending with alternative external funding of firms.[1] This direct test is not feasible in Hungary because of the poorly developed equity and corporate bond market. Although we do not test directly whether the Hungarian financial system amplifies the traditional effects of monetary policy actions, based on some stylized facts we conclude that the conditions for the functioning of the bank lending channel are fulfilled. Moreover, we find significant asymmetric adjustment of loan quantities along bank characteristics suggested by the bank lending literature. In addition, we do not find any sign for asymmetric loan demand adjustment along these variables. According to these findings, we cannot rule out the existence of the bank lending channel in Hungary.

The rest of the paper is organized as follows. In Section 2 we discuss the theoretical background of the bank lending channel. In Section 3, in order to get an overall picture of the bank lending channel, we list several stylized facts about the financial system of Hungary. Section 4 describes the econometric model and presents the results. Section 5 concludes. In this paper we not only present indirect evidence for the bank lending channel but also predict some important future changes in the transmission mechanism in Hungary.

[1] Kashyap, Stein and Wilcox (1993) found evidence for this hypothesis. Their results show that the ratio of commercial papers of bank loans rises following a monetary policy contraction.

2. Bank lending channel: theoretical and methodological background

In this section we provide a concise discussion of the theories for the bank lending channel. First, we shortly introduce the credit channel and explain the functioning of its two sub-channels: the balance sheet channel and the bank lending channel.

The starting idea of the theory of *credit channel* is that there are frictions on the financial markets. These frictions arise from asymmetric information that exists among economic agents that lead to adverse selection and moral hazard behavior.[2] Due to these frictions, internal and external sources of finance are not perfect substitutes of each other (in contrast with the I. theory of Modigliani-Miller) but there exists a gap between the costs of internal (e.g., retained earnings) and external financing (issuing equity or debt), which is called the external finance premium. Monetary policy can influence the external finance premium; monetary tightening increases and monetary loosening decreases its magnitude. Due to this additional effect of policy on the external finance premium, the impact of monetary policy on the cost of borrowing may be amplified (Bernanke and Gertler; 1995). Bernanke and Gertler (1995) emphasize that the so-called credit channel should not be considered a free-standing alternative to the traditional transmission mechanism, but rather as a set of factors that magnify conventional interest rate effects.

While the functioning of the credit channel would magnify the effects of monetary policy, there are theories that suggest that banks may decide to smooth their interest rates, hereby reducing the effect of monetary policy. Adverse selection, moral hazard problems, and relationship lending may, for example, induce banks to increase their loan interest rates at a smaller extent than the raise in their cost of funding due to monetary tightening. So, it is ambiguous whether the banking system amplifies or weakens the functioning of monetary policy relative to the case when the banking system was not considered (and certain aspects of its behavior were not modeled) in the transmission mechanism. It depends on which of these two mechanisms dominate in an economy. The net effect of the banking sector depends on characteristics of the banking system (such as degree of competition, easy access to external financing of firms and banks) and on characteristics of the economy itself (distribution of good and risky borrowers and the relevance of adverse selection behavior).

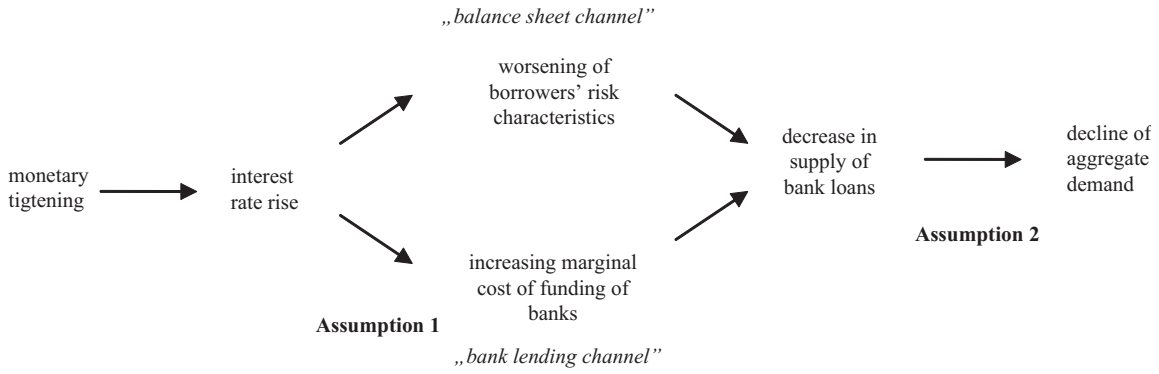
The credit channel is interesting and important for several reasons. First, if the credit view is at work, it implies that monetary policy can affect the real economy without much variation in the policy rate. Second, the view can explain how monetary contraction influences investment and inventory behavior. In addition, understanding the credit channel will offer insights on how innovation in financial institutions might affect the potency of monetary policy. Furthermore, the credit channel can explain the distributional effects of monetary policy on both lenders and borrowers while the conventional view cannot. Finally, the credit view also implies that the impact of monetary policy on economic activity is not always the same. It is sensitive to the state of firms' balance sheet and health of the banking sector. That is, it has obvious implications for the ability of monetary policy to offset particular sorts of adverse shocks.

Two mechanisms have been suggested to explain the effects of monetary policy actions on economic activity based on changing external finance premium (see Chart 1). One is the *balance sheet channel* (also referred to as net worth channel) that stresses the potential impact of monetary policy actions on borrowers' balance sheets, net worth, and cash-flow. The other is the *bank lending channel* that focuses on the loan supply decisions of banks.

[2] Adverse selection means that borrowers with higher risk are more involved in searching for loans and therefore, they have a higher probability of obtaining them than borrowers with lower risk. Moral hazard problem on the other hand arise after granting of credit. Given granted credit, borrowers may be more inclined to start riskier activities increasing the risk of their credit. As a result, in case of higher moral hazard and adverse selection, creditors may decide to decrease the amount of credit or when considering every borrower identical, they may make the conditions for borrowing stricter.

Chart 1

Stylized description of the functioning of the credit channel



Balance sheet channel

The balance sheet channel of monetary policy arises because monetary policy actions affect not only market interest rates but also the financial positions of borrowers, both directly and indirectly. A tight monetary policy directly weakens borrowers' balance sheets in at least two ways. First, rising interest rates directly increase interest expenses, reducing net cash flows and weakening the borrower's financial position. Second, rising interest rates are also typically associated with declining asset prices, which among other things shrink the value of the borrower's collateral. Indirect effect of tight monetary policy on net cash flows and collateral values is due to deterioration in consumers' expenditure. The firm's revenues will decline while its various fixed or quasi-fixed costs do not adjust in the short run. The financing gap, therefore, erodes the firm's net worth and credit worthiness over time.

Lower net worth means that lenders in effect have less collateral for their loans, and so are more exposed to problems arising from asymmetric information. A decline in net worth, which raises the adverse selection problem, thus leads to decreased lending to finance investment spending. Lower net worth of business firms also increases the moral hazard problem because it means that owners have a lower equity stake in their firms, giving them more incentive to engage in risky investment projects. Since taking on riskier investment projects makes it more likely that lenders will not be paid back, a decrease in business firms' net worth leads to a decrease in lending and hence in investment spending. This mechanism may explain why the impact of the credit channel on spending, particularly on inventory and investment spending, may persist well beyond the period of the initial monetary tightening.

Bank lending channel

The *bank lending channel* focuses on possible effects on the supply of loans of banks. The bank lending channel is based on the idea that the cost of funding of the banks increases in response to restrictive monetary policy shocks. There are several reasons why the marginal cost of funding may increase. First, if there is some degree of asymmetric information[3] between banks and their investors, adverse selection problems will arise. This tends to make marginal cost of external funding an increasing function of the risk free interest rate. Second, secured deposits function as money, and therefore reduce as a response to a monetary restriction. If a bank wants to compensate or partly compensate a drop in liabilities, it acquires more uninsured external funding. Due to the decreasing share of secured funding investors consider the bank more risky and require higher risk premia or limit their lending to banks. Third, when aiming to obtain more external funds the banks face additional costs, such as search costs, cost of advertising. As a response, banks may be inclined to increase the spread due to the increasing average cost of funding.

So, the idea behind the theory of bank lending channel is that monetary policy affects not only loan demand, but also banks' loan supply, which in turn, further influences the monetary policy on investment and consumption. According to

[3] Evidence that commercial banks face adverse selection problems when raising external funding have been provided by the event studies of Cornett and Tehranian (1994) and Poloncheck, Slovin and Sushka (1989).

the bank lending literature there are two necessary assumptions for the functioning of the bank lending channel. First, the marginal cost of funding increases as a response to the interest rate hike (assumption 1 on Chart 1). Second, a significant number of firms are dependent on bank loans, i.e., these firms are unable to perfectly substitute between bank loans and other forms of finance (assumption 2).

THEORETICAL MODEL FOR THE BANK LENDING CHANNEL

There are several models that address the working of bank lending channel. Early models, like those of Bernanke and Blinder (1988) and Kashyap and Stein (1994), were developed for the case where central banks control money supply either by direct interventions or by changing the reserve requirement of commercial banks. Nowadays, the main policy instrument of the central banks is the interest rate. Ehrmann at al. (2003) distilled a model for the bank lending channel where central bank operates via the base rates. Consequently, below we focus on a simplified version of this model.[4]

The model

An essential building block of this model is that external finance premium of banks increase due to moral hazard and adverse selection problems when interest rate rises. This increase may vary across banks that have different characteristics.[5]

In this model the loan market is assumed to be characterized by monopolistic competition. The demand for (nominal) loans of bank *i* (L_d^i) is:

$$L_d^i = -a_0 r_{L,i} + a_1 y + a_2 p, \tag{1}$$

where $r_{L,i}$ refers to the bank-specific loan rate, y to aggregate real output, p to price level and a_0, a_1 and a_2 are positive coefficients. Banks choose the bank-specific loan rate ($r_{L,i}$) in order to maximize their profit under the constraint of balance sheet identity:

$$L_i + S_i = B_i + C_i. \tag{2}$$

Loans granted by the bank plus the banks' holding of securities (S_i) should be equal to the liability side consisting of external funding (B_i) including deposits and capital (C_i).

Further assumptions are that bank capital is proportionally related to the level of loans in order to meet the regulatory minimum capital requirement:

$$C_i = kL_i. \tag{3}$$

Banks' holding of liquid securities is linked to the external funding (B_i) in order to meet a liquidity requirement:

$$S_i = sB_i. \tag{4}$$

Banks finance the assets not only by internal sources (capital), but also by interest bearing external sources (B_i). The interest rate paid by bank *i* for its external finance is denoted by $r_{B,i}$. The external finance premium over the risk free rate is likely to be bank-specific:

$$r_{B,i} = r_s \cdot (\mu - c \cdot x_i) \qquad 1 < \mu - c \cdot x_i. \tag{5}$$

[4] The only simplification we make on the Ehrmann et al. (2003) model is that we do not distinguish between secured and non-secured external funding of the banks.

[5] See for example Lowe and Rohling (1992).

where x_i refers to observable characteristics of banks, like its capital adequacy ratio, size, or liquidity position. These are indicators of the banks' stability.

The spread between the interest rate paid by bank *i* for its external finance $(r_{B,i})$ and the risk free rate (r_s) might vary across banks for two reasons.

First, the interest rate elasticity of deposits might vary across banks, just like the preferences of depositors. To exemplify this, banks with more affiliations or with more customer oriented services are likely to attract on average less interest rate sensitive deposits. Both the number of affiliations and the sensitivity of the deposits of the banks are likely to correlate with observable characteristic of the bank (x_i), like size.

Second, the external funds of the banks are supplied at a risk premium over the risk free rate and the risk-premium increases when r_s rises making the funding of loans more expensive for the banks.

Bank *i* has the following profit function:

$$\Pi_i = L_i \cdot r_{L,i} + S_i \cdot r_S - B_i \cdot r_{B,i} - \Psi_i, \tag{6}$$

where Ψ_i denotes bank specific administrative costs.

Each bank maximizes its profit given by (6) under the constraints of (1)–(5). After solving the constraint optimization problem of bank *i*, we get the following expression for the optimal amount of loans:

$$L_i = \frac{a_1}{2} \cdot y + \frac{a_2}{2} \cdot p - \frac{a_0 \cdot \mu \cdot (1-k)}{2} \cdot r_s + \frac{a_0 \cdot c \cdot (1-k)}{2} \cdot x_i \cdot r_s - \frac{a_0}{2} \cdot \frac{\partial \Psi_i}{\partial L_i}. \tag{7}$$

As we can see from the expression, the optimal amount of loans granted by a bank will be a function of its observable characteristics (x_i), such as capitalization, liquidity, share of foreign ownership, and size.

As discussed later in more detail, in most empirical literature the regression of concern is a version of equation (3) and the investigation whether the parameter of $x_i \cdot r_s$ is significant and has the expected sign is the way to identify loan-supply movements. We rely on a slightly modified version of equation (7) for the investigation of the bank-lending channel in Hungary. The identification, however, relies on the homogeneity assumption of loan demand across banks (that L_d^i does not depend on x_i). The accuracy of this assumption will be tested in the empirical part of the paper.

EMPIRICAL APPROACHES FOR THE IDENTIFICATION OF THE BANK LENDING CHANNEL

Several empirical approaches have been used to investigate the functioning of bank lending channel.[6] As already pointed out, the difficulty arises from separating the supply and the demand effect of monetary actions. Earlier papers tried to examine the bank lending channel based on aggregate data, while in more recent papers identification rely on asymmetries in the loan supplies of individual banks.

Identification based on aggregate data

Bernanke and Blinder (1992) rely on aggregate balance sheet data and use vector autoregressive models to see how monetary policy affects real economy and via what transmission mechanism. They find that tighter monetary policy results in an immediate reduction of bank deposits and bank holdings of securities with little immediate but larger

[6] Some of these approaches have mostly been applied to countries and periods with interest rate controlling monetary policy, while others have been used where and when monetary authorities control the money supply. Although, we are interested in the first case, the empirical investigations and results in the second case might be relevant to the first case as well.

delayed effect on loans. Finally, aggregate output also falls. While the authors' finding is certainly in line with the idea of bank lending channel, it may as well be purely due to the standard interest rate channel.

In order to overcome this identification problem, Kashyap, Stein and Wilcox (1993) consider relative fluctuations in bank lending and in commercial papers that are lending substitutes for bank loans. They conclude that tighter monetary policy leads to a rise in the ratio of commercial papers to bank loans. The commercial paper is a proxy for the changes in the firms demand for loans. Hence, changes in the composition of the firms' external finance indicate that loan reduction is due to a shift in the relative marginal cost of loans to that of commercial papers, as suggested by the bank lending theory. However, this identification implicitly assumes that monetary policy shocks affect demand for alternative funds the same way.

Identification based on asymmetric movements in firm behavior

Several researchers used micro-level data to test for some cross-sectional implications of the bank lending theory. Gertler and Gilchrist (1994), for example, investigate whether the influence of monetary policy is larger for small firms that are supposed to be more bank-dependent. Their empirical finding for such an asymmetry however can also be due to the functioning of the balance sheet channel.

Nilsen (1999) takes this approach a step further. He not only investigates asymmetry in loan usage of firms but also analyses whether the cutback found is voluntarily. Namely, he investigates the use of a less desirable alternative credit: trade credit. He finds an increase in the use of trade credit and takes this as a support for bank lending channel.

Identification based on asymmetric movements in loan quantity

Kashyap and Stein (1995) investigate bank lending behavior at the individual bank level. Kashyap and Stein (1995) suggest that smaller banks might have steeper increasing external finance premium than larger banks because large banks have better access to non-deposit funding, as they are less exposed to information asymmetry problems. Based on this, they suggest identifying shifts in supply by seeking for differences in loan quantity adjustment for *larger and smaller banks.*

Kashyap and Stein (2000) point out other possible asymmetric adjustment of banks. They argue that a bank with more *liquid* assets can relatively easily protect its loan portfolio in case of decreasing liabilities, simply by drawing down on its larger buffer stock of securities. The authors find that size and liquidity might be interrelated. Kakes and Sturm (2002) when analyzing bank lending in Germany conclude that in fact, smaller banks tend to hold a larger buffer of *liquid* assets to offset monetary shocks.

Kishan and Opiela (2000) add another factor to the possible distributional effects of monetary policy. They argue that *capital's* role in absorbing shocks to asset markets makes it an indicator of bank health and therefore an indicator of a bank's ability to raise alternative funds.

Based on Haas and Naaborg (2005), in line with the ideas of Kishan and Opiela (2000) we also include *foreign ownership* among bank characteristics and argue that higher foreign ownership might lead to lower marginal cost of financing because banks that are subsidiaries of foreign banks can get relatively cheap foreign funds from their parent banks. Therefore, smaller reaction of loan supply to monetary shocks is expected at banks with foreign ownership due to the working of bank lending channel.

In our empirical analysis we follow the approach of Kashyap and Stein (1995 and 2000), Kishan and Opiela (2000), and Haas and Naaborg (2005) and seek for asymmetries in the adjustment of loan quantity to changes in money market rate among banks with different size, liquidity, capitalization, and foreign ownership characteristics.

3. How much the theory applies for Hungary: looking at stylized facts

In order to get an overall picture of the bank lending channel in Hungary, we first list several stylized facts about its financial system and examine the relevance of these conditions for the bank lending channel. A thorough overview of the financial conditions in Hungary is especially important when investigating the bank lending channel because of several reasons. First, this overview might help to identify and separate the loan supply and the demand effect, which is a rather complicated empirical problem. Moreover, the changing economic environment makes the empirical analysis more difficult. Second, data on past and present behavior of loan supply cannot provide us with ideas about how important the role of financial institutions will be, for example, by the time Hungary joins the EMU. Here we present some stylized facts and investigate the possible future tendencies.

THE REACTION OF EXTERNAL FINANCE PREMIUM OF BANKS TO MONETARY SHOCKS (INVESTIGATION OF ASSUMPTION 1)

The functioning of the bank lending channel has a starting point that monetary tightening leads to increase in the external finance premium of banks. Using our dataset we find, that indeed, the 3-month Forint money market rate (MMR) and average cost of financing[7] (ACF) are highly correlated (0.63), which suggests that an interest rate increase results in higher costs of financing for banks. However, this can still be mainly due to the working of the classical interest rate channel. A more informative measure would be to see whether average cost of funding increases (additionally to the effect of interest rate channel) when MMR increases. More precisely, whether the spread between MMR and ACF is higher when MMR is higher. This correlation is positive and relatively high; 0.33.

The identification of the bank lending channel that we follow is based on identifying asymmetries according to theoretically plausible characteristics of banks that are outlined in the previous section. To investigate whether according to these factors indeed we see a difference in the financing of banks, we compute the correlation of size, liquidity, capitalization, and foreign ownership with average cost of financing.[8] We find, in accordance with the theory of Kashyap and Stein (1995 and 2000), and Haas and Naaborg (2005), that size, capitalization, and foreign ownership (see the first column of Table 1) are negatively correlated with the average cost of financing. The correlations, however, are quite low in most of the cases.

Table 1

Correlation matrix of size, liquidity, capitalization, foreign ownership, and average cost of financing

	ACF	Liquidity	Size	Capit1	Capit2	For. own.
ACF	1	0.05	-0.05	-0.06	-0.02	-0.23
Liquidity	0.05	1	-0.07	-0.005	0.13	0.10
Size	-0.05	-0.07	1	-0.16	-0.14	-0.07
Capit1	-0.06	-0.005	-0.16	1	0.79	0.21
Capit2	-0.02	0.13	-0.14	0.79	1	0.23
For. own.	-0.23	0.10	-0.07	0.21	0.23	1

Note: Calculated for all banks and for the entire sample period, see data description in the empirical part of the paper. We obtain alternative measures of capitalization. Capit1 is computed as equity divided by total assets and Capit2 is the capital adequacy ratio. In our further analysis we use Capit2.

[7] Average cost of financing is computed as interest rate payments per interest-bearing liabilities.

[8] Of course, average cost of funding among banks may differ due to differences in other characteristics of the liability side, such as average maturity. In this simple exercise we assume these other factors to be uncorrelated with the bank characteristics we focus on. One concern might be the relationship for ownership. If foreign-owned banks are more likely to have funding in foreign currency, an increase in domestic interest rate might have a lower influence on their average cost of funding, biasing our parameter of the interaction term with foreign ownership to negative values. At the same time, larger banks have proportionally larger deposit base. As this base is not exposed to the external finance premium an increase in MMR will lead to a lower increase in the average cost of funding. However, this asymmetry is in line with the idea of bank lending channel.

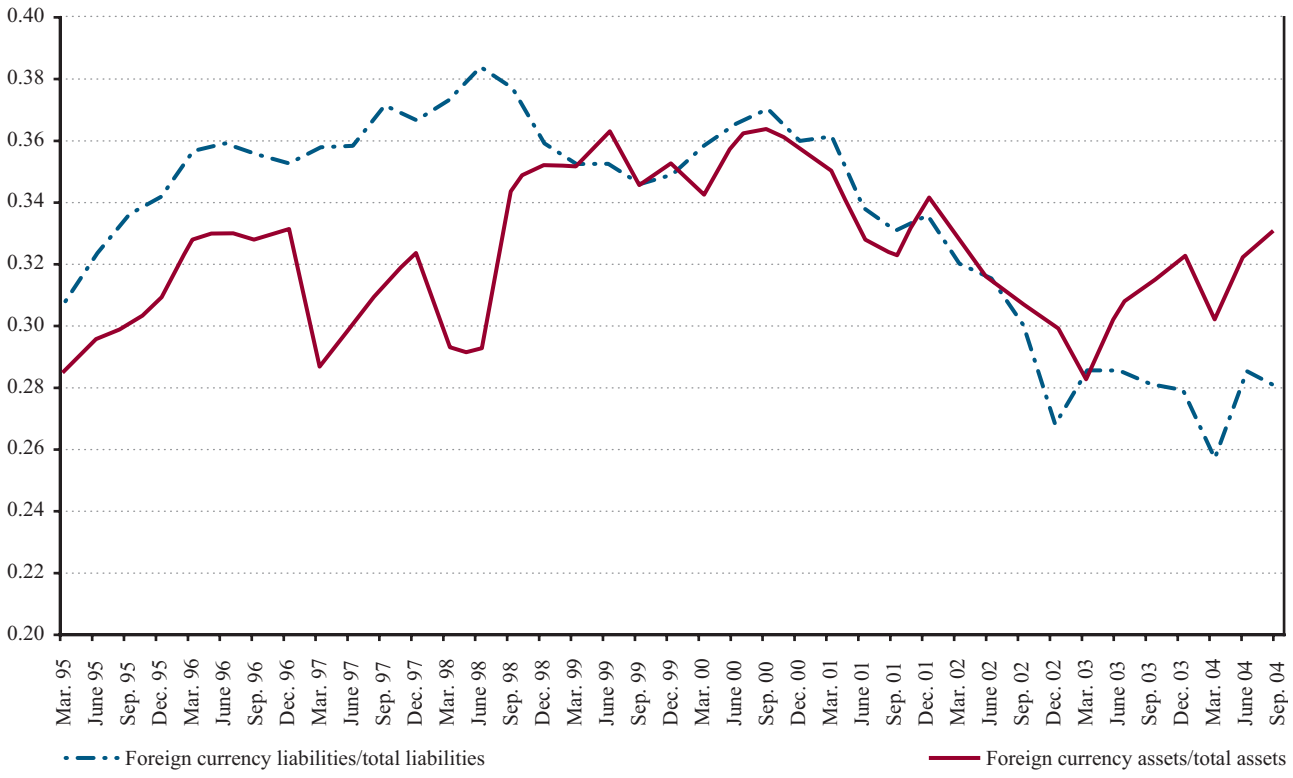
The correlation does not necessarily mean that an increase in money market rate results in a larger increase in the marginal cost of funding, for example, for smaller banks, but might just capture a difference in the cost *levels.* We investigate this question in a more sophisticated way in the empirical part of the paper by regressing changes in ACF on changes in different macroeconomic variables, changes in the MMR, and on interaction-terms of changes in MMR with bank-specific characteristics. The results support that an increase in MMR or in the euro interest rates (3-month EURIBOR) induces significant increase of ACF of an average bank, which supports the working of interest rate channel.

Availability of foreign (currency) funds

The forint yields contain a significant currency risk premium while the country risk premium is almost negligible. Therefore, there is a wide gap between the cost of Forint and foreign currency funds, and even the correlation between domestic and foreign interest rates is low (e.g. euro, Swiss francs). The Chart 2 shows the significance of foreign (currency) funds in liabilities, as of foreign currency denominated liabilities to total liabilities amounted to more than 26% between 1995 and 2004. The share of assets denominated in foreign currency in total assets is even higher in Hungary, it is around 30% during the observed period. It seems that the deepening of the monetary system in Hungary did not affect this proportion; it seems rather stable despite that total assets increase monotonically.

Chart 2

Currency denomination structure of assets and liabilities of the banking sector



Source: MNB.

Additionally, the majority of Hungarian banks are owned by foreign financial institutions. Foreign involvement in the banking market has increased over the observed period, which is a general characteristic of the new EU countries (Schmitz; 2004). Consequently, a significant and increasing proportion of the Hungarian banks can get relatively cheap foreign funds from their parent banks. These banks may face fewer financing constraints if they can receive additional (cheap) funding, equity or debt, from their parent banks (Haas and Naaborg; 2005) due to reduced asymmetric information problems. A bank with foreign parent bank that is facing problems with raising new capital may, for example, receive funds from the parent bank in exchange for (new) shares and when this bank needs additional liquidity the parent bank may provide it with funds in exchange for debt titles. Bonin et al. (2003) find that in countries in Central Europe and Baltic States (CEB) privatized banks experienced a decrease in net interest rate margins after their privatization. They argue

that this provides evidence that foreign ownership made access funds less expensive. Haas and Naaborg (2005) find, analyzing CEB countries as well, that all parent banks interviewed in their study operate some form of internal equity market in which they influence the capital levels of their subsidiaries. Parent banks provide their CEB subsidiaries with debt funding; long-term debt or short-term cash support. However, in general, parent banks cannot fund their subsidiaries in the host-country currency. An example they come up with is that of ING Hungary that receives some euro liquidity from Amsterdam but does all of its funding locally because its business is mainly in Hungarian forint.

This implies that Hungarian banks can substitute domestic funds with relatively cheap foreign funds easily. This weakens the significance of the bank lending channel. The adoption of the euro in Hungary and the common monetary policy will reduce such possibilities for substitution since a significant share of the foreign parent banks and foreign funds are in the euro area.

Trends in liquidity and capitalization of the banking sector

The most commonly used bank characteristics applied to capture the existence of the bank lending channel are capitalization and liquidity position of banks. The banking sector has been characterized by excess liquidity in the last few years, as a consequence of heavy capital inflows in the late nineties, which was sterilized by the central bank. In other words, the increase in funds were more intense, then the lending possibilities of the banks. However, the share of liquid assets of the banking sector has been decreased continuously in the last few years, which might contribute to the increasing relevance of the bank lending channel at an aggregate level over time. The ratio of liquid assets has declined and the loan to deposit ratio has increased, and has approached the euro area's level (according to our dataset, on average, the ratio of liquid assets to total assets decreased from 50% to 23% in the period of 1998 and 2004). Similarly, capitalization of the banking sector has been also almost continuously declining from the late nineties, the capital adequacy ratio lowered significantly (it reduced from about 18% to 11% between 1995 and 2004); in case of some banks it is near the regulatory minimum. It is important to point out, these trends in liquidity and capitalization cannot be regarded an unfavorable developments. The Hungarian banking sector is now converging to "normal" levels (see Table 3). The reduction of excess liquidity and overcapitalization might enhance the bank lending channel, i.e. the effect of monetary policy shocks on banks' lending decision might become stronger.

Table 2

Some characteristics of the banking sector in Hungary and the Eurozone in 2003

	Hungary	Eurozone
Capital adequacy ratio	11.5	12.3
Liquid assets/total assets	19.6	18

Source: MNB, ECB (2003).

However, the above mentioned bank characteristics are not independent from each other. Theory of bank lending channel suggests that banks, which face asymmetric information problem to a greater extent, for example smaller banks, have larger difficulties accessing cheap funds. Consequently, these banks are more inclined to hold more liquid assets and also to be better capitalized. In other words, higher liquidity and capitalization might be an endogenous response from smaller banks to counterbalance their financing difficulties resulting from higher asymmetric information problem. Additionally, limited access to cheap non-deposit funding might be captured by the liability structure of the banks, i.e. that smaller banks are notably more dependent on deposit financing than larger banks, and also better capitalized. According to Kashyap and Stein (2000), data of American banks support this hypothesis. Hernando and Pages (2003) also find that small Spanish banks tend to have more liquid assets and capital, which might be an endogenous response for asymmetric information problems and difficulties resorting uninsured sources of funds.

The Hungarian banking sector seemingly also underpins this hypothesis: smaller banks tend to have higher liquidity and capital adequacy ratio, than that of the larger banks (see Table 4). However, in contrast with the traditional story, the ratio of deposits to total external funds is lower, and the ratio of money market funds in total liabilities is higher at smaller banks than that of the larger banks. This data questions that smaller banks gather more deposits due to limited access to cheap non-deposit funding.

Table 3

Selected indicators of Hungarian banks by size (2003)

	Banks		
	Small	Medium	Large
Liquid assets/total assets	33.8	39.7	19.6
Capital adequacy ratio	19.1	19.6	10.3
Loan/deposit ratio	126.6	140.7	105.1
Deposit/external funds	66.4	48.4	78.5
Money market funds/external liabilities	19.0%	20.3%	5.8%

Source: MNB.

THE STRUCTURE OF THE HUNGARIAN FINANCIAL SYSTEM (INVESTIGATION OF ASSUMPTION 2)

The second assumption for the working of the bank lending channel is that banks dominate the financing of firms, namely that (at least some) firms cannot substitute bank loans by other non-bank sources. From this point of view the picture in Hungary is rather mixed.

The Hungarian financial system is clearly bank-dominated, which creates a ground for the bank lending channel. Capital markets play a marginal role in corporate financing (see Table 4). In Hungary, the ratio of the market capitalization of the stock market to GDP is less than 30% of the average ratio of the EMU countries. Moreover, financial systems of EMU countries are also dominated by banks. In Hungary, the corporate bond market is especially underdeveloped and we do not expect substantial progress in the near future. On the other hand, although the financial intermediation is continuously deepening (loan/GDP ratio rose from 18.3 to 38.2 in the period of 1998-2004), domestic credit per GDP is significantly lower in Hungary than in the eurozone, which reduces the significance of bank loan supply effect on the corporate sector. Another important feature of the financial system is that direct foreign loans account for a significant share of total corporate debt. Consequently, corporations, especially large corporations, can substitute their domestic bank loans by foreign loans relatively easily (see Table 6), of which interest rate is not affected by domestic monetary policy. This fact mitigates the importance of Hungarian banks in the transmission mechanism in the present, but as majority of these loans come from EU banks, the effect of the common monetary shocks might become stronger after adopting the common currency.

Table 4

International comparison of channels of financial intermediation to enterprises (per cent of investment)

	Hungary		Portugal	Spain	Germany	USA
	1998[1]	2000[2]	1998[1]	1998[1]	1998[1]	1998[1]
Domestic liabilities						
Bank credit[3]	20.4	18.9	32.8	19.9	17.0	6.8
Bond issues	1.2	0.1	3.5	1.4	..	..
Equity issues[4]	0.4	0.0	7.6	4.8	3.8	14.3
Foreign sources						
Inter-company loans	4.1	3.1	2.8	2.1	..	..
Bank loans	3.2	13.6	2.2	2.3	..	..
Bond issues	0.3	0.1	0.3	0.0	..	..

[1] 1998: average of 1997 and 1998. [2] 2000: average of 1999 and 2000. [3] Credit of domestic banks contains credit provided for corporate sector (including credit in foreign currency) by the resident banks (including foreign owned). [4] Equity issues: capital-raising public offers on the stock exchange.
Source: Schardax and Reininger (2001), Table 21, page 25.

Table 5

Distribution of corporate and household loans and deposits by currency denomination in 2003 (per cent)

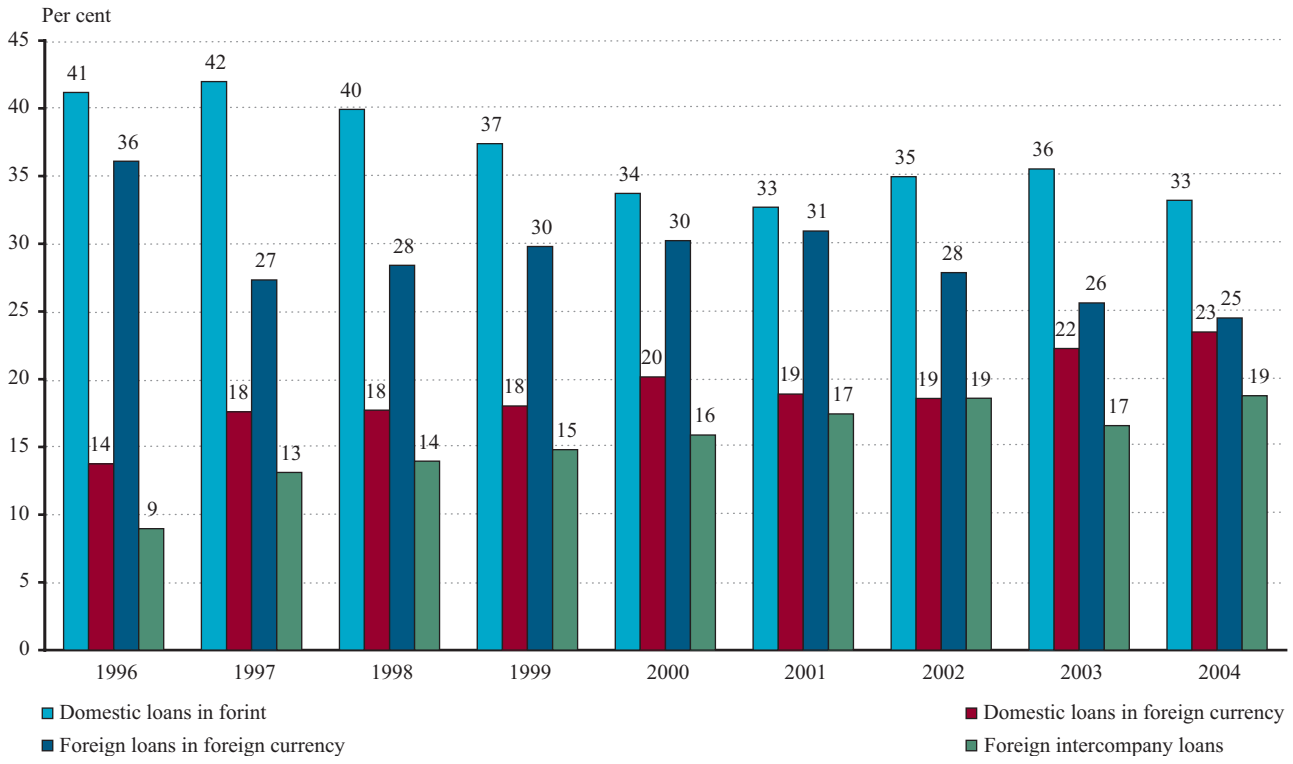
	Non-financial corporations		Households	
	Loans	Deposits	Loans	Deposits
Domestic banks, HUF	44	54	97	87
Domestic banks, foreign currency	29	12	3	13
Foreign banks, foreign currency	27	34	-	-
Total	100	100	100	100

Source: MNB.

Chart 3 clearly shows that the decomposition of corporate loans has changed significantly since 1996. The share of inter-company loans in foreign currency has doubled (increased from 9 to 19%) that might be partly due to the sharply increasing foreign ownership in the corporate sector in this period. At the same time, companies in Hungary appear to be more inclined to substitute their foreign currency denominated loans from abroad with those from banks in Hungary (their total share stays around 50% in the period, but the share of the first drops from 36% to 25% while the share of the second increases from 14% to 23%). The most important trend with respect to the working of the bank lending channel is that the share of loans denominated in Hungarian Forint fell from 41% to 33% from 1996 to 2004 with some cyclical variation in the period between. This tendency suggests a decreasing importance of the bank lending channel in Hungary. However, it may not necessarily continue even in the near future, because the domestic interest rate is expected to converge to the euro interest rate. The diminishing interest rate differential will make the domestic currency denominated loans more attractive for corporate and retail borrowers than before.

Chart 3

Decomposition of corporate loans in Hungary

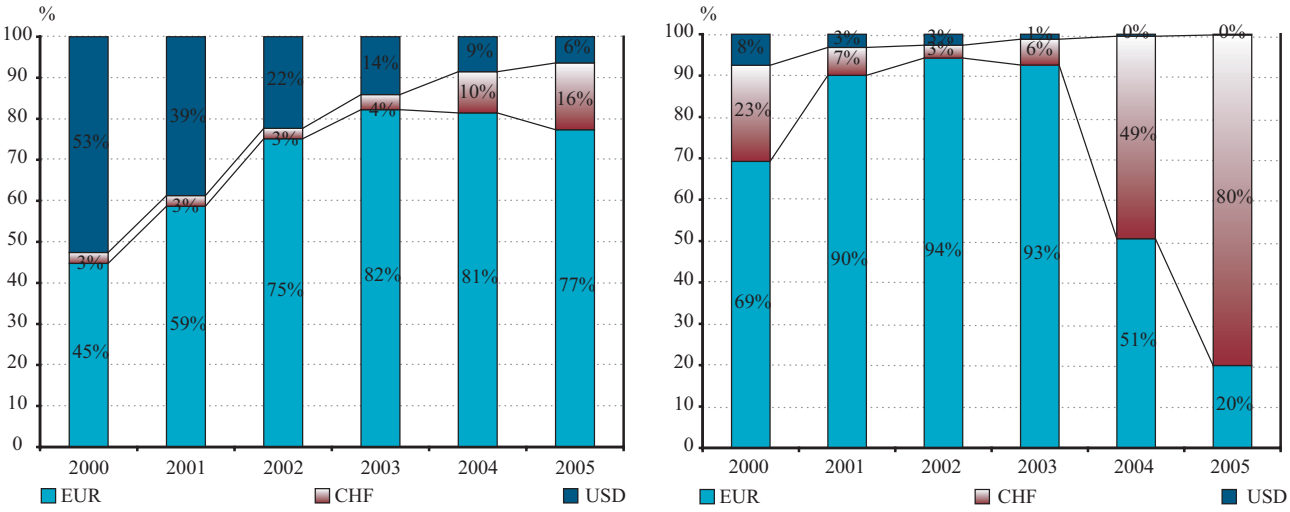


Regarding the expected entrance to the EMU the currency denomination decomposition of loans is also interesting. Chart 4 shows an increasing share of Swiss Franc both in consumer loans and corporate loans, and therefore of total loans in foreign currency. Holding of consumer loans in Swiss Franc increased rapidly in the past two years, to 80% of

all domestic consumer loans in foreign currency. This happened at the expense of euro consumer loans, whose share dropped from 93% to only 20% in between 2003 and 2005. Since 2003 the share of corporate loans in euro also shows a declining pattern. As we mentioned earlier, a significant share of euro loans would suggests a rapid increase in the importance of the bank lending channel by the time of the EMU entry. The observed displacement of the Euro loans by the Swiss Franc denominated loans works against this change. At the same time, as The Report on Financial Stability October (2005) points out, due to risk management considerations banks may start to shift their foreign currency loans from Swiss Franc loans to euro loans.

Chart 4

Currency decomposition of domestic corporate loans in foreign currency (left) and Currency decomposition of domestic consumer loans in foreign currency (right)[9]



Notes: Source: MNB, Data for 2005 is only available until October.

IMPLICATIONS FOR THE FUTURE

Although the majority of the above mentioned factors imply a weak bank lending channel, some expected future developments in the factors suggest its increasing significance. Most importantly, the dominance of foreign, mostly European, ownership of banks, and the substantial share of euro denominated assets and liabilities of banks imply that with the adoption of the common monetary policy – the share of liabilities and assets sensitive to domestic monetary policy will increase substantially. This will strengthen the bank lending rate channel. We do not expect a quick improvement of the equity market in Hungary. So, possibility of companies to substitute bank loans with other sources of financing continues to stay limited in Hungary thereby not showing a tendency that would weaken the bank lending channel.

Since financial markets in Europe are also bank-dominated, we do not expect that bank dependence of borrowers would decline substantially as the Hungarian economy integrates more into and becomes more similar to the European economy.

The banking sector has been characterized by excess liquidity in the last few years, as a consequence of heavy capital inflows in the late nineties, which was sterilized by the central bank. However, the share of liquid assets of the banking sector has been decreased continuously in the last few years, which might contribute to the increasing relevance of the bank lending channel at an aggregate level over time. Similarly, capitalization of the banking sector has been also declining considerably from the late nineties almost continuously, the capital adequacy ratio lowered significantly. The continuously diminishing of excess liquidity in the banking system and the decreasing capitalization due to the increasing efficiency in the banking system outlines the possibility of strengthening of the bank-lending channel in the future in Hungary.

[9] We thank Katalin Bodnár for providing us detailed data on the currency decomposition of corporate and consumer loans.

At the same time, increasing tendency has been observed in the foreign ownership that increased the possibility of banks to get relatively cheap foreign funds from their parent banks. Domestic deposit insurance protection covers additional components since January 2003. The National Deposit Insurance Fund of Hungary included bank bonds and certificates of deposits issued by banks after 1 January 2003 among the insured items. These changes imply a reduction in the possible effectiveness of bank lending channel.

We believe that among these diverse processes the effect of Hungary's EMU entry will be the most influential.

4. Econometric analysis

In this section we describe the data and the empirical approach that we use for the investigation of the bank lending channel in Hungary and discuss the results. Our empirical analysis of the bank lending channel in Hungary uses data on individual bank balance sheets and applies panel-econometric techniques to exploit the heterogeneity among banks and over time.

Data

We use quarterly data for the period of January 1995–2004 September. In order to get comparable results with Ehrmann et al. (2003) we treated the data the same way whenever it was possible. Most mergers have been treated by a backward aggregation of the entities involved in the merger. However, for banks, which merged at the end of our sample period, in 2004, we trimmed the observations after the mergers. We opted for this approach due to its advantages; namely, that we could make use of a larger information set for estimation and that we could avoid the possible bias induced by aggregation. Due to this merger treatment the number of cross-sections might vary over sample periods. The number of banks in a sub sample period ending before some mergers exceeds the number of banks in the whole sample period by the number of these mergers.

After the merger treatment we discarded those banks from the sample which existed for less than two years during the sample period. We also discarded those banks, which had either no deposits, or their loan to total asset ratio was less than 1% over the entire sample period. We trimmed the time series of those banks which had either no deposits or of which the lending activity was negligible for a few quarters during the sample period. Most of these banks have just stated in these periods or were about to close. So, the deletion of these observations eliminated those periods where the functioning of the bank was lead by unusual financial activities. Our final database contains 25 commercial banks. All balance sheet variables are seasonally adjusted.

Normalization of bank-specific variables

An important issue is to normalize the variables that capture possible asymmetries across banks in order to have proper interpretation for the c_j parameters. By demeaning the bank-specific terms their expected value becomes zero so, the c_j parameters can be interpreted as the average effect of monetary policy on loans.

One approach is to define variables that capture possible bank-specific asymmetries as deviations from their cross-sectional means as follows (like in Ehrmann et al.; 2003 and Topi and Vilmunen; 2001):

$$x_{it}^{*} = x_{it} - \frac{1}{N}\sum_{j=1}^{N} x_{jt}$$

This formulation removes a general trend characterizing the financial sector, for example general deepening of the financial sector. Size is usually defined this way. However, liquidity and capitalization are usually measured as (Ehrmann et al.; 2003 and Brissimiss et al.; 2003)

$$x_{it}^{*} = x_{it} - \frac{1}{TN}\sum_{t=1}^{T}\sum_{j=1}^{N} x_{jt}$$

This specification removes the overall average (across banks and over time) from each observation. This way we obtain the interpretability of parameters *c,* but we do not remove a trend from a possibly changing financial market. We chose this approach regarding the liquidity, capitalization, and foreign ownership variables, as we assume that the above mentioned general trends of decreasing liquidity and capitalization, and increasing trend in foreign ownership might be rel-

evant from the point of view of the transmission. An argument for using the second normalization for non-size variables is as follows. The definition of a large bank may differ with changing market conditions, i.e., a bank which is considered to be small on a market with deeper financial sector may be regarded as medium or large in a smaller market. Contrary to size, liquidity and capitalization are less relative measures. This way, we make use of the variability of these characteristics not only across banks, but also over time.

EMPIRICAL APPROACH TO TEST ASYMMETRIC ADJUSTMENT OF COST OF FUNDING

In the beginning of Section 3 we started to check whether monetary tightening leads to increase in the external finance premium of banks by looking at the correlations between the ACF and the different bank-specific variables, respectively. Here we investigate whether an increase in money market rate results an increasing average cost of funding in the banking sector. This hypothesis is similar to assumption 1, however assumption 1 states a relationship between *marginal* cost of funding and money market rate, and not between *average* cost of funding and money market rate.[10] Moreover, we test the hypothesis that there is some asymmetry across banks in the reaction of their average cost of funding to the higher money market rate. This hypothesis is closely related to one of our assumptions in the theoretical model, namely, $0 < c \cdot x_i$ in equation (5).

We regress changes in ACF on changes in different macroeconomic variables, changes in the MMR, and on interaction-terms of changes in MMR with bank-specific characteristics and estimate the following equation:

$$\Delta \log(ACF_{it}) = a_i + \sum_{j=1}^{J_1} b_j \Delta \log(ACF_{i,t-j}) + \sum_{j=0}^{J_2} c_j \Delta r_{t-j} + \sum_{j=0}^{J_3} d_j \Delta \log(GDP_{t-j}) + \sum_{k=1}^{n} \sum_{j=0}^{J_4} e_j z_{k,t-j} + \\ + fx_{i,t-2} + \sum_{j=0}^{J_5} g_{ij} x_{i,t-2} \Delta r_{t-j} + \varepsilon_{it}, \tag{8}$$

where r_t refers to interest rate at time t; L_{it} to nominal loans of bank i at time t; GDP_t to GDP at time t; $z_{k,t}$ defines the k^{th} macro variable at time t which we control for, such as inflation, exchange rate, foreign interest rate; $x_{i,t}$ captures bank-specific variables (in addition to the usual variables: size, liquidity, capitalization we also consider foreign ownership) of bank i at time t; and ε_{it} is the error term. We focus on the significance and the sign of cross-terms when seeking evidence for asymmetric effect of monetary policy on the external cost of funding of banks with different risk characteristics. This expression can be considered as an empirically-extended version of Equation (5) in the theoretical model.

The columns of Table 6 show the results of the five estimated equations.[11] The results in Table 6 show that an increase in MMR or in the euro interest rates (3-month EURIBOR) induces significant increase of ACF of an average bank, which supports the working of interest rate channel. Exchange rate depreciation also leads to higher costs of funding. With respect to the interaction-terms that are our main interest, we have similar results to that of the correlation; an increase in the interest rate induces a larger change in average cost of funding for smaller, less capitalized banks, and for banks with higher domestic share. The fact that the parameter of the interaction-term for liquidity is positive does not contradict with the theory. Additionally, since the Hungarian banking sector has been characterized by excess liquidity, variation in liquidity among banks and over time is not likely to be informative for the functioning of the bank lending channel in Hungary in the investigated period. At the same time, banks that are aware of being exposed more to increasing cost of external funding (higher ACF) may decide to hold more liquid assets in order to protect their portfolio. Our results are in line with the theory and make us somewhat confident that if we find significant asymmetry for a specific bank-characteristic might indeed identify the functioning of bank lending channel.

[10] We have data only on the average cost of funding but not on the marginal cost of funding and therefore rely on this variable as a proxy.

[11] In each version of equation (8) we only include one bank-specific variable (x_i). So, we estimate five separate equations. The results of the equation that contains, for example, size as bank-specific variable can be seen in column two, the results for liquidity in column 3, etc. All tables in this section can be interpreted the same way.

Table 6

Results of regressions for ACF

ACF	GMM, lag2, 1995 Q1-2004 Q3				
Asymmetry (A)	Size	Liquid	Capit1	Capit2	For. own.
Interest rate	1.33*** (7.79)	1.53*** (9.83)	1.54*** (13.13)	1.55*** (9.28)	1.57*** (11.41)
GDP	-0.01*** (-6.23)	-0.01*** (-6.29)	-0.01*** (-8.22)	-0.01*** (-5.98)	-0.01*** (-8.95)
Exchange rate	0.18*** (5.21)	0.19*** (5.60)	0.19*** (8.03)	0.23*** (5.09)	0.19*** (5.80)
Euro interest rate	0.00** (2.04)	0.01*** (3.67)	0.01*** (3.77)	0.00 (1.17)	0.01*** (5.29)
Inflation	-0.10 (-1.45)	-0.11** (-2.00)	0.02 (0.35)	0.05 (0.86)	0.09 (2.06)
A*interestrate	0.00*** (-5.53)	1.28*** (2.94)	-2.38*** (-3.60)	-0.84*** (-2.41)	-0.27 (-1.31)
A	0.00 (-1.36)	-0.01 (-0.07)	0.01 (0.05)	0.04 (0.34)	-0.03 (-0.53)
No. of obs.	855	855	841	841	847
Adjusted R^2	0.53	0.53	0.54	0.54	0.54
J-statistics	511.81 (0.43)	505.52 (0.38)	497.96 (0.47)	493.42 (0.39)	535.87 (0.28)
D-Hansen test	20.46 (0.97)	33.09 (0.52)	27.04 (0.78)	29.16 (0.69)	44.04 (0.11)

*Notes: * significant at 10%, ** at 5%, *** at 1%.*
For GMM we only could use the White 1-step GMM weights. Below the J-statistics and the D-Hansen statistics, the numbers in parentheses are the corresponding p-values. The standard errors of the long-run coefficients are computed by delta method.[12]

EMPIRICAL APPROACH TO TEST ASYMMETRIC ADJUSTMENT OF CREDIT QUANTITIES

Due to the ongoing debates about the bank lending channel, researchers use very different approaches to assess this channel of the monetary transmission mechanism as pointed out in section 2. In our investigation we apply the most frequently used approach of Kashyap and Stein (1995 and 2000) that relies on finding asymmetries in the reaction of loan quantity to monetary policy actions. This method was followed by majority of researches in the Transmission Network in the euro zone.

The empirical model

We rely on the usual approach of assessing the existence of bank lending channel, namely, we test the existence of distributional effects of monetary policy among banks, by introducing interaction-terms: based on Ehrmann et al. (2003) and Kashyap and Stein (1995) and followers, we use the following reduced form model to test for the existence of bank lending channel:

$$\Delta \log(L_{it}) = a_i + \sum_{j=1}^{J_1} b_j \Delta \log(L_{i,t-j}) + \sum_{j=0}^{J_2} c_j \Delta r_{t-j} + \sum_{j=0}^{J_3} d_j \Delta \log(GDP_{t-j}) + \sum_{k=1}^{n} \sum_{j=0}^{J_4} e_j z_{k,t-j} + fx_{i,t-2} + \\ + \sum_{j=0}^{J_5} g_{ij} x_{i,t-2} \Delta r_{t-j} + \varepsilon_{it}, \tag{9}$$

[12] As long-run parameters are non-linear functions of the short-term parameters, we need to apply delta method for the estimation of the variance of the long-run parameters. Delta method is a general approach to compute confidence intervals of functions of maximum likelihood estimates that would be too difficult to compute analytically. In essence, it uses a linear (first order Taylor) approximation of the function and uses this to compute the variance of the simpler linear function.

where r_t refers to interest rate at time *t;* L_{it} to nominal loans of bank *i* at time *t;* GDP_t to GDP at time *t;* $z_{k,t}$ defines the k^{th} macro variable at time *t* which we control for, such as inflation, exchange rate, foreign interest rate; $x_{i,t}$ captures bank-specific variables (in addition to the usual variables: size, liquidity, capitalization we also consider foreign ownership) of bank *i* at time *t;* and ε_{it} is the error term. So, in order to proxy loan demand and monetary changes as closely as possible, we regress the loan growth of banks on GDP growth, inflation rate, domestic interest rate change, foreign interest rate change and focus on the significance and the sign the parameter of cross-terms (g_{ij}) when seeking evidence for loan-supply effects. The interpretation of the long-run value of the g_{ij} s can be summarized as follows:

I. If loan demand can be considered homogeneous across banks:

1. Significantly positive *g* shows genuine difference in loan supply behaviour.

2. If *g* is not statistically different from zero, there is a common loan supply reaction across banks.

3. Significantly negative *g* suggests that the selected x_i variable does not capture loan supply behavior or the basic identification condition is not true.

II. Under heterogeneous loan demand across banks:

1. A significant *g* can capture aggregate effect of heterogeneous demand and supply side reaction of individual banks.

We use asymmetric variables lagged two times to avoid possible endogeneity. If the bank lending channel operates and loan demand is homogeneous across banks then we anticipate the coefficients of cross terms to be significantly positive, as monetary policy changes have a weaker effect on larger, more liquid and better capitalized banks and banks with larger share of foreign ownership according to the bank lending channel theory.

However, the aggregate coefficient of the monetary policy variable (c_j) also gives important information: it shows the aggregate effect of policy change on credit aggregates; a negative coefficient of interest rate implies that loans fall after a monetary tightening. This coefficient includes the demand and supply effects as well.

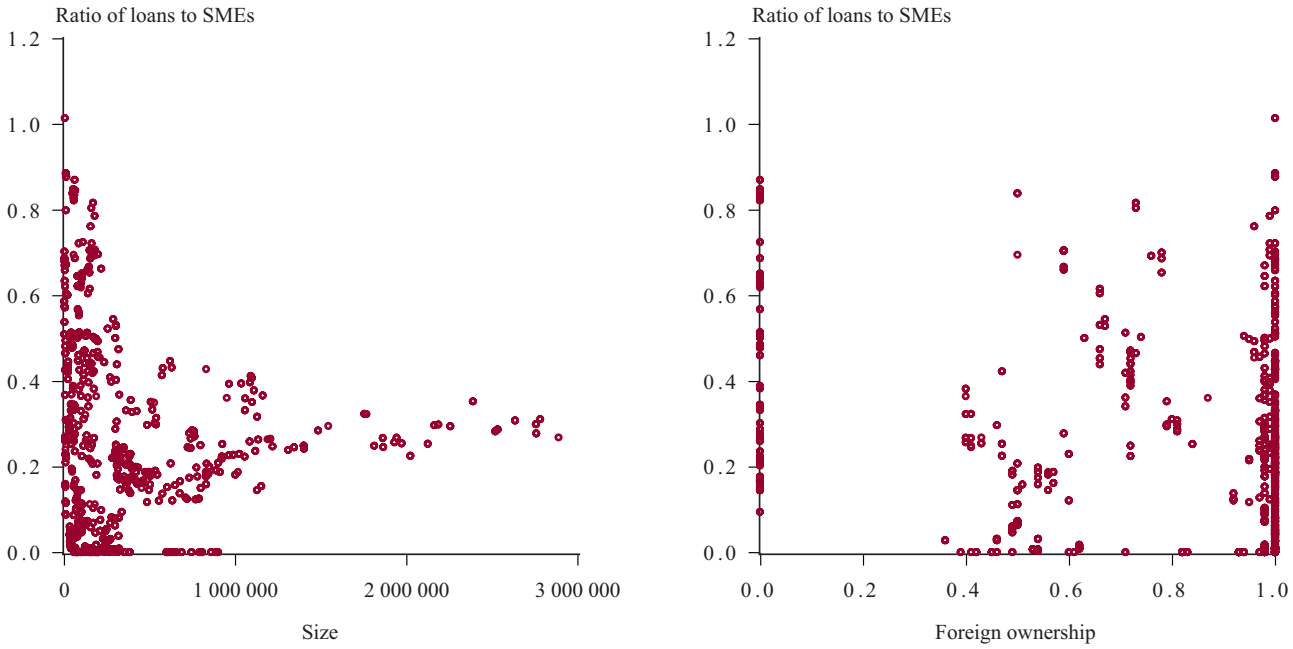
Testing homogeneity of loan demand

In order to properly disentangle the loan supply reaction to monetary policy actions, the Kashyap and Stein model assumes homogeneous reaction of loan demand with respect to the analyzed bank-specific variables.

However, if larger banks tend to lend more to larger companies, whose loan demand is less sensitive to interest rate changes than smaller ones', then the possible positive asymmetry with respect to the size variable might arise from the asymmetric adjustment of loan demand. To check whether it is plausible to assume homogeneity of loan demand for banks with different size we look at how the ratio of loans to small- and medium-size enterprises (SMEs) varies over banks with different size. Chart 5 shows that the ratio varies a lot among small banks while the conditional variance reduces as the size of banks increases and there seems to be a tendency for the ratio to increase with size. This chart shows panel observations, namely several observations (over the investigated period) for the analyzed banks. The correlation between the two variables is slightly negative (-0.07). When we run simple regressions to measure the relationship between these two variables, the parameter of size is never significant and sometimes it even has a positive sign. So, based on this simple investigation we find that the necessary assumption of homogeneous demand for loans for the identification of the bank lending channel is plausible.

Chart 5

Scatter plot of bank size and share of loans to SMEs in total loans (left) and of foreign ownership share and share of loans to SMEs in total loans (right)



Another concern may be a possible demand asymmetry due to the lending decomposition of foreign versus domestic banks. Empirical evidence has been found that foreign (which are also possibly larger) banks lend less to SMEs. The studies of Berger et al. (1995), and DeYoung et al. (1999) show that in the US foreign and large banks tend to supply less loans to small firms while Berger et al. (2001) have similar finding for Argentina. Haas and Naaborg (2005) investigate how foreign bank entry influences credit accessibility for SMEs and find that only those foreign banks whose parent bank is headquartered on another continent lend less to SMEs. Chart 5 also suggests no obvious relationship between the lending to SMEs and foreign ownership. The correlation between the two variables is -0.18. When we run simple regressions to measure the relationship between these two variables, we find negative coefficients for foreign ownership; however, they are never significant. Although we have no economic theory that would suggest a relation between the share of loans to SMEs and either capitalization or liquidity of banks, we checked the possible correlation. Again, the assumption of homogenous demand turns out to be plausible.

Besides the possible heterogeneity of loan demand across banks due to the heterogeneity in size of corporate clients of banks, there might be other concerns as well. The possible demand asymmetry might be due to some other heterogeneity across clients of banks, like the risk characteristics and the sectoral characteristics of the clients.

The size of the banks or other endogenous bank specific characteristics (denoted by x in Equation (9)) may be correlated with the sectoral characteristics of the clients or with the quality of the portfolios, i.e. the risk characteristics of the clients. In case of high correlations, a significantly positive g parameter in Equation (9) cannot be interpreted as empirical evidence of bank lending channel, because the assumption on homogeneity of loan demand is not fulfilled.

Moreover, if smaller banks tend to finance more riskier clients, in the case of a rate hike, the smaller banks' loan supply is expected to decrease faster than that of the large banks due to the larger deterioration of portfolio or/and higher increase of marginal cost of funding. This mechanism is a mixture of the balance sheet channel and the lending channels. Thus, under such portfolio-heterogeneity one cannot distinguish between the two.

In order to rule out the above mentioned concerns we measure the correlations between some bank characteristics (size, liquidity, capitalization, share of foreign ownership) and the ratio of non-performing loans (as a proxy for different risk characteristics) and the share of corporate loans in the loan portfolio (as a proxy for sectoral characteristics of the clients). We find, that these correlations are relatively small, and non of them exceed 0.3 in absolute term.

To sum up, even if the loan demand elasticity of companies might vary over the size of companies, the share of loans to SME-s does not seem to vary over banks with different size. The same can be concluded when analyzing the relationship between the proportion of loans to SMEs and foreign ownership. Moreover, there is no close relationship between some bank characteristics (size, liquidity, caitalization) and the ratio of non-performing loans and the share of corporate loans in the loan portfolio. So, we have no evidence against the assumption that banks with different size, liquidity position, capitalization and with different share of foreign ownership are facing homogenous loan demands and hence, asymmetric reaction of the quantity of loans with respect to these variables can be mainly attributed to asymmetry in loan supply reactions.

Results

In this section we investigate whether an interest rate increase is associated with a decrease of bank loan supply. We investigate this by the method Kahsyap and Stein (1995) which relies on discovering asymmetries in changes in the amount of loans to monetary actions in order to isolate supply and demand effects. We report the results on long-run effects.[13] For testing the significance of long-run parameters that are in general non-linear functions of the estimated short-run coefficients we again use the delta method. We use lag 2 for each variable that was suggested by Akaike and Schwartz criteria.

When estimating the parameters of the empirical model, we include all variables in nominal terms (in Forint). By including CPI and the exchange rate[14] as explanatory variables, we control for inflationary effect as well as revaluation effect addition to their effect on loan demand in real terms.

Table 7 to Table 14 show the estimation results of equation (4) for the different loan aggregates; total loans, corporate loans, total loans in domestic currency, and corporate loans in domestic currency. The most essential loan aggregate with respect to the functioning of the bank lending channel is the total loans, however, asymmetric reaction with respect to less aggregated loan categories may provide us with interesting insights as well. Moreover, the analysis of sub-markets makes the assumption of similar demand elasticities of banks more plausible since the characteristics of clients on on particular market can be considered as to be more homogeneous compared to the aggregate level. However, the theoretical model is based on the profit maximalisation condition of banks on an aggregate level, which may not be true on sectoral level or in case of different denomination of loans. So, in case of the disaggregation on the one hand the basic assumption is more tenable, but on the other hand the theoretical foundation of the empirical model is less established.

First, we estimate equation (4) with only one interaction-term. Then, in order to control for possible correlations in the bank-specific variables, we also estimate equation (4) including two interaction-terms at the same time.

[13] Regression results with short-run parameters can be acquired from the authors.

[14] As we have seen in Section 3 the proportion of loans in other currencies than euro of all domestic loans in foreign currency was still very significant even in 2000 and this ratio has changed within the observed period. Unfortunately, we do not have available data on the decomposition of currency-denominated loans at the bank level for the entire sample period. So, normalization with respect to the euro/HUF exchange rate would also lead to biased parameter estimates of exchange rate.

Results for total loans

In this section we investigate of the possible asymmetric reaction of total loans to monetary policy actions. Table 7 and Table 8 show the results when we include one and two interaction-terms, respectively. The coefficient of the nominal interest rate has the expected sign and is significant in all of the specifications, that is a one percentage point change in the 3-month benchmark rate results in a nearly 1 percent decline in the credit aggregates ranging from 0.82% to 1.01% according to different estimations for the regression with one interaction-term. This value is in between 0.72% and 1.28% for the regression with two interaction-terms. The parameter of the nominal exchange rate proved to be significantly positive, that is, a depreciation of forint relative to euro increases total loans due to the revaluation effect. The parameter of GDP also shows the expected positive sign and is significant. The effect of foreign interest rate (3-month EURIBOR) appears to be almost always negative and sometimes even significant. This coefficient captures two effects; reduction in euro denominated credit due to an increase in this policy variable and substitution effect. Table 7 shows that when we include only one asymmetric cross-term, we find that the sign of all asymmetric effects are in line with the bank-lending channel theory.

As the different bank-characteristics may be correlated with each other, in order to better disentangle the asymmetric effects with respect to each other, we control for two of such characteristics at the same time. Results of such regression can be seen in Table 8 for total credit. We have robust findings for the significant and positive coefficient of foreign ownership and capitalization. Size turns out to be positive in most regressions, except for when controlling for capitalization. The parameter of the interaction-term of liquidity is not significant, and its sign is not robust.

Table 7

Estimation results with long-run coefficients for total loans

Total loan	GMM, lag2, 1995 Q1-2004 Q3			
Asymmetry (A)	Size	Liquid	Capit	For. own
Interest rate	-0.92*** (-14.38)	-0.82*** (-8.27)	-1.01*** (-10.76)	-0.88*** (-14.48)
GDP	0.01*** (10.92)	0.01*** (5.68)	0.01*** (7.42)	0.01*** (11.15)
Exchange rate	0.19*** (8.00)	0.14*** (8.49)	0.15*** (6.88)	0.18*** (8.66)
Euro interest rate	0.00*** (-2.79)	0.00 (-0.44)	0.00 (-0.34)	0.00*** (-2.34)
Inflation	0.12*** (4.65)	0.19*** (4.74)	0.09*** (2.48)	0.12*** (3.26)
A(-2)*interestrate	0.00 (1.00)	0.23* (1.72)	2.96*** (6.78)	0.15** (1.95)
A(-2)	0.00 (-1.34)	0.11* (1.89)	0.08 (0.40)	0.00 (-0.16)
No. of observations	854	854	844	846
Adjusted R^2	0.15	0.16	0.13	0.15
J-statistics	580.55 (0.47)	589.53 (0.37)	569.69 (0.60)	584.33 (0.43)
D-Hansen test	47.75 (0.06)	49.73 (0.04)	28.58 (0.72)	46.10 (0.08)

Notes: For GMM we only could use the White 1-step GMM weights. Below the J-statistics, the numbers in parantheses are the corresponding p-values. The standard errors of the long-run coefficients are computed by delta method.

Table 8

Estimation results with long-run coefficients for total loans with two asymmetric effects and cross-terms

Total loan	GMM, lag2, 1995 Q1-2004 Q3					
A1	Liquid	Capit	For. own.	Capit	For. own.	For. own.
A2	Size	Size	Size	Liquid	Liquid	Capit
Interest rate	-1.08*** (-12.87)	-1.28*** (-10.41)	-0.92*** (-9.25)	-1.03*** (-8.42)	-0.72*** (-7.41)	-0.88*** (-7.08)
GDP	0.01*** (6.87)	0.01*** (7.92)	0.01*** (11.55)	0.01*** (3.90)	0.01*** (5.47)	0.01*** (6.93)
Exchange rate	0.22*** (10.12)	0.17*** (6.36)	0.18*** (9.14)	0.12*** (3.69)	0.16*** (6.01)	0.14*** (6.74)
Euro interest rate	0.00 (-1.40)	0.00 (-0.07)	-0.01*** (-2.33)	0.00 (0.79)	0.00 (0.50)	0.00 (0.17)
Inflation	0.15*** (4.31)	0.12*** (3.18)	0.11*** (3.41)	0.17*** (3.96)	0.18*** (5.07)	0.12*** (2.54)
A1(-2)*ir	-0.02 (-0.10)	0.41 (0.76)	0.44*** (4.91)	2.45*** (11.03)	0.61*** (2.68)	0.02 (0.06)
A2(-2)*ir	0.00 (0.67)	0.00*** (-4.19)	0.00*** (3.89)	-0.09 (-0.26)	0.32 (1.44)	3.11*** (3.01)
A1(-2)*A2(-2)*ir	0.00*** (-6.88)	0.00*** (-6.35)	0.00*** (7.80)	12.92*** (7.72)	2.19*** (2.23)	2.03 (0.47)
A1(-2)	0.00*** (-12.53)	0.00*** (-4.32)	0.00*** (-2.62)	0.10*** (17.53)	0.10*** (29.31)	0.08*** (9.59)
A2(-2)	0.12*** (20.54)	0.01 (1.38)	0.00*** (-2.19)	0.06*** (9.85)	0.00 (-0.26)	-0.01*** (-2.22)
A1(-2)*A2(-2)	0.00*** (3.16)	0.00*** (-16.96)	0.00 (-1.00)	0.27*** (10.14)	-0.09*** (-10.48)	-0.04 (-1.23)
Adjusted R^2	0.17	0.14	0.15	0.16	0.17	0.13
No. of observations	854	844	846	844	846	844
J-statistics	576.98 (0.52)	558.73 (0.72)	595.30 (0.31)	591.36 (0.35)	577.49 (0.51)	590.68 (0.36)
D-Hansen test	22.72 (0.93)	17.06 (0.99)	29.87 (0.66)	31.38 (0.59)	44.26 (0.11)	45.26 (0.09)

Results for corporate loans

As corporate loans are the most important in influencing investment activity, we also investigate the working of bank-lending channel with respect to corporate loan aggregates (see Table 9 and Table 10). We use the same approach as for total credit and obtain similar results. The coefficients of interest rate are negative and significant, GDP growth appear to influence corporate credit quantity positively. The sign of interaction-terms with size and foreign ownership are in line with the bank-lending theory, while for liquidity we find opposite sign (see Table 9). These results are very robust to the inclusion of the second interaction-term (see Table 10).

Table 9

Estimation results with long-run coefficients for corporate loans

Corporate loan	GMM, lag2, 1995 Q1-2004 Q3			
Asymmetry (A)	Size	Liquid	Capit	For. own
Interest rate	-0.61*** (-4.78)	-0.71*** (-3.35)	-0.66*** (-2.95)	-0.92*** (-6.96)
GDP	0.01*** (3.01)	0.00 (1.21)	0.01** (2.05)	0.01*** (4.20)
Exchange rate	0.71*** (15.08)	0.80*** (19.08)	0.68*** (14.24)	0.72*** (13.01)
Euro interest rate	0.01** (2.04)	0.01* (1.88)	0.01 (1.50)	0.01* (1.80)
Inflation	0.16*** (2.38)	0.30*** (5.50)	0.04 (0.49)	0.13*** (2.33)
A(-2)*interestrate	0.00*** (7.70)	-6.38*** (-15.38)	2.55*** (45.49)	1.42*** (4.32)
A(-2)	0.00 (0.42)	0.05 (0.32)	0.08* (1.77)	0.01 (0.17)
No. of observations	856	856	845	848
Adjusted R^2	0.38	0.39	0.38	0.38
J-statistics	568.28 (0.62)	569.75 (0.60)	570.64 (0.59)	560.01 (0.71)
D-Hansen test	26.05 (0.84)	31.60 (0.60)	23.76 (0.90)	20.88 (0.96)

Notes: For GMM we only could use the White 1-step GMM weights. Below the J-statistics, the numbers in parantheses are the corresponding p-values. The standard errors of the long-run coefficients are computed by delta method.

Table 10

Estimation results with long-run coefficients for corporate loans with two asymmetric effects and cross-terms

Corporate loan	GMM, lag2, 1995 Q1-2004 Q3					
A1	Liquid	Capit	For. own.	Capit	For. own.	For. own.
A2	Size	Size	Size	Liquid	Liquid	Capit
Interest rate	-0.87***	-0.02	-0.86***	-0.81***	-0.95***	-0.45***
	(-3.82)	(-0.16)	(-4.37)	(-4.63)	(-4.95)	(-2.77)
GDP	0.00	0.01***	0.01***	0.00	0.00*	0.01***
	(1.58)	(2.84)	(3.22)	(1.47)	(1.64)	(2.95)
Exchange rate	0.77***	0.66***	0.70***	0.78***	0.74***	0.66***
	(13.88)	(11.39)	(11.00)	(18.61)	(17.35)	(13.96)
Euro interest rate	0.00	0.01*	0.01*	0.00	0.00	0.01*
	(0.89)	(1.87)	(1.62)	(0.64)	(0.73)	(1.80)
Inflation	0.23***	-0.03	0.11**	0.17***	0.15***	0.03
	(4.61)	(-0.51)	(1.97)	(2.80)	(2.57)	(0.56)
A1(-2)*ir	-6.15***	6.93***	1.47***	2.82***	1.79***	0.03
	(-14.45)	(9.37)	(5.04)	(3.99)	(3.35)	(0.11)
A2(-2)*ir	0.00***	0.00***	0.00***	-7.48***	-6.19***	4.89***
	(4.31)	(10.29)	(8.20)	(-8.92)	(-8.29)	(5.14)
A1(-2)*A2(-2)*ir	0.00***	0.00***	0.00***	-5.80	3.12	-14.92***
	(-6.47)	(9.29)	(5.44)	(-1.21)	(1.45)	(-3.53)
A1(-2)	0.00***	0.00	0.00	0.07***	0.07***	0.04***
	(-3.39)	(-0.53)	(0.34)	(7.50)	(8.35)	(2.32)
A2(-2)	0.07***	0.07***	0.01	0.01	0.02***	0.02*
	(6.84)	(5.00)	(0.94)	(1.48)	(2.64)	(1.94)
A1(-2)*A2(-2)	0.00	0.00***	0.00***	0.39***	-0.06**	0.19***
	(0.71)	(-4.58)	(-2.31)	(6.26)	(-2.08)	(3.66)
Adjusted R^2	0.39	0.38	0.37	0.40	0.39	0.38
No. of observations	856	845	848	845	848	845
J-statistics	568.18	578.25	563.28	572.86	553.37	563.28
	(0.62)	(0.50)	(0.67)	(0.56)	(0.77)	(0.67)
D-Hansen test	15.51	18.00	16.04	22.53	15.61	17.13
	(1.00)	(0.99)	(1.00)	(0.93)	(1.00)	(0.99)

Results for total loans in domestic currency

In this sub-section we investigate the reaction of the Forint denominated total loans to domestic monetary shocks. Domestic monetary policy might have different effect on forint and foreign currency denominated loans; as a consequence the bank lending channel might also differ for the two categories. For quantities in domestic currency we only have a shorter sample available for estimation, starting from the first quarter of 1998. We apply the usual procedure to test for possible asymmetries that would indicate adjustment in loan demand. Table 11 shows some evidence that an interest rate increase results in a decline of loans in domestic currency. Almost all control variables, even GDP and Euro interest rate, have negative but insignificant sign. With respect to the interaction-terms, we find results that confirm the presence of asymmetries that are in line with the bank lending theory for all investigated variables. When including two cross-terms (see Table 12), we now find robust parameters for size, liquidity, and capital.

Table 11

Estimation results with long-run coefficients for total loans in domestic currency

Total loans in HUF	GMM, lag2, 1995 Q1-2004 Q3			
Asymmetry (A)	Size	Liquid	Capit	For. own
Interest rate	-0.40** (-1.98)	-0.26 (-1.45)	-0.36* (-1.87)	-0.38** (-2.14)
GDP	0.00 (-1.04)	0.00 (-0.50)	0.00 (-0.84)	0.00 (-0.79)
Exchange rate	-0.09 (-1.51)	-0.07 (-1.27)	-0.05 (-0.87)	-0.05 (-0.82)
Euro interest rate	-0.01 (-1.60)	-0.01** (-1.94)	-0.01* (-1.79)	-0.01 (-1.29)
Inflation	0.24** (2.13)	0.31** (2.19)	0.24** (2.00)	0.13 (1.13)
A(-2)*interestrate	0.00 (1.07)	3.44*** (7.45)	1.97*** (4.13)	0.72*** (3.49)
A(-2)	0.00 (-0.10)	0.08 (0.45)	0.05 (0.43)	-0.05 (-0.80)
No. of observations	548	548	548	548
Adjusted R^2	0.29	0.30	0.29	0.29
J-statistics	287.97 (0.05)	282.24 (0.08)	280.93 (0.09)	282.95 (0.07)
D-Hansen test	21.63 (0.48)	27.43 (0.19)	27.12 (0.20)	11.45 (0.97)

Notes: For GMM we only could use the White 1-step GMM weights. Below the J-statistics, the numbers in parantheses are the corresponding p-values. The standard errors of the long-run coefficients are computed by delta method.

Table 12

Estimation results with long-run coefficients for total loans in domestic currency with two asymmetric effects and cross-terms

Total loans in HUF	GMM, lag2, 1995 Q1-2004 Q3					
A1	Liquid	Capit	For. own.	Capit	For. own.	For. own.
A2	Size	Size	Size	Liquid	Liquid	Capit
Interest rate	-0.27 (-1.72)	-0.34 (-1.41)	-0.24 (-1.07)	-0.20 (-0.89)	-0.03 (-0.16)	0.19 (0.75)
GDP	0.00 (-0.45)	0.00 (-0.96)	0.00 (-0.93)	0.00 (-0.60)	0.00 (-0.46)	-0.01 (-1.22)
Exchange rate	-0.08 (-1.45)	-0.06 (-1.13)	-0.03 (-0.56)	-0.05 (-0.88)	-0.03 (-0.56)	0.00 (-0.06)
Euro interest rate	-0.01* (-1.93)	-0.01 (-1.21)	-0.01 (-1.02)	-0.01 (-1.83)	-0.01 (-1.07)	0.00 (-0.26)
Inflation	0.20 (1.44)	0.25** (2.19)	0.07 (0.59)	0.31** (2.21)	0.18 (1.27)	0.16 (1.28)
A1(-2)*ir	3.49*** (9.35)	2.48*** (3.33)	0.49** (2.04)	1.41* (1.92)	0.07 (0.15)	-0.98* (-1.80)
A2(-2)*ir	0.00*** (3.38)	0.00* (1.71)	0.00 (0.91)	2.76*** (4.68)	3.23*** (4.86)	4.69*** (4.14)
A1(-2)*A2(-2)*ir	0.00*** (-4.97)	0.00 (0.54)	0.00 (0.08)	0.91 (0.21)	-3.50 (-1.43)	-15.60*** (-2.76)
A1(-2)	0.00*** (-3.37)	0.00 (-0.81)	0.00*** (2.35)	0.08*** (8.88)	0.09*** (9.38)	0.05*** (2.45)
A2(-2)	0.10*** (6.26)	0.02** (2.24)	-0.05*** (-4.42)	0.04*** (2.45)	-0.05*** (-3.56)	-0.04** (-2.29)
A1(-2)*A2(-2)	0.00 (0.61)	0.00*** (-6.17)	0.00*** (-3.43)	-0.03 (-0.80)	-0.14*** (-4.34)	0.00 (0.03)
Adjusted R^2	0.29	0.28	0.28	0.29	0.30	0.31
No. of observations	548	548	548	548	548	548
J-statistics	287.37 (0.25)	285.78 (0.27)	278.49 (0.38)	280.99 (0.34)	264.28 (0.62)	280.08 (0.36)
D-Hansen test	25.80 (0.26)	19.98 (0.58)	9.48 (0.99)	25.99 (0.25)	14.82 (0.87)	27.51 (0.19)

Results for corporate loans in domestic currency

Here, we investigate the reaction of the Forint denominated corporate loans to monetary shocks. The results (in Table 13) suggest that, among the analyzed credit quantities, this is the most elastic to changes in domestic interest rate. Our results on the possible asymmetries are mostly in line with what we found above, the sign of the coefficients of size and foreign ownership point towards the existence of bank lending channel, however, the coefficient of the interaction-term with not only liquidity but also capitalization has a negative coefficient. The adjusted pseudo R^2 is the highest for these among the least aggregate quantities.

The results with single interaction terms are less robust than for previous loan quantities (see Table 14). While the coefficients of the interaction term of size are always positive and significant, and are always negative and significant for liquidity, the parameter of the interaction-term for foreign ownership and for capitalization is positive and significant only in two cases.

Table 13

Estimation results with long-run coefficients for corporate loans in domestic currency

Corporate loans in HUF	GMM, lag2, 1995 Q1-2004 Q3			
Asymmetry (A)	Size	Liquid	Capit	For. own
Interest rate	-0.96*** (-8.45)	-1.31*** (-8.47)	-0.91*** (-6.15)	-1.20*** (-10.16)
GDP	0.00* (1.63)	0.00 (1.23)	0.00 (0.90)	0.00** (1.99)
Exchange rate	0.14*** (4.29)	0.18*** (4.98)	0.17*** (5.02)	0.16*** (4.82)
Euro interest rate	-0.01** (-2.51)	-0.01*** (-2.93)	-0.01* (-1.86)	-0.02*** (-3.45)
Inflation	-0.01 (-0.13)	0.06 (1.09)	-0.02 (-0.36)	0.00 (0.06)
A(-2)*interestrate	0.00*** (8.62)	-3.33*** (-14.42)	-6.43*** (-20.78)	0.15 (0.66)
A(-2)	0.00 (-1.07)	0.01 (0.12)	0.06 (0.54)	-0.02 (-0.55)
No. of observations	849	849	849	849
Adjusted R^2	0.53	0.53	0.53	0.53
J-statistics	583.62 (0.44)	588.73 (0.38)	587.41 (0.40)	585.72 (0.41)
D-Hansen test	31.89 (0.51)	21.04 (0.94)	37.57 (0.25)	32.96 (0.45)

Table 14

Estimation results with long-run coefficients for corporate loans in domestic currency with two asymmetric effects and cross-terms

Corporate loans in HUF	GMM, lag2, 1995 Q1-2004 Q3					
A1	Liquid	Capit	For. own.	Capit	For. own.	For. own.
A2	Size	Size	Size	Liquid	Liquid	Capit
Interest rate	-1.16*** (-4.66)	-0.06 (-0.36)	-1.07*** (-8.63)	-0.80*** (-4.26)	-0.88*** (-5.73)	-0.19 (-0.96)
GDP	0.00 (1.26)	0.00 (0.46)	0.00 (1.64)	0.00 (1.40)	0.00 (0.77)	0.00 (-0.03)
Exchange rate	0.15*** (4.04)	0.08** (2.00)	0.15*** (4.95)	0.18*** (3.62)	0.12*** (2.56)	0.15*** (3.74)
Euro interest rate	-0.02*** (-3.18)	-0.01*** (-2.82)	-0.02 (-3.49)	-0.02*** (-3.48)	-0.01* (-1.73)	-0.01*** (-2.40)
Inflation	0.05 (0.72)	-0.15*** (-4.16)	0.04 (0.66)	-0.01 (-0.16)	0.02 (0.30)	-0.03 (-0.68)
A1(-2)*ir	-3.95*** (-13.12)	2.74*** (2.70)	0.37 (1.43)	-3.56*** (-7.28)	0.79** (2.21)	-3.20*** (-6.36)
A2(-2)*ir	0.00*** (8.16)	0.00*** (6.96)	0.00*** (4.62)	-0.91 (-1.37)	-3.23*** (-6.30)	3.67*** (2.81)
A1(-2)*A2(-2)*ir	0.00*** (-9.11)	0.00*** (8.94)	0.00 (1.40)	-41.41*** (-8.20)	9.19*** (6.74)	-38.30*** (-7.64)
A1(-2)	0.00*** (-2.67)	0.00 (1.19)	0.00 (-0.27)	0.01** (2.34)	0.03*** (4.92)	0.07*** (8.69)
A2(-2)	0.00 (0.04)	0.11*** (12.73)	-0.03*** (-4.28)	0.03*** (4.42)	-0.01 (-1.35)	-0.04*** (-4.60)
A1(-2)*A2(-2)	0.00* (-1.82)	0.00*** (2.92)	0.00*** (-3.51)	0.03 (0.73)	-0.17*** (-6.59)	-0.10*** (-2.86)
Adjusted R^2	0.53	0.54	0.53	0.54	0.54	0.54
No. of observations	849	839	841	839	841	839
J-statistics	582.06 (0.46)	580.90 (0.47)	584.61 (0.43)	579.45 (0.49)	577.19 (0.51)	569.89 (0.60)
D-Hansen test	29.40 (0.69)	34.20 (0.44)	41.70 (0.16)	34.08 (0.44)	33.22 (0.49)	30.21 (0.63)

5. Conclusions

In this paper we investigate the working of bank lending channel in the case of Hungary. In the spirit of the theory of bank lending channel, we apply the generally used approach of Kashyap and Stein (1995, 2000) that relies on discovering asymmetric movements of loan quantities with respect to certain bank-characteristics.

In addition to the usual bank-specific variables (such as size, liquidity, and capitalization), along which asymmetry is derived from the theory of bank lending channel, we consider foreign ownership as well. We find heterogeneity among banks in the majority of cases with different model specifications. However, this heterogeneity could be associated with heterogeneous loan demand functions across banks. The novelty of the paper is that we make an attempt to test whether demand of loans can be considered homogeneous across banks with respect to some bank-characteristics. We find empirical evidence that demand of loans can be considered reasonably homogeneous across banks with respect to the share of foreign ownership and size of banks. Also, we find that an increase in policy rate induces a larger increase in average cost of funding for smaller, less capitalized banks, and for banks with higher domestic share. This suggests that such banks incur larger increase in their external financing premium in the period of monetary tightening. According to these findings, we cannot rule out the existence of the bank lending channel in Hungary.

We find that a rise in the nominal short-term interest rate results in a decrease in the credit growth. Although the average effect of interest rate is negative on the credit growth it cannot only be attributed to the bank lending channel but may arise from the demand effect due to the traditional interest rate effect and the balance sheet channel.

Some expected future developments outline a changing significance of the bank lending channel. The dominance of foreign, mostly European, ownership of banks and the substantial share of euro denominated assets and liabilities of banks imply that with the adoption of the common monetary policy the share of liabilities and assets, sensitive to domestic monetary policy will increase substantially. Since financial markets in Europe are bank-dominated, we do not expect that bank dependence of borrowers would decline as the Hungarian economy integrates more into and becomes more similar to the European economy. Additionally, the continuously diminishing of excess liquidity in the banking system and the decreasing capitalization due to the increasing efficiency in the banking system outlines the possibility of strengthening of the bank-lending channel in the future in Hungary.

Appendix

Table A)

List of empirical research on the bank-lending channel

	Country	Approach used	Policy instrument	Results
EURO AREA				
Brissimis et al. (2003)	Greece	KS and BB	Athibor 3M	Compatible with the existence of bank-lending channel, but not satisfactory
Ehrmann et al. (2003)	EURO area	KS (interaction-terms)	Nominal short-term interest rate	Inconclusive (depends on the data and method used)
Farinha and Marques (2003)	Portugal	KS modified (level)	Short-term MMR	Exists, effect is stronger for less-capitalized banks
Hernando and Martínez-Pagés (2003)	Spain	KS	MMR 3M	Most evidence rejects the bank-lending channel
Gambacorta (2003)	Italy	KS	Repo	Evidence
De Haan (2003)	The Netherlands	KS	MMR 3M	Evidence for effect on non-secured bank debt
Kaufmann (2003)	Austria	KS (Markov switching specification)	3 months interest rate	Weak evidence
Loupias et al. (2003)	France	KS	3 months interbank interest rate	Weak evidence
Topi and Vilmunen (2003)	Finland	KS (interaction-terms)	SVAR shock	Weak evidence
CEECs				
Horváth et al. (2006)	*Hungary*	*KS*	*Bubor (3 month)*	*Weak evidence*
Juks (2004)	Estonia	KS	EURIBOR	Evidence
Pruteanu (2004)	Czech Republic	KS	2-weeks repo rate and Pribor 1Y	Evidence
Wróbel and Pawlowska (2002)	Poland	KS	Unclear	Evidence

VARIABLES DEFINITION

GDP: qoq growth rate of GDP from seasonally adjusted GDP data.

Inflation: we used the yoy index calculated from trend price level.

Forint interest rate: 3-month benchmark rate

Euro interest rate: 3-month EURIBOR rate

The size variable is defined as the total assets of the bank at book value.

The loans are the total loans at book value.

The liquidity ratio is defined as the ratio of liquid assets to total assets, where the liquid assets includes cash, short-term government securities and short-term interbank deposits and short-term deposits at the central bank.

Capitalization is defined as the capital adequacy ratio.

The share of foreign ownership is defined either as the share of foreign ownership in the bank. In case of missing data we use the share of foreign voting rights as a fairly good proxi.

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