Is there a bank lending channel in Hungary?♦

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JEL classifications:

Keywords: monetary transmission, credit channel, bank lending channel, external finance premium, ARDL model.

♦ The views expressed are those of the authors and do not necessarily reflect the official view of the Magyar Nemzeti Bank.

We are grateful for the useful comments of Péter Benczúr, Katalin Bodnár, Marianna Endrész, Márton Nagy, and Balázs Vonnák .

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Introduction

According to the bank lending channel theory, banks respond to a monetary policy shock by reducing the supply of bank loans, which has a negative effect on real economic activity. The relevance of a bank lending channel follows from the specific function of private banks as financial intermediaries, which is in contrast with their purely passive role in conventional theory, presented by e.g. the IS-LM model. If some borrowers are bank dependent, i.e. cannot switch to alternative sources of financing monetary policy may have an effect through the bank lending channel. The theory of bank lending channel also suggests that the state of financial sector may have a strong influence on the transmission of monetary policy; a common monetary policy shock may induce asymmetric reactions in countries with different conditions on the financial market. In addition, in the EMU the importance of the interest rate channel will increase and so will that of the credit channel. Also, if credit channel exists, ongoing changes in the role of banks play in financial markets may alter the monetary transmission mechanism and may make it more difficult to implement monetary policy (Morris and Sellon; 1995).

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 country. The book edited by Angelioni et al. (2003) summarizes the main findings for the European countries. In this paper we attempt to 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.

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. For the investigation of the bank lending channel we use quarterly panel data of 25 banks for the period of 1995 I. –2004 III. In order to capture supply effects in loan shifts we test whether the quantity of loans of banks that differ with respect to certain characteristics, such as capitalization, liquidity, average cost of funding, size, and foreign ownership reacts differently to monetary policy actions. Section 5 concludes.

Bank lending channel: theoretical background

In this section we provide a concise discussion of the theories for the bank lending channel. We start by introducing the credit view and shortly also explain the balance sheet channel to make a proper distinction of the balance sheet channel and the bank lending channel. The investigation of the latter in the case of Hungary is the focus of the present paper.

Money view vs. credit view

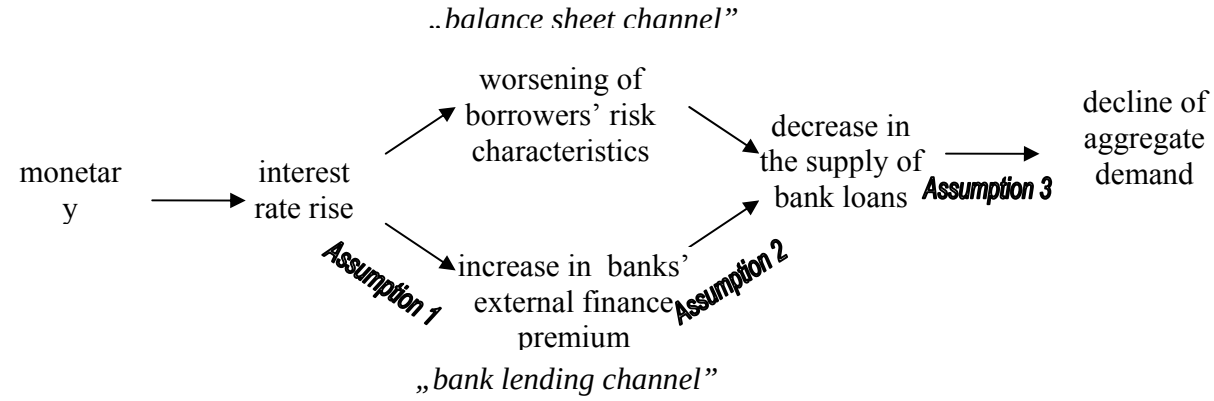
The money view distinguishes only two types of assets: money and all other assets and a single interest rate, which can be thought of as a summary statistic for all credit market conditions. Reserves are valued because they are held against transaction deposits that can only be issued by banks. According to the money view, a decline in reserves results in a reduction in transaction deposits, which raises interest rates. So, according to this view, the effect of monetary policy on interest rates arises from the special characteristics of the liability side of banks' balance sheets, the asset side plays no role.

According to the credit channel theory, a change in monetary policy that raises or lowers open-market interest rates also tends to change the *external finance premium*, that is a difference in costs between funds raised externally (for example, by issuing equity or debt) and funds generated internally (for example, by retaining earnings), in the same direction. Because of this additional influence on the external finance premium effects of monetary policy on costs of borrowing and subsequently on real spending are magnified (in addition to the simple interest rate channel considerations).

The credit view 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 open-market interest 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).

Chart 1: Stylized description of the functioning of the credit channel



The balance sheet channel

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 and net worth and cash-flow.

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.

The bank lending channel[1]

[1] In this article we provide a very brief intuitive introduction to the theory of bank lending channel. In a more extensive version of the paper we provide extensive description of the main theoretical models of the bank lending channel and also extend some of the models.

The bank lending view relies on the rejection of the notion that all non-monetary assets are perfect substitutes. This is because due to asymmetric information between banks and investors adverse selection problems arise for (uninsured) external financing. This tends to make the marginal cost of external financing an increasing function of the amount raised. In this multi-asset world, monetary policy can work through not only by influencing bond-market interest rates but also through affecting loan supply (Kashyap and Stein; 1995 and 2000). For example, even if monetary policy has only little influence on bond rates, it can have a considerable effect on the spread of bonds and loans (and therefore on loan interest rates) and furthermore on investment activities of firms that heavily rely on bank loans.

According to the bank lending literature there are three necessary assumptions for the functioning of the bank lending channel. First, interest rate increase must have an effect on the external finance premium (assumption 1 on Chart 1). Second, banks cannot protect their loan portfolio from changes of their liabilities, so monetary policy indirectly influences bank loan supply (assumption 2). Third, 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 3) (Kashyap and Stein; 1995). In this paper we investigate the fulfillment of these assumptions for the Hungarian economy.

Empirical approaches for the identification of the bank lending channel

Several empirical approaches have been used to investigate the functioning of bank lending channel. As already pointed out, the difficulty arises from separating the supply effect of monetary actions from demand effects. Earlier papers tried to examine the bank lending channel based on aggregate data, while as identification may rely on asymmetries that may only exist in the loan supply movement of banks, researchers make more and more use of panel data on banks.

Identification based on aggregate data

Bernanke and Blinder (1992) rely on aggregate balance sheet data and use VAR 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 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 (movements according to the money view).

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 commercial papers and a fall in bank loans. This asymmetric response makes it more likely that loan reduction is due to a shift in loan supply, as suggested by the lending view. However, this identification implicitly assumes that monetary policy shocks affect demand for alternative funds the same way.

Approaches based on identifying loan supply reduction by searching for 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.

Approaches based on identifying loan supply reduction by searching for asymmetric movements in loan quantity

Kashyap and Stein in their papers suggest investigating bank lending behavior at the individual bank level. KS (1995) suggest that smaller banks might have steeper increasing external finance premium than larger banks. Based on this, they suggest identifying shifts in supply by seeking for differences in loan quantity adjustment for *larger and smaller banks*.

KS (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, 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 assets 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 and therefore, smaller reaction of loan supply due to the working of bank lending channel.

In our empirical analysis we follow the latter approach and seek for asymmetries in the adjustment of loan quantity to changes in money market rate for bank that have size, liquidity, capitalization, average cost of funding, and foreign ownership characteristics.

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. 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 investigate the possible future tendencies.

Liability structure of the Hungarian banking system

Whether monetary tightening leads to increase in the marginal cost of financing additionally to the classical interest (Investigation of Assumption 1)

Using our dataset we find, that indeed, the 3-month money market rate and average cost of financing (computed as interest rate payments per interest-bearing liabilities) are highly correlated, their correlation is 0.63 suggesting 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.

As outlined in the previous section, the identification of the bank lending channel that we follow is based on identifying asymmetries according to theoretically plausible characteristics of banks. 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[2]. We find, in accordance with the theory of KS (1995) and KS (2000), and Haas and Naaborg (2005), that size, capitalization, and foreign ownership (see the first column of Table 2) are negatively correlated with the average cost of financing. The correlations, however, are in most of the cases quite low.

Table 1 : Correlation matrix of size, liquidity, capitalization, and 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

[2] Of course, average cost of funding among banks may differ due to differences in other characteristics of the liabilities side, such as average maturity. In this simple exercise we assume these other factors not to be correlated 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 its 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.

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: 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.

In addition, this correlation does not necessarily mean that an increase in money market rate results in a larger increase in the marginal cost of, for example, for smaller banks, but might just capture a difference in the cost *levels*. To address this question in a more sophisticated way, we regress changes in average cost of funding on changes in different macroeconomic variables, in the money market rate, and on interaction terms of changes in MMR with bank-specific characteristics. The results in Table 2 show that an increase in MMR or in the euro interest rates induces significant increase of marginal cost 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. Our results are in line with the theory therefore 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.

Table 2 : Results of regressions for ACF

ACF	GMM, lag2, 1995 I.-2004 III.				
	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%,
Liquid: liquidity Capit: equity divided by total assets,Capit2: capital adequacy ratio.
ACF: average cost of funding, For. own: foreign ownership.
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[3].

Possibilities to shield bank portfolios from substantial increase of marginal cost induced by increased MMR (Investigation of Assumption 2)

The second important precondition of the bank lending channel is that banks cannot perfectly shield their loan portfolio from changes in the liability side of their balance sheet. Regarding the banks' access to alternative funds the picture of the Hungarian banking system is mixed, so no clear conclusion can be drawn to the bank lending channel.

Availability of foreign (currency) funds

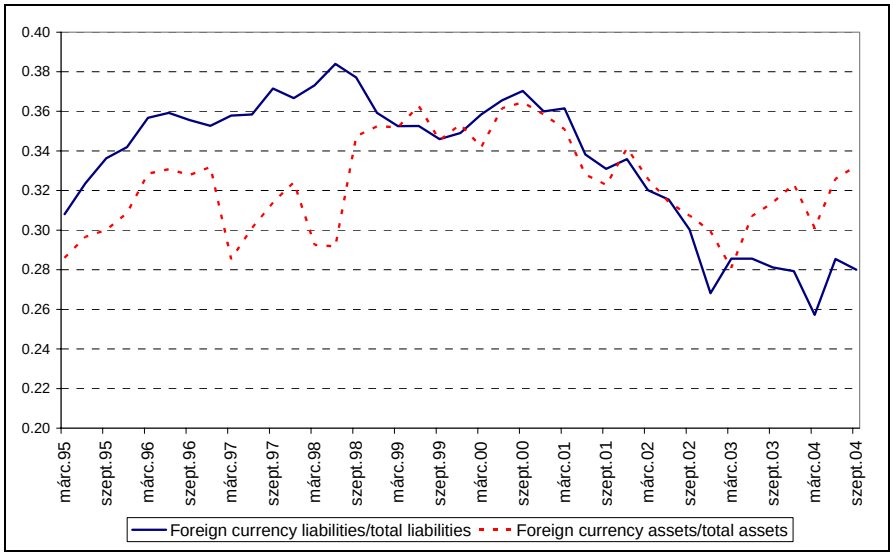
Majority of Hungarian banks are foreign owned, and are subsidiaries of larger foreign banks. Foreign involvement in the banking markets has increased over the observed period, which is a general characteristic of the new EU countries (Schmitz; 2004). Consequently, a significant proportion of the Hungarian banks can get relatively cheap foreign funds from their parent banks. Foreign bank subsidiaries may face fewer financing constraints if they can receive additional funding, equity or debt, from their parent banks (Haas and Naaborg; 2005). A subsidiary that is facing problems with raising new capital may, for example, receive funds from the parent bank in exchange for (new) shares and when the subsidiary 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 an increase 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.

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

[3] 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.

Chart 2

Currency denomination structure of assets and liabilities of the banking sector



Source: MNB

This implies that significant share of banks can substitute domestic deposit funds relatively easily. This weakens the significance of the bank lending channel. The adoption of the euro 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.

The structure of the Hungarian financial system (Investigation of Assumption 3)

The third 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 3). In Hungary, the ratio of the market capitalization of the stock market to the GDP is less than 30% of the average ratio of the EMU countries. Moreover, financial systems of these 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 (loans/GDP ratio raised from 18.3 to 38.2 in the period of 1998-2004, the domestic credit per GDP is significantly lower in Hungary than in the Euro-zone, which reduces the significance of bank loan supply changes' 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 relatively easily substitute their domestic bank loans by foreign loans (see Table 4), 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 might be stronger after adopting the common currency.

Table 3: International comparison of channels of financial intermediation to enterprises (% 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	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.

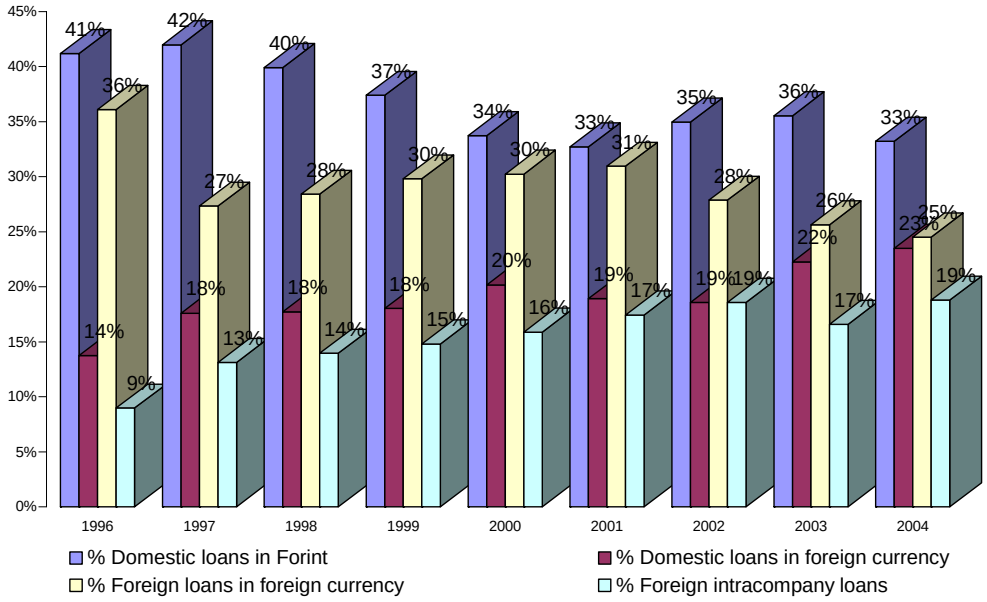
Table 4: Distribution of corporate and household loans and deposits by currency denomination in 2003 (%)

	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. We see that the share of intercompany loans in foreign currency has increased quite a lot (from 9to 19%) which might be partly due to the sharply increasing foreign ownership 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 in Hungarian currency fell from 41% to 33% from 1996 to 2004 with come cyclical variation in the period between.

Chart 3: Decomposition of corporate loans in Hungary

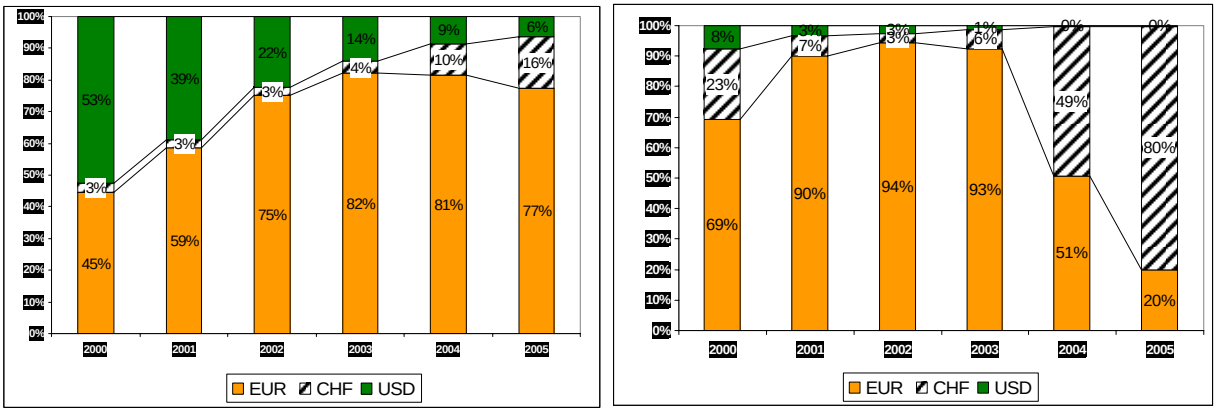


With respect to the expected entrance to the EMU the currency denomination composition of loans might be also interesting. Chart 4 shows an increasing share of Swiss Franc both consumer loans, corporate loans and therefore of total loans in foreign currency. Holding of consumer loans in Swiss Franc increased 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.

A large proportion of consumer loans is housing loans. As MNB (2005) points out, due to risk management considerations banks intend to shift their foreign currency housing loans from Swiss Franc loans to euro loans. As a consequence, interest rate spread of euro loans has increased considerably in 2005 and the APRC of euro loans has increased that of Swiss Franc loans. Such

considerations would suggest the increase of euro loans relative to loans in Swiss Franc, however, within the year of 2005 the increasing/decreasing tendency of the share of consumer loans in Swiss Francs/in euro has continued so far.

Chart 4: Currency composition of domestic corporate loans in foreign currency (left) and Currency composition of domestic consumer loans in foreign currency (right)[4]



Notes: Source: MNB, series are adjusted with the exchange rate, data for 2005 is only available until October.

Trends in liquidity and capitalization of the banking sector

The most commonly used bank characteristics applied to capture the information problems of banks, hence to capture the existence of the bank lending channel, are the size, capitalization and liquidity position of banks. The rational behind this is that large banks have better access to non-deposit funds, as they are less exposed to information asymmetry problems. Similarly, better capitalization ensures a better excess for banks to external sources, while better liquidity position facilitates shielding banks' loan portfolio against monetary policy shocks.

The banking sector have 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 liquidity position of the banking sector has been decreased continuously in he 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 been approached the euro area's level (according to our dataset, on average, capital adequacy ratio reduced from about 18% to 11% between 1995 and 2004 and the ratio of liquid assets to total assets from 50% to 23% in the period of 1998 and 2004). Similarly, capitalization of the banking sector has been also declining considerably from the late nineties almost continuously, the capital adequacy ratio lowered significantly; 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 5). However, the reduction of excess liquidity and overcapitalization might enhance the bank lending channel, i.e. the effect of monetary policy shocks on banks' decision might be stronger.

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

Table 5: 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 with accessing to alternative financial sources. Consequently, these banks are might be more inclined to hold more liquid assets as a buffer against negative shocks to financing possibilities. In other words, higher liquidity might be an endogenous response from smaller banks to counterbalance their less access to non-deposit funding. Additionally, less access to 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 then larger banks, and better capitalized. According to KS (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. Kakes and Sturm (2002) find the same for German banks.
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 6.). However, in contrast with the traditional story, liability structure of the banking sector suggests that higher liquidity does not arise from the fact that smaller banks are dependent more on deposits, as ratio of deposits in total external funds is lower, and the ratio of money market funds in total liabilities is higher at the smaller banks than that of the larger banks. This data questions that banks don't have access to alternative funds.

Table 6: 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%

Implications for the future

Although majority of the above mentioned factors implies a weak bank landing channel, a more thorough empirical analysis of the channel might be of relevance. First, if we can not find evidence on the existence of significant supply effects in borrowing, it may imply that the effect of common

monetary policy will be somewhat weaker in Hungary than in the eurozone as a whole or at least than in those countries where the bank lending channel gained empirical verification, if these differences will be long lasting. However, the expected future developments in the factors affecting the bank lending channel suggest an increasing significance of the bank lending channel. An important change is that with the adoption of the common monetary policy - the possibility to substitute domestic sources with foreign sources in case of a change in the domestic monetary conditions.

At the same time, the past couple of years have been characterized by an increasing access of information about the activities of banks that reduces the importance of asymmetric information. Also, increasing tendency has been observed in the foreign ownership that increased the possibility 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. This reduces the possible effect of bank lending channel.

Econometric analysis

We use quarterly data for the period of January 1995 - 2004 September. In order to get comparable results with Ehrmann at 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.

Because of the revaluation effect of exchange rate changes on existing stocks the results might be biased. Concretely, if the exchange rate and interest rate changes are correlated, the estimated parameters of interest rates will be biased if exchange rate is not included in the regression. (The correlation between the difference in quarterly log exchange rate and nominal interest rate is above 0.4 on the period starting from 1998 and it is above 0.5 from 2001.) On the other hand, if exchange rate is included, the estimated parameter includes both the revaluation effect and the effect of exchange rate changes on transactions[5]. Similar argument holds for CPI. In order to control for inflation and exchange rate changes we decided not to deflate the series of interest but include the above variables as controls. This means that the parameters of these two control variables will capture additional effects to their own influence on the dependent variables, namely, will both be biased upwards and only can be used partly for face validity. However, as these are not the main parameters of our interest, we opt for this option since any imperfect adjustment of the series would also lead to bias in these parameters, only the direction of bias would be uncertain.

1.1. 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

[5] 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. Unfortunatelly, we do not have availale data about the decomposition of currency-denominated loans at the bank level. So, filtering with respect to the euro/huf exchange rate would also lead to biased parameter estimates of exchange rate.

2. In our investigation we use the most frequently used approach of KS (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 eurozone. The empirical literature usually investigates three bank-specific characteristic to capture the asymmetric information problem and the heterogeneity of banks: size, liquidity, and capitalization. In our empirical approach we add further variables.

Size

According to KS (1995) if banks are hit by the same deposit and loan demand shocks small banks will cut their loan supply since they find it costlier to make up for monetary policy induced shortfall in funds. When considering the possibility of heterogeneous demand shocks, a second test should also be added that compares the evolution of large and small bank security holdings in response to monetary shocks. Stronger reaction of small banks also to this dimension would mean strong evidence in favor of the idea of KS (1995). In addition, KS also emphasize that liquidity constraints usually become more pronounced for small banks.

Liquidity

Less liquid banks cannot protect their loan portfolio against monetary tightening simple by drawing down cash and securities (KS; 2000).

Capitalization

Poorly capitalized banks have less access to markets for uninsured funding, so their lending is more dependent on monetary shocks. We used in our analysis the capital adequacy ratio instead of simple capitalization, which reduces the problem that higher capitalization might reflect higher risk.

Average cost of funding

This variable provides a direct proxy for the cost of financing of banks. Banks that can only get access to costly external financing may also be willing to increase the interest rate of their time deposits more resulting in higher cost of financing in general. By this approach we do not seek any theoretical explanation for why external financing may be more costly for certain banks, we investigate whether banks with higher cost of financing and hence more expensive external funding cut their loan supply more than banks with cheaper access in case of monetary tightening.

Foreign ownership

Banks that are subsidiaries of foreign banks can get relatively cheap foreign funds from their parent banks. Therefore, foreign bank subsidiaries may face fewer financing constraints if they can receive additional funding, equity or debt, from their parent banks (Bonin et al.; 2003 Haas and Naaborg; 2005, see section 3 for further discussion)

Along these lines, 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.

The 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 KS (1995) and followers, we use the following reduced from model to test for the existence of bank lending channel:

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

where r_t refers to changes in interest rate at time *t*, L_{it} to (logarithm) of 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 and average cost of funding) of bank *i* at time *t*, 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 of cross-terms when seeking evidence for loan-supply effects. If the bank lending channel operates 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 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.

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 b_i and c_i parameters. By demeaning the bank-specific terms their expected value becomes zero so, the c_i 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 stores 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, average cost of funding, and foreign ownership variables, as we assume that the above mentioned general trends of decreasing liquidity and capitalization and the decreasing trend in ACF and increasing trend in foreign ownership might be relevant 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 small in a smaller market. At the same time liquidity and capitalization are more absolute measures and not relative measures. This way, we make use of the variability of these characteristics not only across banks, but also over time.

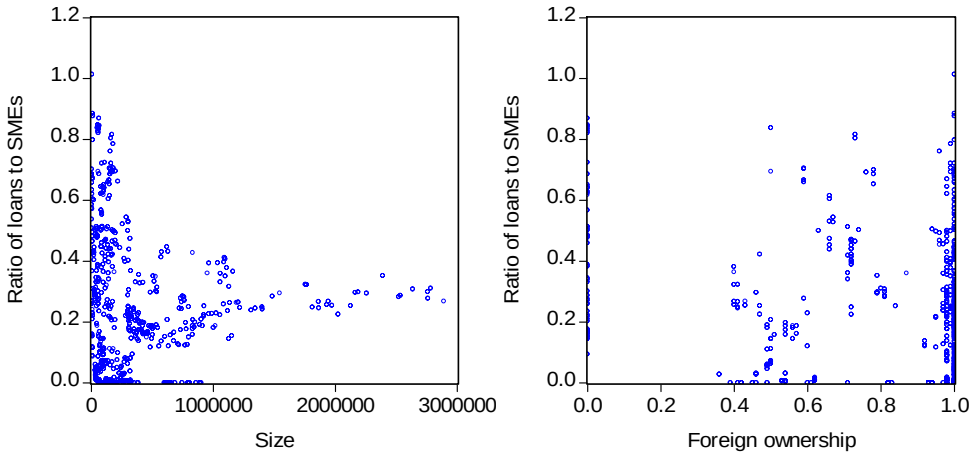
We use asymmetric variables lagged two times to avoid possible endogeneity.

Preliminary investigation about whether possible asymmetric effects may solely be an indicator of loan supply

In order to properly disentangle the loan supply reaction to monetary policy actions, the KS 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 3 shows that the ratio varies really a lot among smaller banks while the conditional variance reduces as size of banks increases and there seems to be a tendency for the ratio to increase with size. Note that 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 access the connection between these two variables, the parameter of size is never significant and it sometimes even has 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 proportion of loans to SMEs and of foreign ownership and proportion of loans to SMEs (to total loans)



Another concern may be a possible demand asymmetry due to the lending composition 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 credit 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 only find that those foreign banks whose parent bank is headquartered on another continent lend less to SMEs. Chart 3 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 access the connection between these two variables, although we find a negative coefficient for foreign ownership, it is not significant.

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 seems to vary over the size of banks. The same can be concluded when analyzing the relationship between the proportion of loans to SMEs and foreign ownership. So, we have no evidence against the assumption that banks with different size and different % of foreign ownership are facing homogenous loan demands and hence, asymmetry with respect to these variables can be mainly attributed to asymmetry in loan supply reactions.

1.2. Results for credit quantities

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, regression results with short-run parameters can be acquired from the authors. For testing the significance of long-run parameters that are in general non-linear functions of the estimated short-run coefficients we use the delta method (see footnote 3). In order to capture percentage changes, we define our variables in log-differences. We used lag 2 for each variable that was suggested by Akaike and Schwartz criteria.

Table 7 to Table 14 show the estimation results of equation (1) for the different loan aggregates; total loans, corporate loans, total loans in domestic currency, and corporate loans in domestic currency.

Results for total loans

Table 7 and Table 8 show parameter estimates for different versions of equation (1) in case of total credit. The coefficient of nominal interest rate shows 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. The parameter of the nominal exchange rate proved to be significantly positive, that is a depreciation of Forint relative to Euro increases total loans by definition. The parameter of GDP also shows the expected positive sign and majority in cases proved to be significant. The effect of foreign interest rate (3-month euribor) appears to be negative in all cases and sometimes even significant. This coefficient captures two effects; reduction in 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, we control for two of such characteristics at the same time. Results of such regression can be seen in Table 8 for the case of total credit. We have robust finding for the significant negative coefficient of ACF and the positive coefficient of foreign ownership and capitalization. Size turns out to be positive in most regressions, except for when controlling for capitalization.

Table 7: Estimation results with long-run coefficients for total loans

Total loan	GMM, lag2, 1995 I.-2004 III.				
Asymmetry (A)	Size	Liquid	Capit	ACF	For. own
Interest rate	-0.92	-0.82	-1.01	-0.83	-0.88
	(-14.38)	(-8.27)	(-10.76)	(-13.59)	(-14.48)
GDP	0.01	0.01	0.01	0.01	0.01
	(10.92)	(5.68)	(7.42)	(9.61)	(11.15)
Exchange rate	0.19	0.14	0.15	0.15	0.18
	(8.00)	(8.49)	(6.88)	(5.48)	(8.66)
Euro interest rate	0.00	0.00	0.00	0.00	0.00
	(-2.79)	(-0.44)	(-0.34)	(-2.16)	(-2.34)
Inflation	0.12	0.19	0.09	0.14	0.12
	(4.65)	(4.74)	(2.48)	(3.23)	(3.26)
A(-2)*interestrate	**0.00**	**0.23**	**2.96**	**-1.96**	**0.15**
	(1.00)	**(1.72)**	**(6.78)**	**(-7.09)**	**(1.95)**
A(-2)	0.00	0.11	0.08	-0.04	0.00
	(-1.34)	(1.89)	(0.40)	(-0.46)	(-0.16)
No. of obs.	854	854	844	854	846
Adjusted R^2	0.15	0.16	0.13	0.15	0.15
J-statistics	580.55	589.53	569.69	578.53	584.33
	(0.47)	(0.37)	(0.60)	(0.50)	(0.43)
D-Hansen test	47.75	49.73	28.58	43.29	46.10
	(0.06)	(0.04)	(0.72)	(0.14)	(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 I.-2004 III.									
A1	Liquid	Capit	ACF	For. own.	Capit	ACF	For. own.	ACF	For. own.	For. own.
A2	Size	Size	Size	Size	Liquid	Liquid	Liquid	Capit	Capit	ACF
Interest rate	-1.08	-1.28	-0.88	-0.92	-1.03	-0.88	-0.72	-1.05	-0.88	-0.88
	(-12.87)	(-10.41)	(-12.07)	(-9.25)	(-8.42)	(-10.14)	(-7.41)	(-12.23)	(-7.08)	(-11.50)
GDP	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	(6.87)	(7.92)	(9.87)	(11.55)	(3.90)	(5.99)	(5.47)	(7.94)	(6.93)	(10.12)
Exchange rate	0.22	0.17	0.16	0.18	0.12	0.10	0.16	0.09	0.14	0.12
	(10.12)	(6.36)	(4.79)	(9.14)	(3.69)	(4.40)	(6.01)	(3.47)	(6.74)	(4.51)
Euro interest rate	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
	(-1.40)	(-0.07)	(-2.40)	(-2.33)	(0.79)	(-0.50)	(0.50)	(-1.14)	(0.17)	(-1.40)
Inflation	0.15	0.12	0.14	0.11	0.17	0.20	0.18	0.16	0.12	0.14
	(4.31)	(3.18)	(3.43)	(3.41)	(3.96)	(5.96)	(5.07)	(4.94)	(2.54)	(3.06)
A1(-2)*ir	**-0.02**	**0.41**	**-1.34**	**0.44**	**2.45**	**-0.85**	**0.61**	**-1.82**	**0.02**	**0.19**
	(-0.10)	**(0.76)**	**(-3.15)**	**(4.91)**	**(11.03)**	**(-2.72)**	**(2.68)**	**(-5.50)**	**(0.06)**	**(1.56)**
A2(-2)*ir	**0.00**	**0.00**	**0.00**	**0.00**	**-0.09**	**0.35**	**0.32**	**3.03**	**3.11**	**-1.77**
	(0.67)	**(-4.19)**	**(1.49)**	**(3.89)**	**(-0.26)**	**(1.09)**	**(1.44)**	**(6.65)**	**(3.01)**	**(-3.33)**
A1(-2)*A2(-2)*ir	0.00	0.00	0.00	0.00	12.92	-1.29	2.19	-6.10	2.03	-1.51
	(-6.88)	(-6.35)	(2.72)	(7.80)	(7.72)	(-0.45)	(2.23)	(-2.29)	(0.47)	(-1.69)
A1(-2)	0.00	0.00	0.00	0.00	0.10	0.10	0.10	0.08	0.08	-0.03
	(-12.53)	(-4.32)	(-5.92)	(-2.62)	(17.53)	(26.45)	(29.31)	(7.68)	(9.59)	(-6.61)
A2(-2)	0.12	0.01	-0.04	0.00	0.06	-0.03	0.00	-0.03	-0.01	-0.01
	(20.54)	(1.38)	(-4.62)	(-2.19)	(9.85)	(-9.97)	(-0.26)	(-11.03)	(-2.22)	(-1.83)
A1(-2)*A2(-2)	0.00	0.00	0.00	0.00	0.27	-0.05	-0.09	-0.05	-0.04	0.00
	(3.16)	(-16.96)	(0.25)	(-1.00)	(10.14)	(-2.81)	(-10.48)	(-1.78)	(-1.23)	(-0.39)
Adjusted R^2	0.17	0.14	0.15	0.15	0.16	0.17	0.17	0.14	0.13	0.15
No. of obs.	854	844	854	846	844	854	846	844	844	846
J-statistics	576.98	558.73	573.73	595.30	591.36	587.51	577.49	576.70	590.68	580.02
	(0.52)	(0.72)	(0.55)	(0.31)	(0.35)	(0.39)	(0.51)	(0.52)	(0.36)	(0.48)
D-Hansen test	22.72	17.06	34.79	29.87	31.38	33.81	44.26	28.24	45.26	44.07
	(0.93)	(0.99)	(0.44)	(0.66)	(0.59)	(0.48)	(0.11)	(0.74)	(0.09)	(0.11)

Results for corporate loans

As corporate loans are the most important in influencing the working of the economy, we also investigate the working of bank-lending channel with respect to these 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 positively influence corporate credit quantity. The sign of interaction terms with size, cost of external funding, and foreign ownership are in line with the bank-lending theory, while for liquidity we find opposite signs (see Table 9).

This significant negative sign remains also in the specification where two cross-terms are included (see Table 10) for liquidity, and the parameter of interaction term variable with all other

bank-characteristics keeps its sign that is in line with the fact that asymmetric adjustment of total loans is passed through towards corporate loans.

Table 9 : Estimation results with long-run coefficients for corporate loans

Corporate loan	GMM, lag2, 1995 I.-2004 III.				
Asymmetry (A)	Size	Liquid	Capit	ACF	For. own
Interest rate	-0.61 (-4.78)	-0.71 (-3.35)	-0.66 (-2.95)	-0.43 (-2.09)	-0.92 (-6.96)
GDP	0.01 (3.01)	0.00 (1.21)	0.01 (2.05)	0.01 (3.91)	0.01 (4.20)
Exchange rate	0.71 (15.08)	0.80 (19.08)	0.68 (14.24)	0.61 (11.73)	0.72 (13.01)
Euro interest rate	0.01 (2.04)	0.01 (1.88)	0.01 (1.50)	0.00 (0.20)	0.01 (1.80)
Inflation	0.16 (2.38)	0.30 (5.50)	0.04 (0.49)	0.10 (2.51)	0.13 (2.33)
A(-2)*interestrate	**0.00** **(7.70)**	**-6.38** **(-15.38)**	**2.55** **(45.49)**	**-3.49** **(-5.89)**	**1.42** **(4.32)**
A(-2)	0.00 (0.42)	0.05 (0.32)	0.08 (1.77)	-0.05 (-0.33)	0.01 (0.17)
No. of obs.	856	856	845	856	848
Adjusted R^2	0.38	0.39	0.38	0.39	0.38
J-statistics	568.28 (0.62)	569.75 (0.60)	570.64 (0.59)	579.39 (0.49)	560.01 (0.71)
D-Hansen test	26.05 (0.84)	31.60 (0.60)	23.76 (0.90)	35.08 (0.43)	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 I.-2004 III.									
A1	Liquid	Capit	ACF	For. own.	Capit	ACF	For. own.	ACF	For. own.	For. own.
A2	Size	Size	Size	Size	Liquid	Liquid	Liquid	Capit	Capit	ACF
Interest rate	-0.87	-0.02	-0.59	-0.86	-0.81	-0.35	-0.95	-0.42	-0.45	-0.14
	(-3.82)	(-0.16)	(-3.48)	(-4.37)	(-4.63)	(-1.56)	(-4.95)	(-2.15)	(-2.77)	(-0.58)
GDP	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01
	(1.58)	(2.84)	(3.43)	(3.22)	(1.47)	(1.04)	(1.64)	(1.74)	(2.95)	(3.08)
Exchange rate	0.77	0.66	0.64	0.70	0.78	0.72	0.74	0.60	0.66	0.64
	(13.88)	(11.39)	(10.63)	(11.00)	(18.61)	(13.59)	(17.35)	(11.72)	(13.96)	(14.57)
Euro interest rate	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00
	(0.89)	(1.87)	(0.29)	(1.62)	(0.64)	(1.14)	(0.73)	(0.91)	(1.80)	(0.49)
Inflation	0.23	-0.03	0.07	0.11	0.17	0.27	0.15	-0.03	0.03	0.10
	(4.61)	(-0.51)	(1.55)	(1.97)	(2.80)	(5.18)	(2.57)	(-0.48)	(0.56)	(2.05)
A1(-2)*ir	**-6.15**	**6.93**	**-2.96**	**1.47**	**2.82**	**-3.49**	**1.79**	**-2.61**	**0.03**	**-0.01**
	(-14.45)	**(9.37)**	**(-3.48)**	**(5.04)**	**(3.99)**	**(-5.10)**	**(3.35)**	**(-3.42)**	**(0.11)**	**(-0.01)**
A2(-2)*ir	**0.00**	**0.00**	**0.00**	**0.00**	**-7.48**	**-6.01**	**-6.19**	**0.74**	**4.89**	**-0.47**
	(4.31)	**(10.29)**	**(6.10)**	**(8.20)**	**(-8.92)**	**(-9.95)**	**(-8.29)**	**(0.88)**	**(5.14)**	**(-0.66)**
A1(-2)*A2(-2)*ir	0.00	0.00	0.00	0.00	-5.80	-18.82	3.12	20.86	-14.92	7.53
	(-6.47)	(9.29)	(4.45)	(5.44)	(-1.21)	(-5.00)	(1.45)	(3.47)	(-3.53)	(2.90)
A1(-2)	0.00	0.00	0.00	0.00	0.07	0.06	0.07	0.07	0.04	-0.05
	(-3.39)	(-0.53)	(1.24)	(0.34)	(7.50)	(5.36)	(8.35)	(6.35)	(2.32)	(-5.20)
A2(-2)	0.07	0.07	-0.03	0.01	0.01	-0.07	0.02	-0.07	0.02	0.00
	(6.84)	(5.00)	(-2.21)	(0.94)	(1.48)	(-8.59)	(2.64)	(-13.75)	(1.94)	(0.07)
A1(-2)*A2(-2)	0.00	0.00	0.00	0.00	0.39	-0.11	-0.06	-0.11	0.19	-0.05
	(0.71)	(-4.58)	(4.92)	(-2.31)	(6.26)	(-1.46)	(-2.08)	(-1.45)	(3.66)	(-1.34)
Adjusted R^2	0.39	0.38	0.38	0.37	0.40	0.40	0.39	0.39	0.38	0.39
No. of obs.	856	845	856	848	845	856	848	845	845	848
J-statistics	568.18	578.25	574.86	563.28	572.86	583.87	553.37	577.26	563.28	574.02
	(0.62)	(0.50)	(0.54)	(0.67)	(0.56)	(0.44)	(0.77)	(0.51)	(0.67)	(0.55)
D-Hansen test	15.51	18.00	32.76	16.04	22.53	32.49	15.61	30.19	17.13	23.25
	(1.00)	(0.99)	(0.54)	(1.00)	(0.93)	(0.55)	(1.00)	(0.65)	(0.99)	(0.92)

Results for loans in domestic currency

Domestic monetary policy might mostly influence the quantities of loans in domestic currency. For quantities in domestic currency we only have a shorter sample available for estimation, we only have data from 1998 I. We use 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 the drop of loans in domestic currency. Almost all control variables, even GDP and foreign interest rate, have negative but mostly insignificant sign. With respect to the cross-terms, we find results that might confirm the existence of bank-lending channel in for all investigated variables, similarly to our results on total loans. 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, 1998 I.-2004 III.				
Asymmetry (A)	Size	Liquid	Capit	ACF	For. own
Interest rate	-0.40 (-1.98)	-0.26 (-1.45)	-0.36 (-1.87)	-0.15 (-0.93)	-0.38 (-2.14)
GDP	0.00 (-1.04)	0.00 (-0.50)	0.00 (-0.84)	0.00 (-1.14)	0.00 (-0.79)
Exchange rate	-0.09 (-1.51)	-0.07 (-1.27)	-0.05 (-0.87)	-0.02 (-0.41)	-0.05 (-0.82)
Euro interest rate	-0.01 (-1.60)	-0.01 (-1.94)	-0.01 (-1.79)	-0.01 (-1.76)	-0.01 (-1.29)
Inflation	0.24 (2.13)	0.31 (2.19)	0.24 (2.00)	0.10 (0.68)	0.13 (1.13)
A(-2)*interestrate	**0.00** **(1.07)**	**3.44** **(7.45)**	**1.97** **(4.13)**	**-2.35** **(-2.12)**	**0.72** **(3.49)**
A(-2)	0.00 (-0.10)	0.08 (0.45)	0.05 (0.43)	0.03 (0.19)	-0.05 (-0.80)
No. of obs.	548	548	548	548	548
Adjusted R^2	0.29	0.30	0.29	0.33	0.29
J-statistics	287.97 (0.05)	282.24 (0.08)	280.93 (0.09)	273.24 (0.15)	282.95 (0.07)
D-Hansen test	21.63 (0.48)	27.43 (0.19)	27.12 (0.20)	21.71 (0.47)	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 loan in HUF	GMM, lag2, 1998 I.-2004 III.									
A1	Liquid	Capit	ACF	For. own.	Capit	ACF	For. own.	ACF	For. own.	For. own.
A2	Size	Size	Size	Size	Liquid	Liquid	Liquid	Capit	Capit	ACF
Interest rate	-0.27	-0.34	-0.11	-0.24	-0.20	-0.17	-0.03	-0.01	0.19	0.19
	(-1.72)	(-1.41)	(-0.59)	(-1.07)	(-0.89)	(-0.92)	(-0.16)	(-0.04)	(0.75)	(0.78)
GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00
	(-0.45)	(-0.96)	(-0.63)	(-0.93)	(-0.60)	(-1.03)	(-0.46)	(-0.96)	(-1.22)	(-0.83)
Exchange rate	-0.08	-0.06	-0.05	-0.03	-0.05	0.03	-0.03	0.02	0.00	-0.04
	(-1.45)	(-1.13)	(-1.10)	(-0.56)	(-0.88)	(0.76)	(-0.56)	(0.44)	(-0.06)	(-0.78)
Euro interest rate	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00
	(-1.93)	(-1.21)	(-2.29)	(-1.02)	(-1.83)	(-1.18)	(-1.07)	(-0.85)	(-0.26)	(-0.65)
Inflation	0.20	0.25	0.05	0.07	0.31	0.23	0.18	0.21	0.16	0.08
	(1.44)	(2.19)	(0.38)	(0.59)	(2.21)	(1.46)	(1.27)	(1.81)	(1.28)	(0.50)
A1(-2)*ir	**3.49**	**2.48**	**1.10**	**0.49**	**1.41**	**-4.26**	**0.07**	**-2.10**	**-0.98**	**-0.01**
	(9.35)	**(3.33)**	**(1.06)**	**(2.04)**	**(1.92)**	**(-4.07)**	**(0.15)**	**(-1.42)**	**(-1.80)**	**(-0.01)**
A2(-2)*ir	**0.00**	**0.00**	**0.00**	**0.00**	**2.76**	**3.77**	**3.23**	**2.38**	**4.69**	**2.32**
	(3.38)	**(1.71)**	**(2.61)**	**(0.91)**	**(4.68)**	**(6.56)**	**(4.86)**	**(6.57)**	**(4.14)**	**(1.41)**
A1(-2)*A2(-2)*ir	0.00	0.00	0.00	0.00	0.91	40.27	-3.50	-6.81	-15.60	-5.03
	(-4.97)	(0.54)	(3.37)	(0.08)	(0.21)	(5.19)	(-1.43)	(-0.84)	(-2.76)	(-0.99)
A1(-2)	0.00	0.00	0.00	0.00	0.08	0.07	0.09	0.06	0.05	0.02
	(-3.37)	(-0.81)	(-0.92)	(2.35)	(8.88)	(7.86)	(9.38)	(4.24)	(2.45)	(1.65)
A2(-2)	0.10	0.02	0.04	-0.05	0.04	0.03	-0.05	0.01	-0.04	-0.07
	(6.26)	(2.24)	(4.66)	(-4.42)	(2.45)	(3.73)	(-3.56)	(2.16)	(-2.29)	(-6.88)
A1(-2)*A2(-2)	0.00	0.00	0.00	0.00	-0.03	-0.29	-0.14	-0.14	0.00	-0.20
	(0.61)	(-6.17)	(2.49)	(-3.43)	(-0.80)	(-3.79)	(-4.34)	(-4.63)	(0.03)	(-3.72)
Adjusted R^2	0.29	0.28	0.32	0.28	0.29	0.34	0.30	0.33	0.31	0.33
No. Of obs.	548	548	548	548	548	548	548	548	548	548
J-statistics	287.37	285.78	278.26	278.49	280.99	281.34	264.28	277.06	280.08	277.01
	(0.25)	(0.27)	(0.38)	(0.38)	(0.34)	(0.34)	(0.62)	(0.40)	(0.36)	(0.40)
D-Hansen test	25.80	19.98	18.11	9.48	25.99	22.83	14.82	22.02	27.51	16.13
	(0.26)	(0.58)	(0.70)	(0.99)	(0.25)	(0.41)	(0.87)	(0.45)	(0.19)	(0.81)

Results for corporate loans in domestic currency

The results (in Table 13) suggest that among the analyzed credit quantities this is the most elastic to changes in domestic interest rate. An interesting finding, however is that foreign interest rate is found to negatively influence the amount of credit in domestic currency. Our results on possible asymmetries are in line with what we found above, the sign of the coefficients of size, acf, and foreign ownership point towards the existence of bank lending channel, however, the interaction term with not only liquidity but also capitalization gets a negative coefficient. The adjusted pseudo R^2 is the highest for these the least aggregate quantities.

In the regression with two asymmetric factors (see Table 14), an interesting finding is that the parameter of the interaction term with foreign ownership that was positive but insignificant in Table 13 now becomes significant and negative in two out of four cases.

Table 13 : Estimation results with long-run coefficients for corporate loans in domestic currency

Corporate loans in HUF	GMM, lag2, 1995.I-2004.III				
Asymmetry (A)	Size	Liquid	Capit	ACF	For. own
Interest rate	-0.96***	-1.31***	-0.91***	-0.86***	-1.20***
	(-8.45)	(-8.47)	(-6.15)	(-5.00)	(-10.16)
GDP	0.00*	0.00	0.00	0.00	0.00**
	(1.63)	(1.23)	(0.90)	(1.57)	(1.99)
Exchange rate	0.14***	0.18***	0.17***	0.16***	0.16***
	(4.29)	(4.98)	(5.02)	(4.00)	(4.82)
Euro interest rate	-0.01**	-0.01***	-0.01*	-0.01**	-0.02***
	(-2.51)	(-2.93)	(-1.86)	(-2.55)	(-3.45)
Inflation	-0.01	0.06	-0.02	0.00	0.00
	(-0.13)	(1.09)	(-0.36)	(0.05)	(0.06)
A(-2)*interestrate	**0.00*** **	**-3.33*** **	**-6.43*** **	**-4.15*** **	**0.15**
	(8.62)	**(-14.42)**	**(-20.78)**	**(-7.01)**	**(0.66)**
A(-2)	0.00	0.01	0.06	-0.06	-0.02
	(-1.07)	(0.12)	(0.54)	(-0.25)	(-0.55)
No. of obs.	849	849	849	849	849
Adjusted R^2	0.53	0.53	0.53	0.53	0.53
J-statistics	583.62	588.73	587.41	593.96	585.72
	(0.44)	(0.38)	(0.40)	(0.32)	(0.41)
D-Hansen test	31.89	21.04	37.57	27.12	32.96
	(0.51)	(0.94)	(0.25)	(0.74)	(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 I.-2004 III.									
A1	Liquid	Capit	ACF	For. own.	Capit	ACF	For. own.	ACF	For. own.	For. own.
A2	Size	Size	Size	Size	Liquid	Liquid	Liquid	Capit	Capit	ACF
Interest rate	-1.16	-0.06	-0.75	-1.07	-0.80	-0.48	-0.88	-0.72	-0.19	-0.41
	(-4.66)	(-0.36)	(-5.29)	(-8.63)	(-4.26)	(-2.32)	(-5.73)	(-3.37)	(-0.96)	(-2.75)
GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(1.26)	(0.46)	(1.61)	(1.64)	(1.40)	(0.79)	(0.77)	(1.78)	(-0.03)	(1.98)
Exchange rate	0.15	0.08	0.14	0.15	0.18	0.15	0.12	0.09	0.15	0.09
	(4.04)	(2.00)	(3.47)	(4.95)	(3.62)	(3.46)	(2.56)	(1.94)	(3.74)	(1.97)
Euro interest rate	-0.02	-0.01	-0.01	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01
	(-3.18)	(-2.82)	(-2.68)	(-3.49)	(-3.48)	(-1.82)	(-1.73)	(-3.04)	(-2.40)	(-3.46)
Inflation	0.05	-0.15	0.01	0.04	-0.01	0.04	0.02	-0.03	-0.03	0.00
	(0.72)	(-4.16)	(0.10)	(0.66)	(-0.16)	(0.81)	(0.30)	(-0.68)	(-0.68)	(0.08)
A1(-2)*interestrate	**-3.95**	**2.74**	**-3.25**	**0.37**	**-3.56**	**-2.58**	**0.79**	**-1.71**	**-3.20**	**-1.21**
	(-13.12)	**(2.70)**	**(-4.35)**	**(1.43)**	**(-7.28)**	**(-3.51)**	**(2.21)**	**(-2.08)**	**(-6.36)**	**(-2.85)**
A2(-2)*interestrate	**0.00**	**0.00**	**0.00**	**0.00**	**-0.91**	**-1.64**	**-3.23**	**-4.78**	**3.67**	**-1.56**
	(8.16)	**(6.96)**	**(3.52)**	**(4.62)**	**(-1.37)**	**(-2.43)**	**(-6.30)**	**(-4.08)**	**(2.81)**	**(-1.61)**
A1(-2)*A2(-2)*ir	0.00	0.00	0.00	0.00	-41.41	-5.32	9.19	15.93	-38.30	4.77
	(-9.11)	(8.94)	(3.83)	(1.40)	(-8.20)	(-0.93)	(6.74)	(2.58)	(-7.64)	(1.56)

A1(-2)	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.07	0.07	-0.06
	(-2.67)	(1.19)	(-4.60)	(-0.27)	(2.34)	(1.72)	(4.92)	(5.52)	(8.69)	(-8.25)
A2(-2)	0.00	0.11	-0.05	-0.03	0.03	-0.05	-0.01	-0.09	-0.04	-0.03
	(0.04)	(12.73)	(-4.97)	(-4.28)	(4.42)	(-4.52)	(-1.35)	(-10.05)	(-4.60)	(-4.30)
A1(-2)*A2(-2)	0.00	0.00	0.00	0.00	0.03	0.06	-0.17	-0.12	-0.10	-0.02
	(-1.82)	(2.92)	(3.61)	(-3.51)	(0.73)	(0.86)	(-6.59)	(-1.23)	(-2.86)	(-0.76)
Adjusted R^2	0.53	0.54	0.53	0.53	0.54	0.53	0.54	0.54	0.54	0.53
Number of observations	849	839	849	841	839	849	841	839	839	841
J-statistics	582.06	580.90	578.70	584.61	579.45	585.55	577.19	592.44	569.89	586.89
	(0.46)	(0.47)	(0.50)	(0.43)	(0.49)	(0.42)	(0.51)	(0.34)	(0.60)	(0.40)
D-Hansen test	29.40	34.20	26.86	41.70	34.08	30.93	33.22	40.47	30.21	28.13
	(0.69)	(0.44)	(0.80)	(0.16)	(0.44)	(0.62)	(0.49)	(0.19)	(0.63)	(0.74)

Results for loans in foreign currency

The results for foreign currency denominated loans are somewhat surprising when we estimate the model for the entire available period: from 1998 till 2004 III.. The elasticity of changes in domestic interest rate is around -0.60 in most cases and significant at the 10% level. At the same time, euro interest rate changes have an elasticity of about 0.017 in most cases and this parameter is significant at the 5% level.

When estimating the model for the period of 2001 I.- 2004 III. we get more plausible results. The elasticity of changes in domestic interest rate on loans in foreign currency is positive in all regressions with an average value of 0.57 in most cases and significant at the 10% level. At the same time, euro interest rate changes have an elasticity of about 0.02 in most cases but the parameter is usually not significant even at the 10% level. This suggests a possible substitution from Forint loans to loans in foreign currency when domestic interest rate rises. None of the significant interaction terms is in line with the bank-lending channel for this loan quantity.

Conclusions

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

We consider in addition to the usual bank-specific variables (such as size, liquidity, and capitalization) foreign ownership and as a direct proxy for the cost of financing of a bank we use average cost of financing. We find heterogeneity among banks which is line with the bank-lending theory in the majority of cases (in most specifications for most variables). That, in general can be taken as a support for the bank-lending channel especially, because we find that demand of loans can be considered reasonably homogeneous with respect to the characteristics we rely upon.

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 can be attributed to the demand effects and/or balance sheet channel rather then the effect of decreasing lending supply arising from the shrinking sources: in contrast to theory of the bank lending channel, the aggregate effect of interest rate changes proved to be insignificant on total deposits and other liability items.

The future importance of the bank lending channel is not obvious. In the future foreign funds and extended borrowing foreign currency, mainly from the euro area, will disappear or at least reduce significantly in the euro area. Additionally, in a major part of the sample the banking system can be characterized by excess liquidity and overcapitalization, and the developments in credit aggregates were driven by structural changes rather than monetary policy actions. This outlines the possibility of strengthening of the bank-lending channel in the future in Hungary. At the same time, with the development of the financial markets borrowers become less bank-dependent, reducing its importance. At the same time, as we show in the extended Stein model, in periods where central bank rates are lower bank lending channel is less likely to be at work and the past couple of years have been characterized by an increasing access of information about the activities of banks that reduces the importance of asymmetric information. Also, increasing tendency can be observed in the foreign ownership that increases the possibility to get relatively cheap foreign funds from their parent banks.

Appendix

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 Martíneu-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. (2005)	*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 Pawłowska (2002)	Poland	KS	Unclear	Evidence

C. 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

Foreign 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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