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IS THERE A BANK LENDING CHANNEL OF MONETARY POLICY IN LATVIA? EVIDENCE FROM BANK LEVEL DATA

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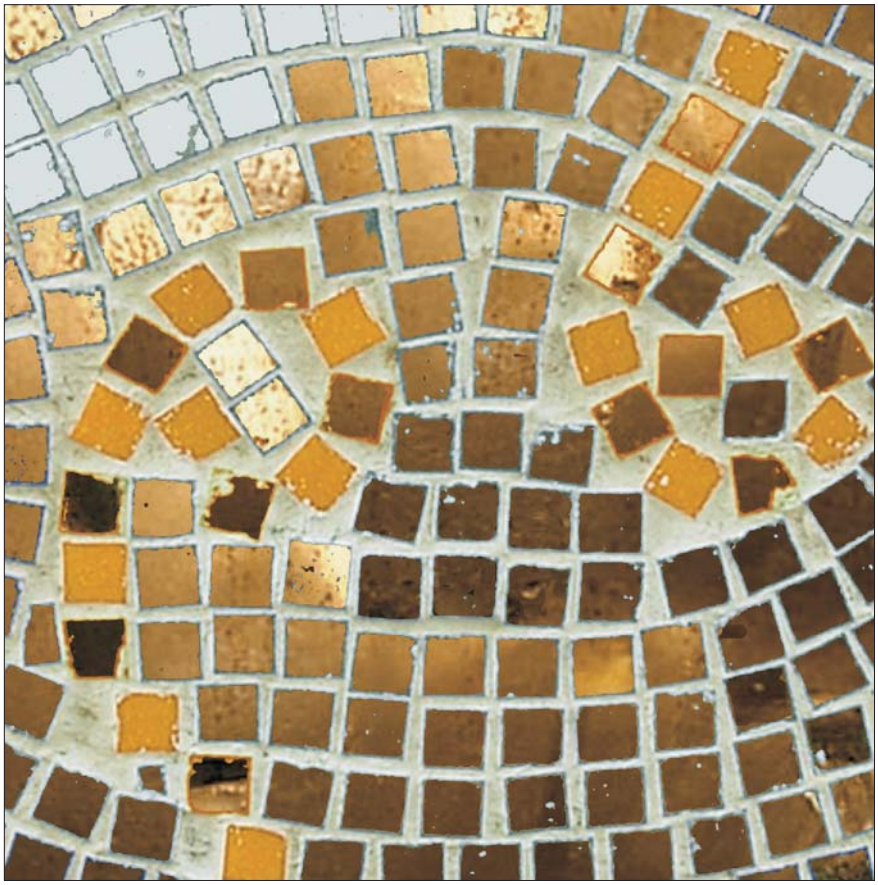

WORKING PAPER

CONTENTS

Abstract	2
Introduction	3
1. The Bank Lending Channel	4
1.1 Interest Rate and Credit Channels: a Brief Overview of Theoretical Concepts	4
1.2 Determinants of the Bank Lending Channel	6
2. A Short Description of Latvia's Banking Sector	7
2.1 Importance of the Banking Sector for Latvia's Financial System	7
2.2 Structure of Latvia's Banking Sector	8
3. Discovering Asymmetries in Bank Lending Behaviour	12
3.1 A Brief Overview of Previous Empirical Studies	12
3.2 Panel Approach to Identifying Asymmetries in Bank Lending	13
3.3 Estimation Method	16
4. Bank Lending Channel in Latvia: Econometric Estimations and Results	17
4.1 Data Issues	17
4.2 Bank Loans to Residents	18
4.3 Bank Loans to Households and Non-Financial Corporations	26
5. Robustness Check	29
5.1 Alternative Specifications	29
5.2 Robustness of the Results for Different Time Periods	30
Conclusion	31
Appendices	33
Bibliography	43

ABBREVIATIONS

CPI – Consumer Price Index
CSB – Central Statistical Bureau of Latvia
ECB – European Central Bank
EURIBOR 3M – Euro Interbank Offered Rate, the index of European interbank euro credit interest rates for credits with a 3-month maturity
FCMC – Financial and Capital Market Commission
GDP – Gross Domestic Product
GMM – Generalised Method of Moments
HHI – Herfindhal-Hirschman Index
LCD – Latvian Central Depository
LIBOR SDR 3M – the index of SDR interest rates for credits with a 3-month maturity, calculated using London Interbank Offered Rate Indices
MFI – monetary financial institution. Credit institutions and other financial corporations whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs and to grant credit and/or make investment in securities for their own account, as well as national central banks.
RIGIBOR 3M – Riga Interbank Offered Rate, the index of Latvian interbank lats credit interest rates for credits with a 3-month maturity
SDR – Special Drawing Rights

ABSTRACT

The goal of this paper is to explore the role of the banking sector in transmission of the Bank of Latvia's monetary policy and to check the existence of the bank lending channel in Latvia. For empirical investigation of the bank lending channel in Latvia, we use the approach that builds on the standard panel regression. The evidence on the bank lending channel is obtained by estimating a bank loan function that takes into account not only the monetary policy indicator and macroeconomic variables, but also bank-specific differences in the lending reaction to monetary policy actions.

Empirical analysis shows that some banks in Latvia have statistically significant negative reaction to a domestic monetary shock; however, the weighted average reaction of the total lats loan growth is not statistically significant. A domestic monetary shock has only a distribution effect and affects banks that are small, domestically owned and have lower liquidity or capitalisation. The bank lending channel is limited only for the supply of lats loans, which dramatically reduces the importance of this channel.

Keywords: *monetary policy transmission, bank lending channel.*

JEL classification: *C23, E52, G21*

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INTRODUCTION

The analysis of the monetary policy transmission, i.e. how monetary policy changes affect the real economy, is one of the most researched areas in macroeconomic literature and a special focus for central bankers. Recent theoretical and empirical findings enlighten, step by step, the transmission process of monetary policy.

According to the traditional interest rate channel, a change in policy-induced interest rates influences the real economy by affecting various relative prices. A higher cost of capital increases the returns required for an investment project and, therefore, diminishes investment expenditures. Changes in interest rates also affect consumption, as higher interest rates decrease the price of future consumption. In the case of a flexible exchange rate regime, interest rate movements affect the nominal exchange rate, price competitiveness and hence also net exports. However, the interest rate channel theory ignores some important processes in the banking sector.

The credit channel view acknowledges the existence of informational imperfections in financial markets and assigns an active role to the supply of bank loans in monetary transmission via two "subchannels" – the balance sheet channel, which states that tight monetary policy may worsen borrowers' risk characteristics and reduce the supply of loans, and the bank lending channel, which states that the central bank policy can affect bank balance sheets and hence also the supply of loans. The latter, i.e. the bank lending channel, is of especial interest for us in this paper, as it focuses more specifically on the particular role of banks in the transmission mechanism.

The existence of the bank lending channel has a very important implication for monetary policy: the transmission process of monetary policy depends on the structure of the financial system. This means that structural changes in financial area may affect monetary transmission. Moreover, monetary policy can also have a distribution effect, as individual banks with different specific (or individual) characteristics will have an asymmetric reaction to monetary shock.

The goal of this paper is to explore the role of the banking sector in transmission of the Bank of Latvia's monetary policy and to check the existence of the bank lending channel in Latvia. For this purpose, we use microeconomic data that help to solve the identification problem of loan supply effect versus loan demand effect of monetary policy. The approach used in the paper builds on currently very widely accepted standard panel regression methodology. Evidence on the bank lending channel is obtained by estimating a bank loan function using data of individual banks. This function takes into account not only the monetary policy indicator and macroeconomic variables but also bank-specific differences in lending reaction to monetary policy actions. The main question is whether there are certain types of banks that show a relatively strong decrease in lending after monetary tightening.

The structure of the paper is as follows. Section 1 provides a brief theoretical overview of monetary transmission channels with a special focus on the bank lending channel. The main features of Latvia's banking sector are described in Section 2. A short overview of empirical research and description of the model and econometric methodology are presented in Section 3. Empirical results on the bank lending channel in Latvia are discussed in Section 4, while Section 5 checks the robustness of these results. The last section concludes.

1. THE BANK LENDING CHANNEL

1.1 Interest Rate and Credit Channels: a Brief Overview of Theoretical Concepts

According to the traditional interest rate channel (or money channel), a change in policy-induced interest rates affects long-term interest rates, which, in turn, influence the real economy by impacting various relative prices in the economy. The emphasis of interest rate transmission mechanism is on the real rather than nominal interest rate and the long-term rather than short-term interest rate.(27) The key is sticky prices, so that expansionary monetary policy that lowers the short-term nominal interest rate also lowers the short-term real interest rate. The expectations hypothesis of the term structure suggests that a lower real short-term interest rate leads to a fall in the real long-term interest rate.

In an overview of competing views on monetary transmission, Ch. Bean et al. (4) denote the following ingredients of the interest rate channel. First, higher interest rates and therefore higher cost of capital induce increasing returns required for an investment project and diminishing investment expenditures. Second, an increase in interest rates alters consumption: the impact of monetary tightening can be decomposed into a substitution and income effect. The former is negative, as higher interest rates decrease the price of future consumption, while the latter depends on net asset positions of consumers. Third, in the case of a flexible exchange rate regime, interest rate movements make the exchange rate volatile thereby altering price competitiveness and affecting net exports. Interest rate movements will also have an impact on the supply side of the economy through intertemporal substitution in labour supply.

The interest rate channel theory assumes that financial intermediaries do not play any special role in the economy. B. S. Bernanke and A. S. Blinder (5) show that the traditional interest rate channel relies on at least one of the three assumptions: 1) loans and bonds are perfect substitutes to borrowers, 2) loans and bonds are prefect substitutes to lenders, or 3) the commodity demand is insensitive to loan rate.

The point of departure of the credit view is the rejection of the assumption that bonds and bank loans are perfect substitutes. B. S. Bernanke and M. Gertler (6) state that "..according to the credit channel theory, the direct effects of monetary policy on interest rate are amplified by endogenous changes in the external finance premium, which is the difference in cost between funds raised externally (by issuing equity or debt) and funds generated internally (by retaining earnings). The size of the external finance premium reflects imperfections in the credit markets that drive a wedge between the expected return received by lenders and the costs faced by potential borrowers. According to the credit view, a change in monetary policy that raises or lowers market interest rates tends to change the external finance premium in the same direction".

Based on the assumption of informational imperfections in financial markets, the credit channel assigns an active role to the supply of bank loans. Therefore, the credit channel stipulates that monetary policy can affect not only the demand for loans, but also the supply of loans. B. S. Bernanke and M. Gertler (6) define two "subchannels" of the credit channel:

– balance sheet channel (or broad credit channel) with a focus on potential impact on borrowers' balance sheets and income statements;

– bank lending channel (or narrow credit channel) with a focus on the supply of loans by credit institutions.

The balance sheet channel does not specifically concentrate on bank loans but refers more generally to the overall supply of funds. This channel may work even if loans and bonds are perfect substitutes in the balance sheets of banks and firms. The balance sheet channel is based on the assumption that the external finance premium should depend on borrower's financial position.

Monetary policy changes can affect the borrowers' risk characteristics, as higher interest rates are expected to weaken the borrowers' financial position. According to B. S. Bernanke and M. Gertler (6), a tight monetary policy weakens directly the borrowers' balance sheets in two ways. First, higher interest rates increase interest payments, weakening the financial position of borrowers. Second, rising interest rates are typically associated with declining asset prices, which reduce the value of borrowers' collateral. Moreover, a tight monetary policy may influence the financial position indirectly, decreasing the demand for firm's output, while various fixed costs do not adjust in the short run. A change in borrowers' risk translates into a shift in the supply curve of funds due to the existence of asymmetric information among lenders and borrowers.

The bank lending channel focuses more narrowly on the special role of banks in the monetary transmission mechanism, as monetary policy may also affect the external finance premium by shifting the bank loan supply. This channel may be at work only under the following conditions.

– Monetary policy should significantly affect the supply (or relative pricing) of bank loans. The model designed by B. S. Bernanke and A. S. Blinder (5) suggests that a tight monetary policy affects the reserve positions of banks, also influencing the supply of bank loans. The key assumption is that, following a reduction in reserves, banks cannot turn freely to the bond market due to external finance premium. In other words, deposits and bonds should be imperfect substitutes for banks.

– Bank loans and bonds should be imperfect substitutes for borrowers and changes in loan supply should affect real activity. B. S. Bernanke and M. Gertler (6) argue that this condition is very likely as banks remain the dominant source of intermediated credit specialising in overcoming informational problems and other frictions in credit markets.

The balance sheet and bank lending channels should not be considered as an alternative to the traditional monetary transmission mechanism. B. S. Bernanke and M. Gertler (6) stress that "..we don't think of the credit channel as a distinct, free-standing alternative to the traditional monetary transmission mechanism, but rather as a set of factors that amplify and propagate conventional interest rate effects. For this reason, the term "credit channel" is something of a misnomer; the credit channel is an enhancement mechanism, not a truly independent or parallel channel".

In addition, unlike the standard interest rate channel, the impact of monetary policy on the real economy, working through the balance sheet and bank lending channels, has important distributional consequences. Banks of different deposit dependence and firms with different financial positions and dependence on bank loans are unlikely to be equally affected by monetary policy shocks.

1.2 Determinants of the Bank Lending Channel

According to theoretical concepts, the two necessary conditions for the existence of the bank lending channel are the ability of monetary policy to affect the bank loan supply, and imperfect substitution between bank loans and bonds for borrowers. Consequently, the significance of the bank lending channel is determined by two factors: the strength of monetary policy impact on the bank loan supply, and dependency of borrowers on bank loans.

The effect of monetary policy on the supply of bank loans depends on the characteristics of the banking sector. Overall, the stronger the nation's banking sector, the weaker the expected impact of policy movements is; balance sheets of large, healthy banks are not sensitive to policy because their reserve contraction can be readily offset with alternative forms of financing without involving reserve requirements.(9) There are various indicators of financial strength of the banking sector in the literature. The size of banks, market concentration, capitalisation and liquidity are among the commonly mentioned factors.(9; 10) A relatively small size of banks, weak bank market concentration, low liquidity and capitalisation would suggest a stronger lending channel, as such banks are more exposed to market imperfections and will face more difficulties in attracting non-deposit financing. Financial strength is also characterised by loan loss provisions, operating costs and return on assets as well as the number of bank failures in the past.

Another important factor is ownership structure of the national banking sector. State influence exerted either through direct public ownership of banks, state control or public guarantees provides additional funding possibilities and reduces informational asymmetries. Foreign involvement in the domestic banking sector also weakens the bank lending channel, as foreign bank subsidiaries may face fewer financing constraints due to potential supply of additional funding from their parent banks.(15; 10)

A. K. Kashyap and J. C. Stein (20) argue that the effect on the bank loan supply depends on the regulatory framework, as risk-based capital requirements can tie a bank's ability to extend loans to its level of equity capital and constrain lending. On the other hand, bank lending behaviour could be also affected by deposit insurance requirements, as high deposit insurance decreases the risk level for clients. A lower risk level reduces deposit costs for banks, thus increasing bank dependency on this type of liabilities.

Finally, the speed of monetary transmission depends on the bank loan maturity and interest rate type. The bigger the share of short-term loans with a floating interest rate, the faster the response of loan supply to changes in monetary policy will be.

Regarding dependency of borrowers on bank loans, it is usually explained by the fact that banks play a special role in the financial system because they are particularly well suited to solve asymmetric information problems in credit markets.(27) The bank-dependent borrowers – small and medium sized firms and households – suffer most from the asymmetric information problems. The higher the share of such borrowers in the credit market, the higher the bank-dependency ratio is. Moreover, the bank dependency is also driven by availability of non-bank finance. Relatively low capital market capitalisation compared with the bank assets and loans implies higher bank dependency and stronger bank lending channel of monetary transmission.

2. A SHORT DESCRIPTION OF LATVIA'S BANKING SECTOR

2.1 Importance of the Banking Sector for Latvia's Financial System

The banking sector plays a significant role in Latvia's economy and dominates other types of financial intermediation (see Table 2.1). The development of the banking sector was extremely dynamic during the last years, with the bank total asset ratio to GDP increasing from 77% in 2002 to more than 140% in 2006. The growth of bank loans to residents was even more rapid, and their ratio to GDP increased almost threefold between 2002 and 2006 mostly due to the growth in loans to households. In 2006, the share of households in total loans to residents was almost one half.

Table 2.1
Financial intermediation in Latvia

(% to GDP)

	2002	2003	2004	2005	2006
Total bank assets	76.8	89.4	105.6	120.8	141.2
Bank loans to residents	32.8	41.5	51.1	68.7	86.9
of which: to non-financial corporations	20.3	23.4	27.3	33.1	40.6
to households	7.3	11.6	17.6	26.8	38.0
Leasing companies' assets	5.3	5.6	6.5	7.8	11.0
Investment fund assets	0.2	0.4	0.5	0.8	1.0
Private pension fund assets	0.3	0.3	0.4	0.4	0.5
Insurance corporations' assets	2.2	2.3	2.1	2.1	2.2
Outstanding debt securities of corporate sector	0.9	1.6	1.3	1.2	1.0
of which non-banks	0.1	0.5	0.0	0.0	0.2
Stock market capitalisation	7.3	9.5	11.4	16.5	12.7
of which non-banks	6.5	8.3	10.4	14.4	10.8

Sources: Bank of Latvia, FCMC, CSB, Riga Stock Exchange and LCD.

Other types of financial intermediation are less important and their development is not so impressive, except for leasing companies' assets to GDP that doubled during the given four year period. Although the increase in assets of investment funds was impressive as well, their relative size is still negligible. The assets of private pension funds and insurance corporations were almost unchanged relative to GDP during the observed period. Stock market capitalisation to GDP was 12.7%, quite low compared with bank total assets and loans. The debt securities market is still undeveloped in Latvia; moreover, it is dominated by bank debt securities.

The relative size of Latvia's banking sector is comparable with that of developed countries (see Table 2.2 for international comparison). Total assets of Latvia's banks to GDP are lower than in the euro area and its two largest countries Germany and France. However, the relative level of bank loans to non-financial corporations is quite comparable with euro area figures. It is interesting to note that bank total assets and loans to non-financial corporations relative to GDP are two times higher in Latvia than in the USA.

In contrast to the banking sector, the stock and debt securities markets are significantly weaker than in the developed countries. Latvia's stock market capitalisation to GDP is 10 times smaller than in the USA and 5–7 times smaller than in the euro area. This gap is even larger for the debt securities market.

Table 2.2

International comparison

(end of 2001; % to GDP)

	USA	Euro area	Germany	France	Latvia[1]
Total bank assets	78.0	267.1	304.3	276.7	141.2
Bank loans to non-financial corporations	18.8	42.6	38.9	35.7	40.6
Outstanding debt securities of non-financial corporations	28.9	6.5	2.8	17.0	0.2
Stock market capitalisation	137.1	71.7	58.1	90.6	12.7

Sources: (10), Bank of Latvia, Riga Stock Exchange and LCD.

The facts above prove the dominant role of Latvia's banking sector in financial intermediation system, which results in a high degree of bank dependency of local borrowers. This dependency is especially pronounced because of a high share of loans to households in the total bank loan portfolio.

2.2 Structure of Latvia's Banking Sector

At the end of 2006, there were 21 banks in Latvia (of which nine were subsidiaries of foreign banks) and three branches of foreign banks (see Table 2.3). The number of banks was almost unchanged during the last five years, while there was an increase in the number of foreign branches and subsidiaries.

Although the number of banks is relatively large taking into account the size of Latvia's population (there is one bank per 95 thousand inhabitants), the banking sector is dominated by few large banks, while other banks are relatively unimportant. At the end of 2006, the market share of the five largest banks in Latvia amounted to almost 70% of total assets and deposits, and constituted more than 75% of all loans granted. HHI also shows a high degree of concentration (in 2006, HHI for assets was 0.127; for comparison, + for assets for the euro area was only 0.0629). The high degree of concentration indicates the dominance of large banks and is a factor that weakens the importance of the bank lending channel in Latvia.

As regards the ownership structure, we get controversial signals about the strength of the lending channel. On the one hand, Latvia's banks are mainly owned by non-residents, with the share of foreign ownership rising to almost 70% of paid-up

[1] End of 2006 for Latvia. Bank loans to non-financial corporations only include loans to domestic enterprises.

capital at the end of 2006. This should weaken the lending channel because banks with foreign ownership have additional possibilities to find non-depository financing after a monetary policy shock.

Table 2.3

Size and ownership structure of Latvia's banking sector

	2002	2003	2004	2005	2006
Number of banks					
Banks and branches of foreign banks	23	23	23	23	24
Branches of foreign banks	1	1	1	1	3
Subsidiaries of foreign banks	6	7	8	9	9
Market concentration (%)					
Market share of five largest banks					
of assets	65.3	63.1	62.4	67.3	69.4
of loans	73.7	73.4	73.6	75.7	77.3
of deposits	68.4	66.6	65.9	69.6	69.9
HHI[2]					
of assets	0.114	0.105	0.102	0.118	0.127
of loans	0.149	0.140	0.139	0.147	0.154
of deposits	0.125	0.112	0.106	0.117	0.118
Ownership					
Non-resident ownership (% of paid-up capital)	54.3	53.9	57.8	58.6	68.8
Government ownership (% of paid-up capital)	7.0	6.5	5.9	10.6	8.2

Source: Bank of Latvia.

On the other hand, Latvia's banking sector has a low level of government participation (there is only one bank owned by the Government, while other banks have no government presence at all). Government involvement usually provides some additional funding possibilities; therefore, the low level of Government's presence in the banking sector of Latvia does not weaken the potential bank lending channel.

Table 2.4 shows the asset and liability structure of Latvia's banking sector as well as bank profitability. Total bank assets increased rapidly during the last five-year period and were more than 140% to GDP in 2006. The growth of total loans outperformed that of assets, and the share of loans in total assets increased from one half in 2002 to more than two thirds in 2006. This growth in loans was mainly driven by loans to residents. Moreover, it was mostly determined by loans issued in foreign currency. The share of loans in lats in total assets and total loans even decreased during the last years of the sample period, and only one fourth of loans to domestic borrowers were in lats at the end of 2006. The small share of loans in national currency weakens the bank lending channel, as the domestic monetary policy primarily affects the availability of lats resources to domestic banks.

[2] HHI is calculated as a sum of the squares of market shares of individual banks. Larger HHI denotes a higher degree of concentration.

Table 2.4
Main indicators of Latvia's banking sector

	2002	2003	2004	2005	2006
Assets					
Total assets (millions of lats)	4 422.5	5 716.7	7 850.1	10 942.9	15 907.3
Total assets to GDP (%)	76.8	89.4	105.6	120.8	141.2
Loans					
Total loans to assets (%)	48.1	52.5	55.8	63.6	68.4
Loans to residents to assets (%)	42.7	46.4	48.4	56.9	61.6
Loans to residents in lats to assets (%)	19.5	20.4	18.9	17.1	14.2
Loan quality					
Non-performing loans to total loans (%)	2.0	1.4	1.1	0.7	0.4
Specific provisions for claims on non-banks to non-performing loans (%)	78.1	89.4	99.1	98.8	116.6
Loan collateral					
Without collateral (%)	–	–	7.8	6.8	6.0
Mortgages (%)	–	–	53.6	63.3	69.4
Commercial pledge (%)	–	–	11.0	11.2	9.4
Deposits					
Total deposits to assets (%)	69.4	65.3	64.9	56.7	48.8
Demand deposits to assets (%)	49.9	47.7	46.8	40.0	33.3
Liabilities to MFIs					
Liabilities to MFIs (except Bank of Latvia) to assets (%)	14.4	18.9	21.1	29.9	37.7
Liquidity					
Liquidity ratio[3] (%)	62.1	57.9	58.1	52.3	51.1
Capital adequacy					
Required capital adequacy (%)	10	10	10/8[4]	8	8
Capital adequacy ratio[5] (%)	13.1	11.7	11.7	10.1	10.2
Profitability					
Return on assets[6]	1.5	1.4	1.7	2.1	2.1
Return on equity[7]	16.4	16.7	21.4	27.1	26.3

Sources: Bank of Latvia, FCMC.

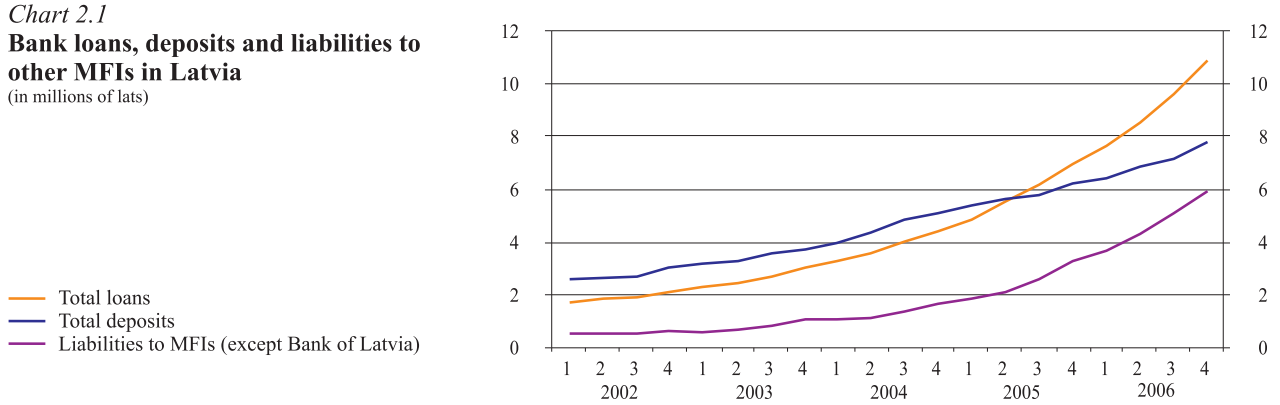
The expansion of banking loans did not decrease the quality of loans, however. On the contrary, the share of non-performing loans to total loans decreased from 2% in 2002 to 0.4% in 2006, indicating a good quality of loan portfolio. Moreover, specific provisions fully covered non-performing loans at the end of 2006. Almost all loans have collateral, either a mortgage or commercial pledge. These facts suggest that the development of Latvia's banking sector did not come at the cost of financial strength and asset quality that would reduce the significance of the bank lending channel in monetary transmission.

The share of deposits in total liabilities diminished to less than a half, indicating that the growth of deposits lagged behind the growth of other liabilities. Two thirds of all deposits were demand deposits. Relatively slower growth of deposits was compensated by a rapid increase in liabilities to MFIs (except the Bank of Latvia),

[3] Liquidity ratio is calculated as assets with maturity of up to 30 days ratio to liabilities with maturity of up to 30 days.
[4] Required capital adequacy was reduced from 10% to 8% in the fourth quarter of 2004.
[5] Capital ratio to risk-weighted assets.
[6] The ratio of profit/loss to assets.
[7] The ratio of profit/loss to capital and reserves.

mainly parent banks. During the last two years, growing liabilities to MFIs (except the Bank of Latvia) financed the high growth in bank loans, outperforming the growth in bank deposits (see Chart 2.1). The share of liabilities to financial institutions in total liabilities shows that Latvia's banks (at least those with foreign ownership) have an important source of non-deposit financing that significantly decreases their susceptibility to monetary shocks and potential strength of the bank lending channel.

Chart 2.1
Bank loans, deposits and liabilities to other MFIs in Latvia
(in millions of lats)



Source: Bank of Latvia.

Due to the expansion of loan portfolio and the reduced required capital adequacy ratio, bank liquidity and capital adequacy ratios, although still remaining at a high level, decreased in 2002–2006. This could be seen as a factor increasing the importance of the bank lending channel over time. Profitability of the banking sector during the observed period was high both looking at returns on assets and returns on equity, which points to the financial strength of Latvia's banks and should reduce the significance of the bank lending channel.

Latvia has a well-established deposit insurance system. According to the Deposit Guarantee Law of the Republic of Latvia passed on 3 June 1998, the amount of guaranteed compensation to one depositor for a deposit made with a bank, a branch of a foreign bank or a credit union shall be in the amount of the guaranteed compensation, but not exceeding 20 000 euro as of 1 January 2008.[8] The deposit insurance system can increase the dependency of banks on deposit financing, strengthening the lending channel of monetary transmission.

To sum up, the descriptive evidence on the strength of the lending channel in Latvia is mixed. Most of the factors, e.g. market concentration, high degree of non-resident ownership leading to a significant level of liabilities to foreign MFIs, low share of loans in lats, good quality of loan portfolio and profitability, indicate that the lending channel should be weak. On the other hand, the high degree of bank dependency of local borrowers, low level government presence as well as decreased liquidity and capital ratios speak in favour of the presence of the lending channel. Moreover, Latvia's banking sector is rather diversified, and there are a large number of smaller banks whose balance sheet structure and hence liquidity and capital adequacy indicators, among others, diverge substantially from banking sector's averages. Therefore, in order to draw conclusions about the role of Latvia's banking sector in monetary policy transmission, we need to perform some formal empirical tests.

[8] Until the end of 2007, the maximum compensation amount was 15 000 euro.

3. DISCOVERING ASYMMETRIES IN BANK LENDING BEHAVIOUR

3.1 A Brief Overview of Previous Empirical Studies

The issue of the bank lending channel has deserved special attention of researchers in the last 20 years. Early empirical studies focused on macroeconomic evidence**,** as perhaps the simplest implication of the lending channel is that bank loans should be closely correlated with monetary policy measures. For instance, B. S. Bernanke and A. S. Blinder (5) find that increases in the US federal funds rate urge banks to slow down the loan growth. However, while correlations between policy indicators, bank loans and activity are consistent with the credit view, such evidence cannot provide unambiguous support to the lending view. A. K. Kashyap and J. C. Stein (20; 21) argue that another way to read these results is that a tight monetary policy operates through standard interest rate channels to depress economic activity and to reduce the demand for credit. Consequently, there can be an induced correlation between activity and bank lending even if there is no lending channel.

To overcome the identification problem, the use of disaggregated data on bank balance sheets was proposed. If the credit view is correct, one should expect loan portfolios of banks with different characteristics to respond differently to a contraction in monetary policy.(21; 22) According to the lending channel theory, informational imperfections in financial markets that create bank loan supply effects of monetary policy also result in differential loan supply responses across banks. The underlying assumption is that the more difficult it is for a bank to offset the effects of a restrictive monetary policy measure, the higher the degree to which it suffers from asymmetric information vis-à-vis its suppliers of funds.

As a result, the use of microeconomic data became the dominant empirical method of investigating the existence of bank lending channel in recent years. For example, A. K. Kashyap and J. C. Stein (22) found that within the group of small banks changes in monetary policy matter more for loans of the banks with the least liquid balance sheets. Building on these results, they argue in favour of the existence of a lending channel for the United States.

There is a lot of empirical evidence on operational lending channels in European countries as well. M. Ehrmann et al. (10) found that for the euro area liquidity is an important indicator of bank reaction to a monetary policy action, with less liquid banks reacting more strongly than more liquid banks, although not in all countries. On the other hand, such factor as the size of a bank or the degree of its capitalisation is generally not important for the way a bank adjusts its lending to interest rate changes.

The existence of the lending channel has been ascertained by numerous researches at an individual country level. A. Worms (34) reports that in Germany the average bank response to monetary policy mainly depends on its share of short-term interbank deposits in total assets, hence also on its liquidity. The results of research by L. de Haan (14) suggest that a lending channel is operative in the Netherlands. I. Hernando and J. Martínez-Pagés (16) have found some evidence that less liquid banks in Spain may display a stronger response than banks with a higher degree of liquidity, although this evidence seems to be supported mostly by a loan portfolio composition effect. C. Loupias et al. (25) report on some asymmetry between liquid

and illiquid banks in France. Similar results have been obtained for Italy by L. Gambacorta (13).

Recently, the existence of the bank lending channel was examined also in East European countries. A. Pruteanu (30) detected a bank lending channel for 1996–1998 in the Czech Republic, with capitalisation influencing the impact of monetary policy on bank lending. Also, liquidity appears to make differences in the reaction of lending to monetary policy, but only within banks with mostly Czech participation. C. Horváth et al. (17) found heterogeneity among banks in the majority of cases for Hungary. In general, that can be taken as a support for the bank lending channel, especially because it was found that the demand for loans can be considered reasonably homogenous with respect to the banking characteristics. Empirical analysis conducted by R. Juks (19) provided evidence in favour of bank lending channel in Estonia, and the liquidity position of Estonian banks seems to be an important determinant of loan supply.

To our knowledge, the only paper that addresses the topic of a lending channel in Latvia by using micro data is by M. Köhler et al. (24) in which the authors analyse the role of banks in monetary policy transmission in the Baltic States. Their results indicate that small and well-capitalised banks react more strongly to monetary policy shocks. Nonetheless, several drawbacks of this paper should be acknowledged. The use of yearly data taken from the BankScope Database of Bureau van Dijk significantly decreases the number of observations. As a result, the equations are estimated by the Ordinary Least Squares Method with a first-order autoregressive term instead of the Generalised Method of Moments, without taking into account possible endogeneity of bank specific variables. In addition, there is no breakdown of loans by domestic currency and foreign currency. We will try to address these problems in our paper.

3.2 Panel Approach to Identifying Asymmetries in Bank Lending

The approach we use to investigate asymmetries in bank lending in Latvia builds on currently very standard panel regression introduced by A. K. Kashyap and J. C. Stein.(21; 22) The evidence on the bank lending channel is obtained by estimating a bank loan function that takes into account not only the monetary policy indicator and macroeconomic variables but also bank-specific differences in the lending reaction to monetary policy measures. The main question is whether there are certain types of banks that show a relatively strong decrease in lending after monetary tightening.

The model is given by the following equation where the growth rate of loans is regressed on lagged monetary policy indicators, set of macroeconomic variables and bank specific characteristics. The most important feature of the model is the inclusion of interaction terms that are the product of Latvia's monetary policy indicator and bank specific characteristics:

$$\Delta \ln x_{i,t} = \mu_i + \sum_{j=1}^{k} \alpha_j \Delta \ln x_{i,t-j} + \sum_{j=1}^{k} \beta_j^{*} \Delta MP_{t-j}^{*} + \sum_{j=1}^{k} \beta_j^{LV} \Delta MP_{t-j}^{LV} +$$
$$+ \sum_{j=1}^{k} \varphi_j \Delta \ln Y_{t-j} + \sum_{j=1}^{k} \phi_j \Delta \ln P_{t-j} + \sum_{j=1}^{k} \lambda_j Z_{i,t-j} + \sum_{j=1}^{k} \gamma_j Z_{i,t-j} \Delta MP_{t-j}^{LV} + \varepsilon_{i,t} \qquad [1]$$

where
$i = 1,...,N$ and $t = 1,...,T$;
$x_{i,t}$ is loans of bank i in quarter t;
MP_t^* is the foreign monetary policy indicator;
MP_t^{LV} is Latvia's monetary policy indicator;
Y_t is real income;
P_t is the price level;
$Z_{i,t}$ is a set of bank-specific characteristics;
μ_i is the bank specific intercept (fixed effect);
N is the number of banks;
T is the number of observations.

An important difference from the traditional panel model is the inclusion of two monetary policy indicators in equation [1] due to the specific nature of monetary regime in Latvia. As the exchange rate of lats is fixed to euro (prior to 2005, the lats was fixed to SDR currency basket), the scope for the monetary policy is rather limited and interest rates of lats are to a large extent driven by changes in the ECB's monetary policy. Therefore we need to distinguish between the effect of foreign monetary policy and the Bank of Latvia's monetary policy on interest rates and loan growth. However, we use foreign interest rates for foreign monetary policy and the spread between the domestic and foreign interest rates for domestic monetary policy. It should be noted that since two monetary policy indicators are used in the model, we assume that only the indicator of Latvia's monetary policy interacts with bank specific characteristics. Therefore a bank lending channel exists only for domestic monetary policy, while the changes in foreign monetary policy equally affect all domestic interest rates.

Various researchers have suggested several bank characteristics that determine how sensitive different banks are to changes in monetary policy.

– The size of a bank is important, as the large banks can encounter fewer asymmetric information problems than the small ones and therefore may find it easier to raise non-deposit funds in response to a monetary shock.(21) The indicator for a relative bank size is calculated using the following formula:

$$S_{i,t} = \ln A_{i,t} - \frac{1}{N_t}\sum_{i=1}^{N_t} \ln A_{i,t} \qquad [2]$$

where
$S_{i,t}$ indicates the relative size of a bank;
$A_{i,t}$ is total assets of a bank;
N_t is the number of banks in period t.

– Another bank characteristic is liquidity. Liquid banks can use liquid assets to protect their loan portfolios, while it is more problematic for relatively less liquid banks.(22)

$$Liq_{i,t} = \frac{L_{i,t}}{A_{i,t}} - \frac{1}{T}\sum_{t=1}^{T}\left(\frac{1}{N_t}\sum_{i=1}^{N_t}\frac{L_{i,t}}{A_{i,t}}\right) \quad [3]$$

where

$Liq_{i,t}$ is relative liquidity of a bank;

$L_{i,t}$ is liquid assets of a bank, determined as a sum of cash, claims on the central bank and other credit institutions as well as fixed-income debt securities of the central government.

– Capitalisation determines that well capitalised banks have easier access to non-deposit funds and therefore can decrease their loan supply by a lesser amount than poorly capitalised banks.(29)

$$Cap_{i,t} = \frac{C_{i,t}}{A_{i,t}} - \frac{1}{T}\sum_{t=1}^{T}\left(\frac{1}{N_t}\sum_{i=1}^{N_t}\frac{C_{i,t}}{A_{i,t}}\right) \quad [4]$$

where

$Cap_{i,t}$ indicates relative capitalisation of a bank;

$C_{i,t}$ denotes capital and reserves of a bank.

– Foreign ownership is a characteristic widely used in researches on Eastern European banking sectors.(30; 17) Banks with foreign ownership have an additional access to non-deposit funds and are less sensitive to changes in monetary policy. The traditional way to quantify foreign ownership is a dummy variable, which is equal to 1 for banks that have parent foreign banks.[9] However, this definition has two main drawbacks. First, the existence of a foreign parent bank does not necessarily mean that it would supply the required funds. Second, in a relatively small sample like ours, there are only few cases when the dummy variable changes during the observed period, which gives rise to some econometrical problems while estimating the coefficient before the foreign ownership variable. To overcome these problems, we define foreign ownership as a ratio of net liabilities to parent foreign banks to total assets, so that, strictly speaking, this variable reflects the actual amount of funds that domestic banks receive from their foreign parent banks:

$$F_{i,t} = \frac{NLA_{i,t}}{A_{i,t}} \quad [5]$$

where

$F_{i,t}$ indicates foreign ownership of a bank;

$NLA_{i,t}$ is net liabilities to parent foreign banks.

The formulation of bank characteristics in equations [3] and [4] sets the overall mean of liquidity and capitalisation equal to zero across time and banks. In such a way time changes in average liquidity and capitalisation are not removed from the analysis. On the other hand, the definition of size characteristic in equation [2]

[9] A non-resident bank with more than 50% of domestic bank's capital.

excludes rapid growth of the banking sector, setting the average size of a bank to zero for each point in time. In order to avoid different values of bank characteristic variables for a given quarter, only one lag of specific characteristic variables enters the regression.

The long-run coefficients of the interaction term in equation [1] are used to test for the presence of loan supply effects of monetary policy provided that all other variables of the equation capture sufficiently the loan movements caused by loan demand or loan supply factors other than monetary policy.

As regards macroeconomic variables, it is a common practice to include price changes (CPI or GDP deflator changes) and real GDP growth to account for the impact of macroeconomic environment on loan demand. The main drawback of these variables is an implicit assumption that the loan demand elasticities with respect to GDP growth and inflation are homogenous across banks. It is possible, for instance, that banks face different loan demand because of different sectoral composition of their loan portfolios.

To overcome this problem, we use such bank-specific real income and price variables (34) which are approximated by a weighted average of sectoral incomes and prices (we use 11 production sectors from NACE classification and the households sector as well). Sectoral real incomes and prices are weighted by sectors' shares in loan portfolio of a bank. The production sectors' real income growth was approximated by the changes in real value added, whereas the private households' real income growth by the real wage growth. The bank-specific price growth was calculated using production sectors' deflators and CPI.

One more obvious candidate for the price variable in equation [1] would be real estate prices, as the share of mortgage loans in total loan portfolio is large. In addition, the expected increase in real estate prices was closely connected with the growth of mortgage loans in Latvia. Unfortunately, we failed to find a reliable indicator for real estate prices for the time period used in our study.

3.3 Estimation Method

Due to the dynamic nature of the model, a correlation between the lagged-endogenous variables and the error term, leading to biased and inconsistent OLS estimates, is obtained.(28) In order to account for the autoregressive nature of the model and for the possible endogeneity of bank characteristics, the Generalised Method of Moments (GMM) as designed by M. Arellano and S. Bond (1) has been used.

To eliminate the individual effect from the model, the equation is first-differenced. Utilising the orthogonality conditions between lagged values of the dependent variable and disturbances, the lagged values of the dependent variable with second and more lags serve as instruments. This ensures efficiency and consistency of estimated coefficients in the hypothesis of $N \to \infty$ and small T, on condition that the disturbance in equation [1] is not subject to serial correlation and the set of instrument variables is valid.

In addition to the presence of a lagged dependent variable on the right hand side of the equation, an endogeneity problem emerges, as bank loans can be strongly correlated with other balance sheet positions and hence also with bank specific

characteristics. In this case, it is not clear which position drives the other. There are two traditional measures to deal with this problem. First, in order to address possible endogeneity problems, all right hand side variables enter the regression with at least one lag. Second, lagged levels of predetermined variables (bank specific characteristics) should be used as instruments. The differences of strictly exogenous variables are used as an instrument as well, and we assume that monetary policy indicators, demand and price growth are independent of individual bank loan growth.[10]

As estimation methodology includes the first differencing, there should be a presence of first order autocorrelation but not a second order correlation in the residual term of the first difference equation, which is tested by m1 and m2 tests[11]. To check the adequacy of the chosen instruments, we use the Sargan test statistics.

Another important issue is the choice between 1-step and 2-step GMM estimator. The difference between the two estimators consists in specification of an individual weighting matrix where the 2-step estimator uses 1-step residuals thus achieving higher efficiency. However, 2-step standard errors tend to be biased downward in small samples, and 1-step results are recommended for inferences on coefficients, although the 2-step Sargan test is recommended for inferences on model specification.

4. BANK LENDING CHANNEL IN LATVIA: ECONOMETRIC ESTIMATIONS AND RESULTS

4.1 Data Issues

The analysis is performed using quarterly data for the period from the second quarter of 1998 until the fourth quarter of 2006 (35 observations). Data on loans and bank specific characteristics are computed from the monthly bank statements submitted to the Bank of Latvia and FCMC by each bank. The sample covers all banks that were operating for at least 12 quarters during the observation period. Branches of foreign banks were not included in the analysis due to the lack of separately recorded capital in their balance sheets. We treat mergers in such a way that banks involved in a merger are consolidated and subsequently reported under the absorbing bank for the whole sample period. Thus, banks that were absorbed are not included in the original sample, which consists of 23 independent banks. To increase the number of observations, the estimation was done for an unbalanced sample. Moreover, despite the rapid development and transformation of the Latvian banking sector during the observation period, identification and exclusion of outliers was not done.

As already noted in Section 3, there are two monetary policy indicators in our model due to the need to distinguish between the effect of foreign monetary policy and Bank of Latvia's monetary policy on domestic interest rates under fixed exchange rate regime.

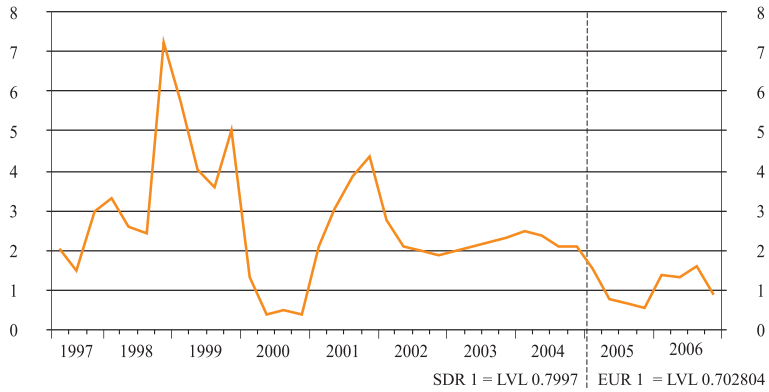
– Foreign monetary policy is represented by changes in EURIBOR 3M interest rate (prior to 2005, a synthetic LIBOR SDR 3M interest rate was used).

[10] It is still possible that the loan growth of the largest banks have some influence on domestic variables. However, the exclusion of domestic macroeconomic variables from the instrument list has a negligible effect on the results.

[11] See (1) for test description.

– The remaining part is represented by changes in the spread between RIGIBOR 3M interest rate and foreign monetary policy indicator (see Chart 4.1). This spread is partly determined by the Bank of Latvia's monetary policy, although there is a substantial influence of other factors as well, e.g. the exchange rate risk or differences in the ratings of Latvian and foreign banks; in addition, the domestic money market is small and fragmented. Consequently, the spread between RIGIBOR 3M and EURIBOR 3M is not only the outcome of Bank of Latvia's monetary policy decisions, and we would rather interpret this variable as a domestic monetary shock.

Chart 4.1
Spread between 3-month RIGIBOR and 3-month foreign interest rate (SDR LIBOR prior to 2005, EURIBOR afterwards)
(in percentage points)



Sources: Bank of Latvia and ECB.

Real income and price variables are constructed as a weighted average of sectoral value added and deflators (real wage rate and CPI used for households), as discussed in Section 3.

It is worth mentioning that data can be subject to the seasonality problem. A way to deal with it is to include seasonal dummies in equation [1] as was done by J. Topi and J. Vilmunen (32), or S. Kaufmann (23). However, it is possible that seasonality will not be adequately handled by including seasonal dummies due to a specific seasonal pattern of some banks, and seasonal dummies should be used for each bank individually.(16) Unfortunately, the inclusion of individual seasonal dummies will significantly increase the number of estimated parameters. Therefore, similar to C. Horváth et al. (17), we seasonally adjusted all balance sheet and macroeconomic variables using X-12-ARIMA programme.

4.2 Bank Loans to Residents

In the remaining part of Section 4, we present the panel estimation results of equation [1] for the growth of bank loans in Latvia. At first, we examine the loan growth function for total loans to resident non-MFIs (excluding government) as well as the growth of loans separately in lats and in foreign currency. To get a further insight, loans to domestic households and domestic non-financial corporations are analysed.

The m1 and m2 tests indicate that the first-order autocorrelation is present in residuals, while the second-order autocorrelation is not. As noted before, the presence of the first-order autocorrelation does not imply inconsistency of the estimates. However, the presence of the second-order autocorrelation would imply

inconsistency. The Sargan test statistics suggest that a chosen set of instruments is valid.

Table 4.1

Loans to resident non-MFIs in lats and foreign currency

(long-term coefficients, *p*-values in parentheses)
Dependent variable: growth of loans to resident non-MFIs in lats and foreign currency $(\Delta \ln x_{i,t})$
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
	all 4	size	liquidity	capitalisation	ownership
Domestic monetary shock (ΔMP_t^{LV})	–0.0062	–0.0070	–0.0023	–0.0226	–0.0047
	(0.678)	(0.762)	(0.904)	(0.307)	(0.882)
Foreign monetary policy (ΔMP_t^{*})	–0.0256	0.0226	0.0014	–0.0229	0.0682
	(0.584)	(0.803)	(0.985)	(0.668)	(0.411)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	0.0171	–0.0076			
	(0.321)	(0.585)			
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	0.0837		0.0328		
	(0.234)		(0.666)		
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.3980**			**0.2848**	
	(0.055)			**(0.042)**	
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.1837				0.1477
	(0.261)				(0.478)
Real income growth $(\Delta \ln Y_t)$	–0.1467	0.1220	–0.1350	–0.4857	0.1126
	(0.860)	(0.914)	(0.902)	(0.565)	(0.929)
Price level growth $(\Delta \ln P_t)$	**3.4359**	**2.7843**	**3.3980**	**2.0969**	**3.8637**
	(0.004)	**(0.058)**	**(0.034)**	**(0.060)**	**(0.026)**
Size $(Size_{i,t})$	–0.0713	**–0.2021**			
	(0.143)	**(0.054)**			
Liquidity $(Liq_{i,t})$	**0.5442**		**0.9346**		
	(0.001)		**(0.000)**		
Capitalisation $(Cap_{i,t})$	0.2938			**0.5512**	
	(0.236)			**(0.058)**	
Foreign ownership $(F_{i,t})$	0.0021				**–0.5614**
	(0.991)				**(0.018)**
m1 ~ N(0,1)	–2.528	–2.438	–2.549	–2.491	–2.536
	(0.011)	(0.015)	(0.011)	(0.013)	(0.011)
m2 ~ N(0,1)	–1.284	–1.227	–1.392	–1.341	–1.656
	(0.199)	(0.220)	(0.164)	(0.180)	(0.098)
Joint Wald test ~ χ^2	4926.0	903.2	310.7	133.4	149.7
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sargan (2^{nd} step) ~ χ^2	1.869	6.199	11.730	15.610	8.834
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	739	739	739	739	739
Number of banks	23	23	23	23	23

Table 4.1 shows the panel regression estimates of equation [1] for total loans to resident non-MFIs both in lats and foreign currency. We present 5 alternative equations: column (a) contains an equation that includes all four bank individual characteristics (size, liquidity, capitalisation and foreign ownership), while

columns (b) to (e) contain equations with only one characteristic. It should be noted that from this point on only the long run coefficients of loan growth equations will be discussed[12], while the short run coefficients are shown in Appendix 1.

The effect of foreign monetary policy on the growth of total loans is not statistically significant in all five equations. Moreover, the signs of the foreign monetary policy effect vary from one specification to another. Similar results are obtained for the average effect of a domestic monetary shock. Although the effect in all equations is negative, the impact of the domestic monetary shock is statistically significant in none of the alternative equations.

As regards the asymmetric effect of domestic monetary shock, all coefficients before the interaction terms of domestic monetary shock with bank specific variables appear to have positive signs consistently with theoretical assumptions. However, the only characteristic that appears to have statistically significant impact on bank reaction to a monetary shock is capitalisation. This result does not depend on specification (the effect is statistically significant both in column (a) and (d)), suggesting that banks with higher capitalisation on average reduce the supply of total loans by a lesser amount after a domestic monetary shock.

The growth of loans is also driven by macroeconomic variables, with estimation results indicating a positive elasticity of the total loan growth to price changes. Moreover, the elasticity coefficient on price growth is very high and exceeds 1, varying from 2.1 to 3.9 in different specifications. It is possible however, that such a high elasticity of price growth comes at the cost of underestimated elasticity of income, as the coefficients before real income are not statistically significant and even negative in some columns. Moreover, we should not forget about real estate prices, which increased much more rapidly than consumer prices and deflators. In any case, the elasticity of total loans to changes in nominal income (which is the sum of real income and price changes) still exceeds 1 and is statistically significant.[13] Obviously, such a high elasticity can be explained by the rapid expansion of bank loans during the observed period and the increase of loan rate to GDP.

The final block of explanatory variables contains individual bank characteristics. All individual characteristics have a significant effect on loan growth in columns (b) to (e), with a positive impact for liquidity and capitalisation, and a negative one for size and foreign ownership. However, only liquidity appears to have a significant effect on loan growth in the specification with all 4 individual variables included. The results of column (a) confirm that more liquid banks report on average a higher growth of loan portfolios.[14]

In column (a), there is still a negative and almost statistically significant linear relationship between the bank size and growth rate of total loans. One possible explanation mentioned by M. Köhler et al. (24) is that smaller banks lend more

[12] The long-term coefficient of a variable is computed as the sum of its coefficients (lags and current values) divided by 1 minus the sum of the coefficients of lags of the dependent variable. The significance of long-term coefficients is tested using the Wald test.

[13] Elasticity of the nominal income in column (a) is 3.3 and *p*-value is 0.001, according to the Wald test.

[14] Similar results were obtained by other researchers for some euro area countries. See, for example, J. Topi and J. Vilmunen (32).

aggressively to private borrowers in order to increase their market share. It is interesting that such negative relationship is not unique for Latvia and has been also reported by A. Pruteanu (30) for the Czech banking sector and by J. Topi and J. Vilmunen (32) for Finland.

Summarising the results for total loans to resident non-MFIs, we can conclude that the total loan growth on average is not significantly affected by a monetary shock, either foreign or domestic. However, there is some evidence of an asymmetric reaction of the loan supply to a domestic monetary shock, which could be an evidence of the bank lending channel in Latvia. In addition, total loans are driven by price changes as well as liquidity of individual banks.

Although we have already obtained some evidence on the bank lending channel, further investigation is needed to get robust evidence on asymmetric reaction to a domestic monetary shock. It would be reasonable to distinguish between loans issued in lats and loans issued in foreign currencies, as one would expect the bank lending channel to be pronounced for loans in lats but not for loans in foreign currency. Consequently, our next step is to perform a similar analysis of the growth of loans to resident non-MFIs issued in lats, and Table 4.2 shows the estimation results of this analysis.

As in Table 4.1, the growth of loans in lats is not statistically significantly dependent on foreign interest rate changes, although the coefficients are negative in all five specifications. The effect of the difference between domestic and foreign interest rates on the growth of loans in lats is negative, with coefficients varying from –0.025 in column (e) to –0.047 in column (b). At the same time, the reaction of loan growth to the domestic monetary shock is statistically significant in column (d), and *p*-values are not very high in columns (a) and (b). If we focus on equation which includes all four bank specific variables, we can conclude that an increase in the difference between RIGIBOR 3M and EURIBOR 3M decreases quarterly growth of lats loan portfolio of an average bank by 3.9 percentage points. However, statistical significance of this result is weak, perhaps due to the dynamic transformation of Latvia's banking sector and a rapid expansion of bank loans during the observed period. High volatility of the domestic monetary shock indicator at the beginning of the sample period (see Chart 4.1) could be another reason for insignificant results.

It is worth stressing that the above chart characterises an effect on loan portfolio of a bank with an average size, liquidity, capitalisation and no foreign ownership. Therefore this chart does not, in any way, indicate the effect on total loans in lats, as different banks have different shares in the total loan portfolio. The effect on total loans in lats could be derived only after investigating the asymmetric reaction of individual banks to a domestic monetary shock.

Turning to the asymmetric reaction of different banks to a domestic monetary shock, there is a statistically significant difference depending on the level of capitalisation as in the case of total loans. Namely, banks with relatively higher capitalisation are less sensitive to changes in the spread between domestic and foreign interest rates, which could be explained by easier access to alternative financing. This effect appears to be statistically significant both in column (a) and in column (d). In addition, the coefficients before the interaction term are higher than in Table 4.1. Other bank specific characteristics do not appear to be statistically significant, however almost all coefficients before interaction terms are positive, as was

expected theoretically. So, there is also a tendency (although not statistically significant) that banks which are large, have higher liquidity or are owned by foreign MFIs are less sensitivity to a domestic monetary shock and thus also to domestic monetary policy.

Table 4.2

Loans to resident non-MFIs in lats

(long-term coefficients, *p*-values in parentheses)
Dependent variable: growth of loans to resident non-MFIs in lats $(\Delta \ln x_{i,t})$
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
	all 4	size	liquidity	capitalisation	ownership
Domestic monetary shock (ΔMP_t^{LV})	–0.0389	–0.0472	–0.0278	**–0.0449**	–0.0245
	(0.213)	(0.113)	(0.383)	**(0.078)**	(0.451)
Foreign monetary policy (ΔMP_t^{*})	–0.0211	–0.0047	–0.0306	–0.0243	–0.002
	(0.762)	(0.959)	(0.694)	(0.802)	(0.982)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	0.0144	–0.0141			
	(0.702)	(0.582)			
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	0.0919		0.0549		
	(0.447)		(0.640)		
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.5435**			**0.4164**	
	(0.089)			**(0.050)**	
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.3262				0.1452
	(0.148)				(0.594)
Real income growth $(\Delta \ln Y_t)$	0.8577	0.4647	–0.1583	0.2159	0.4051
	(0.513)	(0.716)	(0.896)	(0.843)	(0.753)
Price level growth $(\Delta \ln P_t)$	1.3294	–1.0961	0.2568	–0.5034	–1.1861
	(0.429)	(0.500)	(0.876)	(0.702)	(0.405)
Size $(Size_{i,t})$	–0.0554	**–0.225**			
	(0.562)	**(0.013)**			
Liquidity $(Liq_{i,t})$	0.3971		**1.2664**		
	(0.128)		**(0.058)**		
Capitalisation $(Cap_{i,t})$	0.5389			**0.9357**	
	(0.270)			**(0.060)**	
Foreign ownership $(F_{i,t})$	0.1299				–0.2296
	(0.404)				(0.415)
m1 ~ N(0,1)	–2.101	–2.021	–2.109	–2.11	–2.045
	(0.036)	(0.043)	(0.035)	(0.035)	(0.041)
m2 ~ N(0,1)	–1.414	–1.741	–1.328	–1.482	–1.638
	(0.157)	(0.082)	(0.184)	(0.138)	(0.101)
Joint Wald test ~ χ^2	571600	32.8	169.9	68.8	39
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
Sargan (2nd step) ~ χ^2	1.058	7.595	9.552	10.77	8.918
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	728	728	728	728	728
Number of banks	23	23	23	23	23

The existence of an asymmetric effect has a very important practical implication for monetary policy in Latvia. It was shown above that the domestic monetary shock

has a negative effect on the growth of lats loans of an average bank. However, if the largest share of domestic credit market is occupied by banks which are large, have relatively high liquidity or capitalisation, or are owned by non-residents, the effect of domestic monetary shock on loan growth will be reduced. Obviously, the opposite case will mean the increased importance of the domestic monetary shock. To find out which case is prevailing in Latvia, we calculated the weighted average reaction of lats loan growth for banks with large, medium and small share on the domestic lats loan market. Table 4.3 shows the results of these calculations (note that all calculations use 2006 data).

Table 4.3

Asymmetric impact of monetary shock on banks with large, medium and small share in lats loans market in Latvia in 2006

(changes in quarterly growth of loans in lats at a 1.0 percentage point increase in spread between RIGIBOR 3M and EURIBOR 3M)

	Share of loans in lats (%)	Reaction to monetary shock (%)	*p*-value
1. Banks with large share	54.2	5.99	0.491
2. Banks with medium share	29.5	–7.88	0.020
3. Banks with small share	16.2	–5.42	0.149
All banks	**100.0**	**0.46**	**0.876**

The first group of banks with the highest presence in the domestic lats loan market consists of banks that issue more than a half of loans in lats to resident non-MFIs. The average reaction of these banks to a monetary shock is even positive, although not statistically significant, indicating their indifference to domestic monetary shocks. Relatively lower liquidity and capitalisation of these banks is compensated by their size and foreign ownership providing the access to alternative financing.

The second group of banks with a medium share in the domestic market consists of banks that issue approximately one third of total loans in lats. These banks are negatively and statistically significantly affected by a domestic monetary shock (an increase of interest rate spread by 1.0 percentage point decreases the quarterly growth of loans by 7.9 percentage points), which could be explained by lower capitalisation and liquidity.

The last group of banks with small presence in the market consists of the remaining banks. These banks capture only 16% of loans in last to resident non-MFIs and are negatively affected by a monetary shock (an increase of interest rate spread by 1.0 percentage point decreases the quarterly growth of loans by 5.4 percentage points); this effect, however, is not statistically significant. While the banks of the last group are small, higher capitalisation and liquidity levels reduce their sensitivity to domestic monetary shocks.

Although some banks have a statistically significant negative reaction to a monetary shock, the weighted average reaction of the total lats loan growth is very small and not statistically significant mainly due to the reaction of the first group consisting of large and foreign owned banks. As a result, we can conclude that the domestic monetary shock and hence also Latvia's monetary policy do not have a significant effect on the growth of total loans in lats. However, a domestic monetary shock has a distribution effect – it will affect banks that are small, domestically owned and have lower liquidity or capitalisation.

Turning back to the results shown in Table 4.2, the demand effect of loans in lats appears to be insignificant, although the elasticity of both the real income growth and price rises is positive in column (a). Although the bank size, liquidity and capitalisation have statistically significant linear relationship with the growth of loans in lats in columns (b) to (d), only the liquidity variable has a weak statistical significance in column (a), implying that more liquid banks have on average a higher growth of loans in lats.

Although some interesting results have been obtained for the growth of loans in lats, it is worth mentioning that the loans in lats represent only one-forth of total loans to non-MFI residents; their importance is decreasing over time. Therefore, it is important to investigate the growth of loans to resident non-MFIs issued in foreign currency, and Table 4.4 shows the estimation results. According to them, loans in foreign currency are not statistically significantly affected by foreign monetary policy. Moreover, the effect of a domestic monetary shock is insignificant, too. That is why we failed to find an empirical evidence of a substitution effect, although the theory predicts the replacement of loans in domestic currency with loans in foreign currency under the fixed exchange regime when the interest rate spread is changing. This can be partly determined by the fact that the observation period mainly covers the time when the lats was fixed to SDR, and the exchange risk was significantly higher than after its re-pegging to euro. Furthermore, the substitution effect can be clearly seen for the end of 2006 and beginning of 2007, when the structure of loans changed in favour of loans in foreign currency due to the increasing interest rate spread.

We found that a monetary shock is irrelevant not only for the average growth of loans in foreign currencies, but also for individual banks, as all coefficients before interaction terms are statistically insignificant and there are no signs of asymmetry in bank reaction to a domestic monetary shock.

Loans in foreign currency are rather sensitive to changes in prices, however. Elasticities are very high and exceed 1, varying from 2.4 to 4.5 depending on specification. Similar to Table 4.1, these high elasticities possibly come at the cost of underestimated elasticity of real income, as the coefficients before real income are not statistically significant. However, the sum of two elasticities, indicating elasticity of loans to nominal income, exceeds 1 and is statistically significant.[15]

As in Table 4.1, the banks with a relatively high ratio of liquid assets to total assets have a tendency to increase their loans in foreign currency more rapidly, while the large banks have lower growth of loans.

We can make some intermediate conclusions at this point. First, there is some evidence of a bank lending channel in Latvia, as reaction of total loans to a domestic monetary shock is asymmetric where banks with a relatively higher level of capitalisation are less sensitive to a domestic monetary shock (and there is some weak evidence that the size, liquidity and foreign ownership are also important for the effect of a monetary shock).

[15] Elasticity of the nominal income in column (a) is 4.6 and *p*-value is 0.001 according to the Wald test.

Table 4.4

Loans to resident non-MFIs in foreign currency

(long-term coefficients, *p*-values in parentheses)
Dependent variable: growth of loans to resident non-MFIs in foreign currency $(\Delta \ln x_{i,t})$
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
	all 4	size	liquidity	capitalisation	ownership
Domestic monetary shock (ΔMP_t^{LV})	0.0017	–0.0163	–0.0129	–0.0216	0.0018
	(0.930)	(0.615)	(0.642)	(0.364)	(0.957)
Foreign monetary policy (ΔMP_t^{*})	–0.0534	0.0436	0.0302	–0.0330	0.0794
	(0.496)	(0.714)	(0.785)	(0.708)	(0.511)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{it})$	0.0020	0.0114			
	(0.915)	(0.457)			
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	–0.0775		–0.0846		
	(0.346)		(0.206)		
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	–0.0762			–0.1297	
	(0.812)			(0.627)	
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	–0.0234				0.0150
	(0.876)				(0.929)
Real income growth $(\Delta \ln Y_t)$	0.0484	–0.6754	–0.5181	–0.6433	–0.6123
	(0.956)	(0.441)	(0.595)	(0.491)	(0.512)
Price level growth $(\Delta \ln P_t)$	**4.5220**	**3.9054**	**3.5821**	**2.3882**	**4.2409**
	(0.001)	**(0.008)**	**(0.017)**	**(0.022)**	**(0.006)**
Size $(Size_{i,t})$	**–0.1077**	–0.1548			
	(0.089)	(0.115)			
Liquidity $(Liq_{i,t})$	**0.5449**		**0.7220**		
	(0.002)		**(0.006)**		
Capitalisation $(Cap_{i,t})$	0.1004			0.4226	
	(0.646)			(0.121)	
Foreign ownership $(F_{i,t})$	0.1176				**–0.4967**
	(0.615)				**(0.030)**
m1 ~ N(0,1)	–2.714	–2.631	–2.712	–2.660	–2.687
	(0.007)	(0.009)	(0.007)	(0.008)	(0.007)
m2 ~ N(0,1)	–1.028	–0.951	–0.966	–1.043	–1.128
	(0.304)	(0.342)	(0.334)	(0.297)	(0.259)
Joint Wald test ~ χ^2	1059.0	178.8	90.2	35.2	81.1
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Sargan (2nd step) ~ χ^2	1.235	8.848	8.570	10.180	9.407
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	739	739	739	739	739
Number of banks	23	23	23	23	23

These results are mainly in line with other empirical evidence on European countries, although researchers usually emphasise the importance of liquidity level for the bank lending channel (10; 16; 25). However, there is also evidence that banks with different capitalisation have different sensitivity to monetary policy in other countries as well.(14; 13; 17; 19)

Overall, a domestic monetary shock does not have a significant effect on the total growth of loans in lats. However, the domestic monetary shock has a distribution effect by affecting the banks that are small, domestically owned and have lower liquidity or capitalisation. This asymmetric effect is pronounced for the loans issued in lats, while there is no statistically significant asymmetry in the reaction of loans issued in foreign currency. As a result, we can conclude that the bank lending channel is limited only for the supply of lats loans and it dramatically reduces the significance of this channel.

4.3 Bank Loans to Households and Non-Financial Corporations

In the previous section the focus was on total loans in lats and in foreign currency without a breakdown by sector. However, such breakdown could give some additional useful information about the lending channel in Latvia. As the results of previous analysis indicate that the bank lending channel is active for the supply of loans in lats, we will only focus on loans in lats and divide them into loans to households and loans to non-financial corporations.

Table 4.5 shows the results for the growth of loans in lats to domestic households. Similar to the results presented in Table 4.2, the effect of foreign monetary policy on the growth of loans to households is negative, although not statistically significant. The same is true of the domestic monetary shock, which affects loans to households negatively (except column (a)) but not statistically significantly.

The asymmetric effect of a domestic monetary shock on loans to households is more pronounced however, as now two characteristics – capitalisation and liquidity – are important for sensitivity of an individual bank to domestic monetary shock. This shows that the lending channel operates for the loans to domestic households in lats. Moreover, now the importance of liquidity in asymmetric reaction is in line with other research carried out on the European banking sectors mentioned above.

In contrast to the previous results, the growth of loans to households is related to changes in real income whose elasticity is rather high and exceeds 1. The same is true of price growth in column (a), although the long term coefficient is not statistically significant.

As in other equations, the growth of loans to households is positively and statistically significantly affected by liquidity. Moreover, there are signs that the level of bank capitalisation is important for the growth rates of loans to households as well.

Table 4.5

Loans to resident households in lats

(long-term coefficients, *p*-values in parentheses)
Dependent variable: growth of loans to resident households in lats $(\Delta \ln x_{i,t})$
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
	all 4	size	liquidity	capitalisation	ownership
Domestic monetary shock (ΔMP_t^{LV})	0.0024	–0.0196	–0.0097	–0.0188	–0.0020
	(0.937)	(0.607)	(0.787)	(0.576)	(0.955)
Foreign monetary policy (ΔMP_t^{*})	–0.0291	–0.0487	–0.1227	–0.1047	–0.0475
	(0.633)	(0.484)	(0.193)	(0.242)	(0.561)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	0.0161	–0.0214			
	(0.604)	(0.326)			
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	**0.2115**		**0.2030**		
	(0.016)		**(0.067)**		
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.4780**			**0.3571**	
	(0.085)			**(0.018)**	
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.0126				–0.1410
	(0.961)				(0.616)
Real income growth $(\Delta \ln Y_t)$	**2.7335**	2.0577	1.8019	1.6137	**2.6386**
	(0.034)	(0.199)	(0.289)	(0.285)	**(0.074)**
Price level growth $(\Delta \ln P_t)$	1.5916	–3.1254	–5.7338	–1.2799	–2.8019
	(0.728)	(0.649)	(0.339)	(0.832)	(0.601)
Size $(Size_{i,t})$	–0.0325	–0.1924			
	(0.764)	(0.229)			
Liquidity $(Liq_{i,t})$	**0.4717**		**0.7681**		
	(0.032)		**(0.078)**		
Capitalisation $(Cap_{i,t})$	0.6053			**0.8553**	
	(0.195)			**(0.077)**	
Foreign ownership $(F_{i,t})$	–0.2492				–0.5369
	(0.407)				(0.164)
m1 ~ N(0,1)	–2.728	–2.669	–2.770	–2.690	–2.670
	(0.006)	(0.008)	(0.006)	(0.007)	(0.008)
m2 ~ N(0,1)	–0.319	–0.109	–0.461	–0.095	–0.282
	(0.750)	(0.913)	(0.645)	(0.924)	(0.778)
Joint Wald test ~ χ^2	37010.0	38.2	35.0	25.0	50.2
	(0.000)	(0.000)	(0.001)	(0.023)	(0.000)
Sargan (2^{nd} step) ~ χ^2	0.025	10.690	10.560	8.779	11.240
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	727	727	727	727	727
Number of banks	23	23	23	23	23

The growth of loans in lats to resident non-financial corporations appears to be independent of interest rate changes (see Table 4.6). Also, there are some signs of asymmetric reaction of bank loans to a domestic monetary shock, as the only coefficient before the capitalisation interaction term is statistically significant in column (d), and almost statistically significant in column (a).

Table 4.6

Loans to resident non-financial corporations in lats

(long-term coefficients, *p*-values in parentheses)
Dependent variable: growth of loans to resident non-financial corporations in lats $(\Delta \ln x_{i,t})$
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
	all 4	size	liquidity	capitalisation	ownership
Domestic monetary shock (ΔMP_t^{LV})	0.0067	0.0209	0.0253	0.0105	0.0317
	(0.844)	(0.660)	(0.566)	(0.784)	(0.465)
Foreign monetary policy (ΔMP_t^{*})	0.0790	0.1657	0.0954	0.1915	0.1827
	(0.467)	(0.380)	(0.588)	(0.324)	(0.318)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	–0.0065	–0.0217			
	(0.699)	(0.237)			
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	0.0320		–0.0065		
	(0.822)		(0.973)		
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	0.2830			**0.3721**	
	(0.109)			**(0.044)**	
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.2777				0.0749
	(0.371)				(0.781)
Real income growth $(\Delta \ln Y_t)$	–0.6098	–1.0984	–1.0138	–0.8955	–1.0436
	(0.562)	(0.468)	(0.436)	(0.552)	(0.475)
Price level growth $(\Delta \ln P_t)$	4.9744	5.8528	5.6989	6.1028	5.2826
	(0.302)	(0.344)	(0.345)	(0.285)	(0.314)
Size $(Size_{i,t})$	–0.0172	–0.0964			
	(0.902)	(0.661)			
Liquidity $(Liq_{i,t})$	**0.6104**		**1.1058**		
	(0.007)		**(0.051)**		
Capitalisation $(Cap_{i,t})$	0.3304			0.3758	
	(0.450)			(0.340)	
Foreign ownership $(F_{i,t})$	–0.2331				**–0.7613**
	(0.429)				**(0.009)**
m1 ~ N(0,1)	–2.757	–2.731	–2.687	–2.773	–2.780
	(0.006)	(0.006)	(0.007)	(0.006)	(0.005)
m2 ~ N(0,1)	–0.902	–0.923	–1.005	–0.921	–0.966
	(0.367)	(0.356)	(0.315)	(0.357)	(0.334)
Joint Wald test ~ χ^2	1044.0	127.9	173.6	47.7	39.4
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sargan (2nd step) ~ χ^2	1.245	9.576	7.244	9.085	7.650
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	698	698	698	698	698
Number of banks	23	23	23	23	23

Surprisingly, the loans to non-financial corporations are not statistically significantly affected by real income or price growth. Elasticities on price changes are positive and very high, although not statistically significant, while those on real income are even negative and not statistically significant. The only variable with a significant effect on the growth of loans to non-financial corporations is liquidity, which has the usual positive influence, and foreign ownership, which has a negative effect (although it is not statistically significant in column (a)).

These results confirm our previous conclusion about the existence of the bank lending channel for the loans issued in lats. Moreover, it shows that the bank lending channel is active for loans to households, while there is also some evidence of asymmetric effect of a domestic monetary shock on loans to non-financial corporations.

5. ROBUSTNESS CHECK

5.1 Alternative Specifications

To perform a robustness check of the results presented in Section 4, we use some alternative specifications of the panel regression presented in equation [1]. First, we relax the assumption that the demand for loans is independent of bank specific characteristics. Second, in order to check whether interest rates, price and real income are sufficient to account for the impact of the macroeconomic environment on loan growth, time dummies are included instead of the abovementioned variables.

It is possible that elasticities of loan growth to real income and the price changes differ across banks with various individual characteristics. In this case, we need to modify equation [1] and to include interactions between bank specific characteristics and demand variables (price and real income) in the model:

$$\Delta \ln x_{i,t} = \mu_i + \sum_{j=1}^{k} \alpha_j \Delta \ln x_{i,t-j} + \sum_{j=1}^{k} \beta_j^{*} \Delta MP_{t-j}^{*} + \sum_{j=1}^{k} \beta_j^{LV} \Delta MP_{t-j}^{LV} +$$
$$+ \sum_{j=1}^{k} \varphi_j \Delta \ln Y_{t-j} + \sum_{j=1}^{k} \phi_j \Delta \ln P_{t-j} + \sum_{j=1}^{k} \lambda_j Z_{i,t-j} + \sum_{j=1}^{k} \gamma_j Z_{i,t-j} \Delta MP_{t-j}^{LV} +$$
$$+ \sum_{j=1}^{k} \delta_j Z_{i,t-j} \Delta \ln Y_{t-j} + \sum_{j=1}^{k} \eta_j Z_{i,t-j} \Delta \ln P_{t-j} + \varepsilon_{i,t} \qquad [6].$$

The empirical results of the modified model [6] are presented in Appendix 2, Table A6.1. Although there is some evidence of an asymmetric demand reaction (higher elasticity to price changes for banks with higher level of liquidity for loans in lats as well as higher elasticity to price changes for banks with higher level of capitalisation for loans in foreign currency), the main conclusions from Section 4 are still valid. Banks with higher level of capitalisation have a lower reaction to a domestic monetary shock that is pronounced for loans issued in lats, especially for loans issued to domestic households. In addition, Table A6.1 indicates that the level of liquidity also drives sensitivity of loans to changes in domestic interest rates, as in response to a restrictive monetary shock more liquid banks display a smaller diminishing of lats loans.

Another robustness check is to use dummies for every observation period instead of monetary shocks and demand variables.(25) If the latter are sufficient, the results of both models with regard to the interaction coefficients should be comparable:

$$\Delta \ln x_{i,t} = \mu_i + \sum_{j=1}^{k} \alpha_j \Delta \ln x_{i,t-j} + \sum_{j=1}^{k} \beta_j^{*} \Delta MP_{t-j}^{*} + \sum_{j=1}^{k} \beta_j^{LV} \Delta MP_{t-j}^{LV} +$$
$$+ \sum_{j=1}^{k} \varphi_j \Delta \ln Y_{t-j} + \sum_{j=1}^{k} \phi_j \Delta \ln P_{t-j} + \sum_{j=1}^{k} \lambda_j Z_{i,t-j} + \sum_{j=1}^{k} \gamma_j Z_{i,t-j} \Delta MP_{t-j}^{LV} + d_t + \varepsilon_{i,t} \qquad [7]$$

where d_t denotes time dummies.

Table A6.2 in Appendix 2 shows the empirical results of equation [7] with the time dummies without interaction terms between individual bank characteristics and demand variables, while Table A6.3 shows the model which allows for an asymmetric reaction of the loan demand. These results also confirm the existence of the lending channel in Latvia, as banks with higher capitalisation and liquidity show weaker reaction to the domestic monetary shock both in Table A6.2 and Table A6.3. As before, this is valid for loans issued in lats to domestic households, with some weak evidence of the existing lending channel for loans in lats to non-financial corporations. Liquidity is also an important factor for the overall growth of loans (see Table A6.2). As in Section 4, there are signs of a negative link between the size of a bank and the quarterly growth of loans. Finally, it should be noted that Table A6.3 points to some degree of asymmetry in the demand for loans, this being especially pronounced in the equation describing the growth of loans in lats to domestic households.

5.2 Robustness of the Results for Different Time Periods

Although the period of our analysis is relatively short, we should take into account that Latvia's banking sector underwent significant changes between 1998 and 2006. Therefore, it is quite possible that the reaction of banking loans differs at the beginning and at the end of the sample period. To check it, we estimated the main panel regression from equation [1] for two different subsamples. The first subsample covers the period from 1998 to 2001, whereas the second subsample starts with the first quarter of 2002. Table A6.4 in Appendix 2 shows the empirical results of the two subsamples.

The results for total loans (columns (a) and (b)) are rather similar for both time periods. In addition to the importance of capitalisation indicated in Section 4, the results in Table A6.4 state statistically significant importance of the bank size for sensitivity to a domestic monetary shock. As expected theoretically, larger banks have weaker reaction to a domestic monetary shock. The level of bank liquidity is an important factor for the total loan growth in both equations.

There is some time instability for the growth of loans in lats as well as for the growth of loans in foreign currency, however. The results in column (c) show the existence of the lending channel for lats loans between 1998 and 2001, while column (d) shows no asymmetries after 2002. Surprisingly, after 2002 there appears an asymmetric reaction in the growth of loans in foreign currency – as usual, banks with higher capitalisation have a weaker reaction to domestic monetary shock.

Finally, we check the time stability of loan growth functions for loans in lats to households and non-financial corporations (see Table A6.5 in Appendix 2). In contrast to Table A6.4 which shows no asymmetric reaction to a monetary shock for loans in lats after 2002, our estimation indicates the existence of the bank lending channel in both periods for loans in lats to domestic households (moreover, the coefficient before the interaction term between a monetary shock and capitalisation is higher in the second period). In addition, there is a sign that capitalisation was an important factor for the sensitivity of loans issued to non-financial corporations in the first period.

Overall, the evidence on the time stability of bank lending channel in Latvia is rather mixed; at the same time, there are some indications that in the last five-year period, compared with 1998–2001, the bank lending channel was less important. It might be due to Latvia's banking sector becoming stronger and healthier, with more foreign capital injections definitely providing additional possibilities of non-deposit financing and higher independence from domestic monetary shocks. However, it is worth mentioning that while the analysis of different subsamples gives some useful information, these conclusions should be taken with great caution, as the number of observations is significantly smaller than in previous estimations.

CONCLUSIONS

In contrast to the traditional interest rate channel, the bank lending channel focuses on a special role of banks in the monetary transmission mechanism. The two necessary conditions for the existence of the bank lending channel are the ability of monetary policy to affect the bank loan supply and the dependency of borrowers on bank loans.

The descriptive evidence on the strength of the lending channel in Latvia is mixed. Most factors such as the market concentration, a high degree of non-resident ownership leading to significant level of liabilities to non-resident MFIs, the low share of lats loans, good quality of the loan portfolio and high profitability indicate that the lending channel should be weak. On the other hand, the high degree of bank dependency of the local borrowers, little government presence as well as decreased liquidity and capital ratios speak in favour of the presence of lending channel.

For empirical investigation of the bank lending channel in Latvia we use the approach that builds on the standard panel regression. The evidence on the bank lending channel is obtained by estimating a bank loan function that takes into account not only the monetary policy indicator and macroeconomic variables, but also bank-specific differences in the lending reaction to monetary policy actions. The main question is whether there are certain types of banks that show a relatively strong decrease in lending after monetary tightening.

The results for total loans to resident non-MFIs in lats indicate that there is some evidence of asymmetric reaction of the loan supply to a domestic monetary shock, which could be an evidence of bank lending channel in Latvia. The lats loan portfolios of the banks with higher capitalisation are less sensitive to changes in the spread between the domestic and foreign interest rates, which could be explained by easier access to alternative financing. There is also a tendency, although not statistically significant, that banks which are larger or have relatively higher liquidity, or are owned by foreign MFIs have weaker sensitivity to a domestic monetary shock. Moreover, the bank lending channel is operating for loans in lats to households, while there is almost no evidence of an asymmetric effect of a domestic monetary shock on loans to non-financial corporations. At the same time, there is no statistically significant asymmetry in the reaction of loans granted in foreign currency.

These results are robust, as the asymmetric reaction to a monetary shock remains significant under different specifications of the panel regression. Moreover, not only capitalisation, but also liquidity and size appear to have a significant impact on bank

sensitivity to domestic interest rate in some specifications. The evidence on the time stability of the bank lending channel in Latvia is rather mixed, and there are some indications that compared with 1998–2001 the bank lending channel has been less important in the last five-year period. It might be due to Latvia's banking sector becoming stronger and healthier, with more foreign capital injections definitely providing additional opportunities for non-deposit financing and higher independence from domestic monetary shocks.

Our analysis shows that although some banks in Latvia have a statistically significant negative reaction to a domestic monetary shock, the weighted average reaction of the total lats loan growth is not statistically significant mainly due to the reaction of the dominating banks. A domestic monetary shock has only a distribution effect and affects banks that are small, domestically owned and have lower liquidity or capitalisation. As this asymmetric effect is not pronounced for loans issued in foreign currency, we can conclude that the bank lending channel is limited only to the supply of lats loans, which dramatically reduces the importance of this channel. Therefore, although there is evidence that the Bank of Latvia's monetary policy can influence the lats loan supply of some banks, transmission through the lending channel stops there, as there is no significant effect on total loans and real economy.

APPENDICES

Appendix 1. Short-term coefficients of panel regressions

Table A1

Loans to resident non-MFIs in lats and foreign currency

Dependent variable: growth of loans to resident non-MFIs in lats and foreign currency $(\Delta \ln x_{i,t})$

Sample period: 1998 Q2–2006 Q4

	Lags	Coefficient	Std. error	*t*-value	*p*-value
Growth of loans $(\Delta \ln x_{i,t})$	1	0.0476	0.0609	0.782	0.435
	2	0.0574	0.0233	2.470	0.014
Domestic monetary shock (ΔMP_t^{LV})	1	–0.0017	0.0083	–0.208	0.835
	2	–0.0038	0.0129	–0.294	0.769
Foreign monetary policy (ΔMP_t^{*})	1	–0.0628	0.0591	–1.060	0.288
	2	0.0399	0.0325	1.230	0.220
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	1	0.0089	0.0100	0.889	0.375
	2	0.0064	0.0095	0.679	0.498
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	1	0.0752	0.0447	1.680	0.093
	2	–0.0003	0.0305	–0.009	0.993
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	1	0.1738	0.0937	1.850	0.064
	2	0.1824	0.0843	2.160	0.031
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	1	0.0339	0.0825	0.411	0.681
	2	0.1305	0.0824	1.580	0.114
Real income growth $(\Delta \ln Y_t)$	1	–0.1622	0.5211	–0.311	0.756
	2	0.0309	0.2594	0.119	0.905
Price level growth $(\Delta \ln P_t)$	1	1.0744	0.7222	1.490	0.137
	2	2.0006	0.6295	3.180	0.002
Size $(Size_{i,t})$	1	–0.0638	0.0421	–1.520	0.130
Liquidity $(Liq_{i,t})$	1	0.4870	0.1221	3.990	0.000
Capitalisation $(Cap_{i,t})$	1	0.2630	0.2187	1.200	0.230
Foreign ownership $(F_{i,t})$	1	0.0019	0.1652	0.011	0.991

Table A2

Loans to resident non-MFIs in lats

Dependent variable: growth of loans to resident non-MFIs in lats $(\Delta \ln x_{i,t})$

Sample period: 1998 Q2–2006 Q4

	Lags	Coefficient	Std. error	*t*-value	*p*-value
Growth of loans $(\Delta \ln x_{i,t})$	1	–0.0077	0.1028	–0.075	0.940
	2	0.0546	0.1520	0.359	0.719
Domestic monetary shock (ΔMP_t^{LV})	1	–0.0121	0.0169	–0.718	0.473
	2	–0.0250	0.0273	–0.914	0.361
Foreign monetary policy (ΔMP_t^{*})	1	–0.0583	0.0792	–0.736	0.462
	2	0.0383	0.0384	0.997	0.319
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	1	0.0185	0.0201	0.920	0.358
	2	–0.0048	0.0218	–0.222	0.825
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	1	0.0355	0.0895	0.397	0.692
	2	0.0521	0.0609	0.854	0.393
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	1	0.3256	0.2106	1.550	0.122
	2	0.1923	0.2012	0.956	0.340
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	1	0.1247	0.1341	0.930	0.353
	2	0.1861	0.1359	1.370	0.171
Real income growth $(\Delta \ln Y_t)$	1	0.2979	0.6859	0.434	0.664
	2	0.5196	0.6499	0.799	0.424
Price level growth $(\Delta \ln P_t)$	1	1.3447	1.1580	1.160	0.246
	2	–0.0777	1.0490	–0.074	0.941
Size $(Size_{i,t})$	1	–0.0528	0.0785	–0.672	0.502
Liquidity $(Liq_{i,t})$	1	0.3784	0.1691	2.240	0.026
Capitalisation $(Cap_{i,t})$	1	0.5136	0.5792	0.887	0.376
Foreign ownership $(F_{i,t})$	1	0.1238	0.1287	0.962	0.336

Table A3

Loans to resident non-MFIs in foreign currency

Dependent variable: growth of loans to resident non-MFIs in foreign currency $(\Delta \ln x_{i,t})$
Sample period: 1998 Q2–2006 Q4

	Lags	Coefficient	Std. error	*t*-value	*p*-value
Growth of loans $(\Delta \ln x_{i,t})$	1	0.0266	0.0509	0.523	0.601
	2	0.0425	0.0229	1.860	0.064
Domestic monetary shock (ΔMP_t^{LV})	1	–0.0028	0.0136	–0.206	0.837
	2	0.0044	0.0136	0.320	0.749
Foreign monetary policy (ΔMP_t^{*})	1	–0.0890	0.0802	–1.110	0.267
	2	0.0393	0.0427	0.919	0.358
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	1	0.0017	0.0122	0.138	0.890
	2	0.0002	0.0108	0.018	0.985
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	1	0.0202	0.0571	0.354	0.723
	2	–0.0923	0.0455	–2.030	0.043
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	1	–0.1124	0.2168	–0.518	0.604
	2	0.0415	0.1032	0.402	0.688
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	1	–0.0834	0.0948	–0.880	0.379
	2	0.0616	0.1024	0.602	0.547
Real income growth $(\Delta \ln Y_t)$	1	–0.0994	0.6116	–0.163	0.871
	2	0.1445	0.2964	0.488	0.626
Price level growth $(\Delta \ln P_t)$	1	1.2838	0.8567	1.500	0.134
	2	2.9256	0.6879	4.250	0.000
Size $(Size_{i,t})$	1	–0.1002	0.0595	–1.680	0.093
Liquidity $(Liq_{i,t})$	1	0.5072	0.1441	3.520	0.000
Capitalisation $(Cap_{i,t})$	1	0.0935	0.2045	0.457	0.648
Foreign ownership $(F_{i,t})$	1	0.1095	0.2147	0.510	0.610

Table A4

Loans to resident households in lats

Dependent variable: growth of loans to resident households in lats $(\Delta \ln x_{i,t})$

Sample period: 1998 Q2–2006 Q4

	Lags	Coefficient	Std. error	*t*-value	*p*-value
Growth of loans $(\Delta \ln x_{i,t})$	1	–0.1370	0.0695	–1.970	0.049
	2	–0.0898	0.1121	–0.801	0.424
Domestic monetary shock (ΔMP_t^{LV})	1	0.0083	0.0228	0.363	0.717
	2	–0.0053	0.0215	–0.248	0.805
Foreign monetary policy (ΔMP_t^{*})	1	0.0186	0.0644	0.290	0.772
	2	–0.0544	0.0720	–0.756	0.450
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	1	0.0105	0.0205	0.514	0.607
	2	0.0092	0.0209	0.442	0.658
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	1	0.2500	0.1340	1.870	0.062
	2	0.0094	0.0876	0.108	0.914
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	1	0.2147	0.1840	1.170	0.244
	2	0.3717	0.2342	1.590	0.113
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	1	–0.0620	0.2277	–0.272	0.785
	2	0.0775	0.1391	0.557	0.578
Real income growth $(\Delta \ln Y_t)$	1	1.5241	0.8986	1.700	0.090
	2	1.8294	1.1420	1.600	0.110
Price level growth $(\Delta \ln P_t)$	1	–5.7185	5.9820	–0.956	0.339
	2	7.6711	5.0650	1.510	0.130
Size $(Size_{i,t})$	1	–0.0398	0.1296	–0.307	0.759
Liquidity $(Liq_{i,t})$	1	0.5787	0.2535	2.280	0.023
Capitalisation $(Cap_{i,t})$	1	0.7426	0.6651	1.120	0.265
Foreign ownership $(F_{i,t})$	1	–0.3058	0.3926	–0.779	0.436

Table A5

Loans to resident non-financial corporations in lats

Dependent variable: growth of loans to resident non-financial corporations in lats $(\Delta \ln x_{i,t})$

Sample period: 1998 Q2–2006 Q4

	Lags	Coefficient	Std. error	*t*-value	*p*-value
Growth of loans $(\Delta \ln x_{i,t})$	1	0.0739	0.0589	1.250	0.210
	2	–0.0026	0.0489	–0.052	0.958
Domestic monetary shock (ΔMP_t^{LV})	1	–0.0087	0.0142	–0.614	0.539
	2	0.0150	0.0368	0.408	0.683
Foreign monetary policy (ΔMP_t^{*})	1	0.0114	0.0632	0.180	0.857
	2	0.0619	0.0808	0.767	0.443
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	1	0.0112	0.0133	0.842	0.400
	2	–0.0173	0.0113	–1.530	0.126
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	1	0.0219	0.1345	0.163	0.871
	2	0.0078	0.0854	0.092	0.927
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	1	0.2517	0.1438	1.750	0.081
	2	0.0112	0.0999	0.112	0.911
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	1	0.1773	0.1769	1.000	0.317
	2	0.0806	0.1459	0.552	0.581
Real income growth $(\Delta \ln Y_t)$	1	–0.5866	0.7492	–0.783	0.434
	2	0.0203	0.2821	0.072	0.943
Price level growth $(\Delta \ln P_t)$	1	1.8618	2.1830	0.853	0.394
	2	2.7579	2.4790	1.110	0.266
Size $(Size_{i,t})$	1	–0.0159	0.1294	–0.123	0.902
Liquidity $(Liq_{i,t})$	1	0.5669	0.2029	2.790	0.005
Capitalisation $(Cap_{i,t})$	1	0.3069	0.4121	0.745	0.457
Foreign ownership $(F_{i,t})$	1	–0.2165	0.2701	–0.801	0.423

Appendix 2. ALTERNATIVE SPECIFICATIONS OF PANEL REGRESSIONS

Table A6.1

Bank loan functions with asymmetric demand reaction

(long-term coefficients, *p*-values in parentheses)
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
Dependent variable: growth of loans $(\Delta \ln x_{i,t})$	total in lats and foreign currency	total in lats	households in lats	other residents in lats	total in foreign currency
Domestic monetary shock (ΔMP_t^{LV})	–0.0094	–0.0325	0.0030	0.0005	–0.0035
	(0.516)	(0.176)	(0.920)	(0.987)	(0.848)
Foreign monetary policy (ΔMP_t^{*})	–0.0273	0.0589	–0.0321	0.0862	–0.0629
	(0.563)	(0.479)	(0.581)	(0.436)	(0.403)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	0.0885	0.0749	0.1919	0.0858	0.0169
	(0.387)	(0.501)	(0.986)	(0.910)	(0.885)
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	**0.1215**	**0.1798**	**0.2007**	0.1829	–0.0529
	(0.086)	**(0.074)**	**(0.044)**	(0.201)	(0.529)
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.4096**	**0.5191**	**0.3799**	0.2623	–0.0735
	(0.056)	**(0.054)**	**(0.081)**	(0.257)	(0.770)
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.1883	0.3090	–0.1794	0.4023	0.0187
	(0.222)	(0.168)	(0.455)	(0.181)	(0.895)
Real income growth $(\Delta \ln Y_t)$	0.0337	1.3941	0.0894	–2.0374	0.0351
	(0.977)	(0.185)	(0.971)	(0.431)	(0.976)
Price level growth $(\Delta \ln P_t)$	**2.8793**	0.3895	0.3413	5.1358	**4.3787**
	(0.015)	(0.810)	(0.945)	(0.369)	**(0.000)**
Size $(Size_{i,t})$	–1.1084	–0.9951	**–2.7902**	0.7742	–0.8700
	(0.301)	(0.467)	**(0.021)**	(0.643)	(0.387)
Liquidity $(Liq_{i,t})$	0.2583	0.0429	5.8234	1.1005	0.0384
	(0.789)	(0.972)	(0.176)	(0.650)	(0.978)
Capitalisation $(Cap_{i,t})$	4.3252	7.3325	–0.3461	–1.7362	1.8305
	(0.320)	(0.112)	(0.928)	(0.848)	(0.670)
Foreign ownership $(F_{i,t})$	5.2034	12.1938	**50.2931**	41.7545	4.7650
	(0.159)	(0.124)	**(0.016)**	(0.208)	(0.303)
Real income growth * Size $(\Delta \ln Y_t \cdot Size_{i,t})$	–6.3636	–3.4606	–43.5901	14.0762	–5.9962
	(0.568)	(0.831)	(0.170)	(0.372)	(0.551)
Price level growth * Size $(\Delta \ln P_t \cdot Size_{i,t})$	11.7273	–5.7509	79.3158	–12.2945	7.4694
	(0.386)	(0.711)	(0.130)	(0.589)	(0.555)
Real income growth * Liquidity $(\Delta \ln Y_t \cdot Liq_{i,t})$	9.0179	12.0314	6.7462	20.5253	8.6216
	(0.314)	(0.249)	(0.468)	(0.244)	(0.504)
Price level growth * Liquidity $(\Delta \ln P_t \cdot Liq_{i,t})$	7.2861	**10.7404**	54.8671	18.8161	2.2946
	(0.302)	**(0.095)**	(0.106)	(0.060)	(0.808)
Real income growth * Capitalisation $(\Delta \ln Y_t \cdot Cap_{i,t})$	–0.0619	–0.0303	–0.0800	–0.0468	–0.0951
	(0.254)	(0.773)	(0.463)	(0.707)	(0.166)
Price level growth * Capitalisation $(\Delta \ln P_t \cdot Cap_{i,t})$	0.3839	0.2842	–0.0092	0.1327	**0.4478**
	(0.028)	(0.390)	(0.968)	(0.564)	**(0.003)**
Real income growth * Foreign ownership $(\Delta \ln Y_t \cdot F_{i,t})$	0.3213	0.8086	0.5312	0.1836	0.1701
	(0.430)	(0.306)	(0.296)	(0.742)	(0.573)
Price level growth * Foreign ownership $(\Delta \ln P_t \cdot F_{i,t})$	–0.1154	–0.3953	–0.4148	–0.6390	0.0592
	(0.717)	(0.265)	(0.355)	(0.107)	(0.902)

	(a)	(b)	(c)	(d)	(e)
m1 ~ N(0,1)	–2.557	–2.154	–2.749	–2.676	–2.684
	(0.011)	(0.031)	(0.006)	(0.007)	(0.007)
m2 ~ N(0,1)	–1.259	–1.953	–0.366	–1.019	–1.022
	(0.208)	(0.051)	(0.714)	(0.308)	(0.307)
Joint Wald test ~ χ^2	282.5	2545.0	105.8	437.1	338.6
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sargan (2nd step) ~ χ^2	0.000	0.000	0.000	0.000	0.000
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	739	728	727	698	739
Number of banks	23	23	23	23	23

Table A6.2

Bank loan functions with time dummies

(long-term coefficients, *p*-values in parentheses)
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
Dependent variable: growth of loans $(\Delta \ln x_{i,t})$	total in lats and foreign currency	total in lats	households in lats	other residents in lats	total in foreign currency
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	0.0218	0.0260	0.0202	–0.0097	0.0038
	(0.221)	(0.384)	(0.511)	(0.573)	(0.839)
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	0.1034	0.1335	**0.2174**	–0.0115	–0.0552
	(0.138)	(0.296)	**(0.013)**	(0.942)	(0.459)
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.4349**	**0.6386**	**0.5326**	0.2508	–0.0725
	(0.041)	**(0.037)**	**(0.060)**	(0.129)	(0.813)
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.0756	0.1952	–0.1641	0.2792	–0.0660
	(0.609)	(0.449)	(0.523)	(0.385)	(0.639)
Size $(Size_{i,t})$	**–0.1066**	–0.0136	–0.0147	–0.1157	**–0.1494**
	(0.017)	(0.898)	(0.893)	(0.205)	**(0.019)**
Liquidity $(Liq_{i,t})$	**0.5265**	**0.6160**	**0.4609**	**0.4428**	**0.5242**
	(0.001)	**(0.089)**	**(0.014)**	**(0.005)**	**(0.007)**
Capitalisation $(Cap_{i,t})$	0.0881	0.5907	0.6823	–0.0349	–0.0820
	(0.699)	(0.294)	(0.127)	(0.916)	(0.637)
Foreign ownership $(F_{i,t})$	0.0060	–0.1483	–0.1984	0.0241	0.1601
	(0.974)	(0.478)	(0.504)	(0.895)	(0.533)
m1 ~ N(0,1)	–2.602	–2.238	–2.881	–2.736	–2.772
	(0.009)	(0.025)	(0.004)	(0.006)	(0.006)
m2 ~ N(0,1)	–0.986	–1.955	–0.281	–0.930	–0.842
	(0.324)	(0.051)	(0.779)	(0.352)	(0.400)
Joint Wald test ~ χ^2	326.1	590.7	72.3	96.5	40.3
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sargan (2nd step) ~ χ^2	0.000	0.000	0.000	0.000	0.000
	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	739	728	727	698	739
Number of banks	23	23	23	23	23

Table A6.3

Bank loan functions with asymmetric demand reaction and time dummies

(long-term coefficients, *p*-values in parentheses)
Sample period: 1998 Q2–2006 Q4

	(a)	(b)	(c)	(d)	(e)
Dependent variable: growth of loans $(\Delta \ln x_{i,t})$	total in lats and foreign currency	total in lats	households in lats	other residents in lats	total in foreign currency
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	0.0203 (0.301)	0.0289 (0.302)	0.0028 (0.918)	0.0009 (0.965)	0.0005 (0.975)
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	**0.1369** **(0.066)**	**0.2183** **(0.056)**	**0.2145** **(0.027)**	0.1504 (0.285)	–0.0313 (0.686)
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.4782** **(0.055)**	**0.6719** **(0.040)**	**0.4127** **(0.049)**	0.2734 (0.256)	–0.0547 (0.823)
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.0725 (0.646)	0.1581 (0.482)	–0.2990 (0.242)	0.3184 (0.263)	–0.0432 (0.761)
Size $(Size_{i,t})$	**–0.1011** **(0.037)**	–0.0341 (0.761)	–0.0643 (0.526)	**–0.1673** **(0.038)**	**–0.1401** **(0.050)**
Liquidity $(Liq_{i,t})$	**0.4420** **(0.002)**	0.3470 (0.288)	0.0718 (0.719)	–0.0791 (0.781)	**0.4656** **(0.000)**
Capitalisation $(Cap_{i,t})$	0.1513 (0.643)	0.5513 (0.468)	0.4709 (0.188)	–0.3169 (0.490)	0.0305 (0.888)
Foreign ownership $(F_{i,t})$	–0.1077 (0.783)	–0.3457 (0.311)	–0.1156 (0.753)	–0.3007 (0.523)	0.1301 (0.819)
Real income growth * Size $(\Delta \ln Y_t \cdot Size_{i,t})$	–1.3830 (0.135)	–1.0508 (0.502)	**–3.2483** **(0.007)**	1.4123 (0.461)	–1.0346 (0.310)
Price level growth * Size $(\Delta \ln P_t \cdot Size_{i,t})$	0.5942 (0.625)	1.3015 (0.427)	**7.5795** **(0.087)**	1.7650 (0.480)	0.1263 (0.938)
Real income growth * Liquidity $(\Delta \ln Y_t \cdot Liq_{i,t})$	1.7998 (0.559)	4.4972 (0.288)	–1.9396 (0.630)	1.8576 (0.726)	0.9057 (0.786)
Price level growth * Liquidity $(\Delta \ln P_t \cdot Liq_{i,t})$	**4.0869** **(0.097)**	**13.6276** **(0.036)**	**45.1147** **(0.007)**	41.7930 (0.162)	3.1132 (0.450)
Real income growth * Capitalisation $(\Delta \ln Y_t \cdot Cap_{i,t})$	–11.7511 (0.220)	–8.8939 (0.627)	**–55.8635** **(0.070)**	12.7249 (0.400)	–10.1962 (0.353)
Price level growth * Capitalisation $(\Delta \ln P_t \cdot Cap_{i,t})$	14.1156 (0.367)	10.4597 (0.578)	**111.8860** **(0.029)**	–0.4703 (0.983)	6.8352 (0.631)
Real income growth * Foreign ownership $(\Delta \ln Y_t \cdot F_{i,t})$	8.0164 (0.505)	17.6505 (0.085)	8.0646 (0.405)	2.0928 (0.891)	5.7259 (0.731)
Price level growth * Foreign ownership $(\Delta \ln P_t \cdot F_{i,t})$	6.7127 (0.436)	0.5250 (0.951)	20.3643 (0.448)	**24.5485** **(0.099)**	5.6683 (0.616)
m1 ~ N(0,1)	–2.622 (0.009)	–2.239 (0.025)	–2.903 (0.004)	–2.678 (0.007)	–2.777 (0.005)
m2 ~ N(0,1)	–1.198 (0.231)	–2.180 (0.029)	–0.460 (0.645)	–1.016 (0.310)	–1.024 (0.306)
Joint Wald test ~ χ^2	444.7 (0.000)	237.8 (0.000)	303.9 (0.000)	286.0 (0.000)	396.5 (0.000)
Sargan (2^{nd} step) ~ χ^2	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
Number of observations Number of banks	739 23	728 23	727 23	698 23	739 23

Table A6.4

Loans to resident non-MFIs in lats and foreign currency: two subsamples

(long-term coefficients, *p*-values in parentheses)

	(a)	(b)	(c)	(d)	(e)	(f)
Dependent variable: growth of loans $(\Delta \ln x_{i,t})$	total loans in lats and foreign currency		total loans in lats		total loans in foreign currency	
Sample period	1998 Q2–2001 Q4	2002 Q1–2006 Q4	1998 Q2–2001 Q4	2002 Q1–2006 Q4	1998 Q2–2001 Q4	2002 Q1–2006 Q4
Domestic monetary shock (ΔMP_t^{LV})	0.0029 (0.905)	0.0158 (0.651)	0.0024 (0.914)	–0.1193 (0.195)	–0.0094 (0.729)	–0.0064 (0.821)
Foreign monetary policy (ΔMP_t^{*})	0.0147 (0.856)	0.0023 (0.962)	**0.1604 (0.047)**	0.1891 (0.322)	–0.1418 (0.234)	0.0432 (0.591)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	**0.0302 (0.067)**	**0.0370 (0.077)**	0.0257 (0.228)	–0.0403 (0.504)	0.0045 (0.791)	0.0335 (0.137)
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	0.1488 (0.122)	0.1131 (0.420)	0.1496 (0.198)	–0.2161 (0.344)	–0.0545 (0.626)	0.0087 (0.933)
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.4610 (0.024)**	**1.3657 (0.017)**	**0.5879 (0.017)**	0.5694 (0.421)	–0.1182 (0.720)	**0.9377 (0.009)**
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.3039 (0.406)	0.2038 (0.292)	0.2276 (0.564)	0.7072 (0.234)	–0.1576 (0.596)	0.0905 (0.601)
Real income growth $(\Delta \ln Y_t)$	–1.2885 (0.120)	–0.3976 (0.725)	0.5800 (0.703)	0.5774 (0.772)	–0.4903 (0.513)	–0.5029 (0.774)
Price level growth $(\Delta \ln P_t)$	**8.4758 (0.003)**	0.8120 (0.355)	**4.8226 (0.083)**	2.5348 (0.408)	5.1754 (0.126)	1.4369 (0.169)
Size $(Size_{i,t})$	0.0066 (0.930)	–0.1380 (0.131)	0.0031 (0.981)	–0.3267 (0.377)	–0.0626 (0.511)	–0.1280 (0.246)
Liquidity $(Liq_{i,t})$	**0.7849 (0.049)**	**0.2940 (0.000)**	0.0353 (0.946)	1.4921 (0.169)	**0.7159 (0.057)**	**0.2271 (0.008)**
Capitalisation $(Cap_{i,t})$	0.3090 (0.210)	–0.3886 (0.508)	**0.9614 (0.049)**	–0.0859 (0.962)	0.3063 (0.295)	–0.4766 (0.165)
Ownership $(F_{i,t})$	–0.2689 (0.562)	–0.0409 (0.873)	–0.0311 (0.916)	–0.2413 (0.585)	–0.3379 (0.524)	0.0296 (0.904)
m1 ~ N(0,1)	–2.328 (0.020)	–1.941 (0.052)	–2.125 (0.034)	–2.066 (0.039)	–2.527 (0.012)	–2.564 (0.010)
m2 ~ N(0,1)	–2.012 (0.044)	–1.218 (0.223)	–1.741 (0.082)	–0.318 (0.750)	–1.262 (0.207)	–0.792 (0.428)
Joint Wald test ~ χ^2	6525.0 (0.000)	8078.0 (0.000)	4625.0 (0.000)	1988.0 (0.000)	1019.0 (0.000)	6462.0 (0.000)
Sargan (2^{nd} step) ~ χ^2	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	2.450 (1.000)	0.000 (1.000)
Number of observations	308	431	306	422	308	431
Number of banks	21	22	21	22	21	22

Table A6.5

Loans to resident non-MFIs in lats: two subsamples

(long-term coefficients, *p*-values in parentheses)

	(a)	(b)	(c)	(d)
Dependent variable: growth of loans $(\Delta \ln x_{i,t})$	loans to resident households in lats		loans to resident non-financial corporations in lats	
Sample period	1998 Q2–2001 Q4	2002 Q1–2006 Q4	1998 Q2–2001 Q4	2002 Q1–2006 Q4
Domestic monetary shock (ΔMP_t^{LV})	0.0353	0.0142	**0.0728**	–0.1168
	(0.189)	(0.884)	**(0.001)**	(0.209)
Foreign monetary policy (ΔMP_t^{*})	–0.0214	0.2106	**0.3163**	–0.1605
	(0.815)	(0.125)	**(0.003)**	(0.151)
Domestic monetary shock * Size $(\Delta MP_t^{LV} \cdot Size_{i,t})$	0.0078	–0.0014	–0.0013	–0.0924
	(0.704)	(0.982)	(0.935)	(0.161)
Domestic monetary shock * Liquidity $(\Delta MP_t^{LV} \cdot Liq_{i,t})$	0.2032	0.1401	0.0336	–0.4465
	(0.052)	(0.574)	(0.818)	(0.278)
Domestic monetary shock * Capitalisation $(\Delta MP_t^{LV} \cdot Cap_{i,t})$	**0.4159**	**0.7012**	**0.2412**	–1.4249
	(0.046)	**(0.098)**	**(0.019)**	(0.138)
Domestic monetary shock * Foreign ownership $(\Delta MP_t^{LV} \cdot F_{i,t})$	0.2550	–0.3821	0.0051	0.6955
	(0.423)	(0.548)	(0.985)	(0.135)
Real income growth $(\Delta \ln Y_t)$	**5.3875**	2.3998	–0.1348	–1.2561
	(0.043)	(0.176)	(0.860)	(0.518)
Price level growth $(\Delta \ln P_t)$	–3.4745	–0.3369	**6.5704**	0.5050
	(0.713)	(0.962)	**(0.025)**	(0.770)
Size $(Size_{i,t})$	0.0123	–0.1386	–0.1290	**–0.3672**
	(0.937)	(0.597)	(0.208)	**(0.061)**
Liquidity $(Liq_{i,t})$	0.0611	0.8249	0.1376	**0.6075**
	(0.781)	(0.201)	(0.689)	**(0.008)**
Capitalisation $(Cap_{i,t})$	**0.7878**	0.2441	0.1425	–0.6587
	(0.058)	(0.834)	(0.634)	(0.705)
Foreign ownership $(F_{i,t})$	0.3126	–0.3944	–0.2778	0.3899
	(0.372)	(0.343)	(0.355)	(0.233)
m1 ~ N(0,1)	–2.231	–2.181	–1.987	–2.261
	(0.026)	(0.029)	(0.047)	(0.024)
m2 ~ N(0,1)	0.162	0.488	–1.253	1.218
	(0.871)	(0.626)	(0.210)	(0.223)
Joint Wald test ~ χ^2	1320.0	1739.0	2542.0	475.7
	(0.000)	(0.000)	(0.000)	(0.000)
Sargan (2^{nd} step) ~ χ^2	0.121	0.000	0.000	0.000
	(1.000)	(1.000)	(1.000)	(1.000)
Number of observations	305	422	292	405
Number of banks	21	22	20	21

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