



The Importance of the Bank-Lending Channel in Estonia: Evidence from Micro-Economic Data

Reimo Juks



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The paper studies the importance of the bank-lending channel in Estonia. The results from the descriptive evidence suggest that there is a significant share of bank dependent borrowers in Estonia, but the impact of a monetary policy shock on the loan supply of banks seems to be ambiguous. The empirical analysis provides evidence in favour of the bank-lending channel in Estonia. First, well-capitalized banks seem to experience a smaller outflow of deposits after a monetary contraction. Second, the liquidity position of banks seems to be an important determinant of the loan supply suggesting that more liquid banks are able to maintain their loan portfolios, while less liquid banks must reduce their loan supply after a monetary policy contraction. This finding is consistent with the evidence for the euro area, where liquidity is also the most important determinant of the loan supply.

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Author's e-mail address: reimo.juks@hhs.se

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Introduction

For the effective functioning of the Economic and Monetary Union, it is critical to study how the monetary policy of the European Central Bank is transmitted into the real economy of the euro area countries. The recent research has concentrated on the existing euro area countries, with less emphasis on the new member states that joined the EU with a commitment to striving towards the eventual adoption of the euro. However, a proper initial understanding of the differences in the monetary policy transmission mechanisms (MTM) across the new member states, as well as in comparison with the existing euro area, is pivotal to the successful management of monetary policy by the European Central Bank.

This research paper studies the importance of the bank-lending channel in Estonia. This case study is of general importance in many respects. First, although Estonia can officially adopt the euro no earlier than 2006, the currency board arrangement with the fixed exchange rate vis-à-vis the euro means that Estonia adopted the euro *de facto* since its launch. Consequently, unlike the research on some other new member states, this analysis is less likely to suffer from the so-called ‘Lucas critique’, which states that a change in policy regime also alters the economic behaviour of relevant agents. Hence, this paper could provide some valid initial insights into the differences in MTM between the new member states and the older euro area countries. Second, Estonian banks have a high share of foreign ownership and close ties with their parent banks. Thus, the results from this analysis provide further evidence on the responses of the banks to a monetary policy shock in the context of the banks’ networks, which tend to have a wide reaching presence in the euro area.

The central task of this analysis of the bank-lending channel is to identify how the loan supply of banks reacts to a monetary policy shock. Past studies on MTM in Estonia, including work on the bank-lending channel, have relied on macro data (see Lättemäe 2003). However, studies based solely on macroeconomic data are likely to suffer from an identification problem, that is, the difficulty of disentangling loan supply effects from loan demand effects. The virtue of micro-economic data is that it enables a better differentiation of loan supply effects from those of loan demand, thus allowing for a more precise estimation of the bank-lending channel. The contribution this study makes to the existing literature on Estonia comprises empirical evidence on the bank-lending channel using individual bank balance sheet data.

The first part of the paper determines the theoretical importance of the bank-lending channel in monetary policy transmission mechanisms. According to the lending channel, a tightening of monetary policy reduces the amount of reserves and thus deposits in the banking sector resulting in a change in bank loan supply, which in turn affects real activity through a change in the investment of bank dependent borrowers. Hence, the significance of this channel depends on: 1) the number of bank dependent borrowers and 2) the quantitative impact of monetary policy on the supply of bank loans. The theoretical part of the paper discusses these and other related factors of the bank-lending channel in more detail.

The second part of the paper quantifies the importance of the theoretical determinants of the bank-lending channel in Estonia using descriptive statistics. The emphasis is on: 1) the role of the banking sector in the financial structure of the economy, 2) the share of bank credit in private sector financing and 3) the financial health and strength of the banking sector.

The third part of the paper provides empirical evidence on the significance of the bank-lending channel in Estonia using bank balance sheet data. The empirical analysis builds on the

theoretical model by Stein (1998). The idea of the model is to identify the response of bank loan supply to a monetary policy shock by seeking the asymmetric responses of bank lending to a monetary policy shock. This study uses three bank specific measures, which could determine the sensitivity of the loan supply of the banks to monetary policy: size, liquidity and capital adequacy. In addition to the loan supply analysis, the study also determines how the effect of monetary policy on deposits varies across different banks.

The results from the descriptive evidence suggest that bank loans are special for a significant share of borrowers in Estonia. The dominant role of banks in financial intermediation and the slow development of stock and bond markets make direct capital market finance costly, especially for households and small and medium sized firms. The impact of a monetary policy shock on the loan supply of the banks, however, seems to be disputable. The high market concentration and the presence of foreign ownership weaken the potential effect of monetary policy on the loan supply of the banks. The fact that the parent institutions of the Estonian banks serve as liquidity-providers in times of monetary tightening has become especially evident during the last two years. Nevertheless, the cost of these external resources compared with the internal resources could still be relatively high. Indeed, the price of domestic deposits is considered to be 1.5–2 times more favourable. All in all, it is not clear from the descriptive evidence how the loan supply of banks reacts to a monetary policy shock that drains the reserves from the banking sector.

The empirical analysis provides evidence in favour of the bank-lending channel in Estonia. First, the evidence of the effect of the EURIBOR on domestic demand and time deposits suggests that there are significant differences in the behaviour of deposits across banks. The most important determinant of deposits seems to be the capital adequacy ratio of the banks. As a consequence, a monetary policy shock that leads to a drain of deposits from the banking sector has the highest effect on the deposits of less capitalized and more risky banks. Second, the liquidity position of banks seems to be an important determinant of loan supply suggesting that more liquid banks are able to maintain their loan portfolios, while less liquid banks must reduce their loan supply after monetary policy contraction. This finding is consistent with the evidence for the euro area, where liquidity is also the most important determinant of loan supply.

1. The Role of the Bank-Lending Channel in Monetary Policy Transmission Mechanisms

1.1. The Concept of the Bank-Lending Channel

Standard economic theory suggests that monetary policy has little impact on the growth of real output in the long run steady state¹. However, over the short and medium term, monetary policy can affect economic activity through several channels². There are two channels of monetary policy transmission relying on credit market frictions: 1) bank lending (i.e. narrow credit) channel and 2) balance sheet (i.e. broad credit) channel. These two mechanisms together form the credit view³ of monetary transmission mechanisms. The following section provides a compact overview of the bank-lending channel.

Before proceeding it is useful to clarify some definitions. Following Mishkin's notation⁴, all depository institutions that offer commercial, consumer or mortgage loans (including mainly commercial banks, but also savings and loan associations, credit unions) are referred to as banks throughout the paper. The distinction between depository and non-depository loan granting institutions is relevant, as only the first group is subject to reserve requirements. As a result, any monetary policy changing the amount of reserves and deposits in the economy has an impact on real activity mainly through depository institutions⁵.

The bank-lending channel attributes the effects of monetary policy to movements in the supply of bank credit, which in turn affects real activity through a change in the investments of bank dependent borrowers⁶ (Mishkin 1996). A typical example of the bank-lending channel stipulates that an open market sale by the monetary authority reduces the amount of reservable deposit financing in the banking sector. A fall in these reserves leads banks to reduce loan supply, thereby raising the cost of capital to bank-dependent borrowers and reducing their aggregate spending. (Kashyap and Stein 1997)

¹ The long run steady state is determined by the real variables such as the degree of knowledge, skills and technology (Bank of England 2003). For a more detailed overview of the empirical evidence, see Walsh (1998).

² The assumption of imperfect price adjustment is required for any theory in which monetary policy has real effects no matter which channel is at work (Kashyap *et al* 1994).

³ Briefly, the credit view states that monetary policy does not affect only the short-term open market interest rates, but also amplifies this traditional impact on the cost of capital due to imperfections in the credit market. The imperfections cause a wedge between the cost of internal and external funds (i.e. external finance premium) and the size of this premium will depend on the creditworthiness of a borrower. As a result, the effect of monetary policy on the agents' balance sheet will also matter. According to the bank-lending channel the cost of external *bank* financing increases due to the impact of monetary policy on banks' balance sheets, while under the balance sheet it is the balance sheet of borrowers rather than lenders that matters for the cost of *all* kinds of external finance.

⁴ This notation is from Mishkin (1998).

⁵ This does not imply that monetary policy cannot influence economic activity through other channels. In fact, one can distinguish the traditional interest rate, exchange rate, expectations and broad credit channels, which might be at work with or without depository institutions (see Bank of England 2001).

⁶ Hall (1999) and Cecchetti (1995) argue that there is no reason in principle why the bank-lending channel should concentrate only on deposit-taking institutions. If monetary policy affects the ability of any finance supplier whose funds are imperfectly substitutable for some class of borrows, then there could be credit effects.

Note that this fall in aggregate demand is in addition to that induced by a rise in open bond-market interest rates operating via the standard interest rate channel. To illustrate the argument, consider the traditional interest rate channel that relies on at least one of the following three assumptions (Bernanke and Blinder 1988):

- 1) banks do not issue loans;
- 2) bonds and loans are perfect substitutes for banks;
- 3) bonds and loans are perfect substitutes for borrowers.

Consequently, banks do not play any special role in this traditional framework as loans and bonds are identical⁷. It follows that a monetary authority conducting an open market sale decreases the relative quantity of money, thereby increasing its relative price, that is, the nominal interest rate on bonds and loans⁸. Provided that prices do not adjust immediately this also implies a rise in the real interest rate, which in turn results in increasing cost of capital and thus declining aggregate demand.

However, the effect of this standard interest rate channel might be magnified via the lending channel, which also considers the effect of monetary policy on aggregate activity through its independent impact on the supply of bank loans (see for instance Hall 1999). Provided that bank loans are special (i.e. none of the above assumptions are satisfied) and monetary policy has a potential to negatively affect the supply of loans, the cost of loans relative to the cost of bonds will rise and those who rely mainly on bank lending are forced to cut back their investment spending (Kashyap *et al.* 1994).

Moreover, it is possible that the standard interest rate channel is inactive, while the bank-lending channel is at work leading to marked changes in real economic activity. This situation will occur when money and bonds are close substitutes, that is, when the interest rate elasticity of money demand is infinite⁹. Interestingly, in this context any changes in money supply have no impact on aggregate activity according to the standard interest rate channel, whereas monetary policy could still have potentially large effects on output through the bank-lending channel. This explains how small changes in short-term open market interest rates could lead to large changes in aggregate activity¹⁰. In addition, it implies that short-term interest rates or long-term government bond rates

⁷ The only role of banks in this context is to transfer the funds between a central bank and borrowers. If the central bank reduces the amount of reserves, the amount of reservable deposits falls. If the liability side of the banks does not matter, they will replace lost deposits with other sources and keep the supply of loans unchanged. (Kishan *et al.* 2000)

⁸ In real life the central bank's control for the nominal market interest rate might not be so simple as there is an increasing proliferation of assets, which can be classified as money, but are not controllable by the central bank (e.g. mutual funds with check writing privileges). This makes the traditional interest channel less important for the effective monetary policy (see Kashyap and Stein 1997).

⁹ This situation is also called as the liquidity trap and is graphically presented as a horizontal LM curve. Keynes suggested that the liquidity trap might occur when interest rates are extremely low. (Mishkin 1998) Furthermore, at the start of EMU there existed a widespread concern that the ECB might face a period of deflation, that is a situation in which monetary policy becomes ineffective (see Favero *et al.* 1999).

¹⁰ In fact, a similar result could also occur with the more realistic imperfect substitution assumption between money and bonds. Bernanke and Blinder (1988), extend the traditional IS/LM model incorporating bank loans to the model. This extended model illustrates that the effect of restrictive monetary policy on interest rates is unclear as a fall in money supply does not only shift the LM curve to the left, but also the IS curve to the left due to falling credit supply. The net effect on output is magnified, but the effect on interest rates is ambiguous.

may not reflect the real stance of monetary policy (see Hall 1997 or Kashyap *et al.* 1994).

In addition, unlike the standard interest rate channel, the impact of monetary policy on the real economy working through the bank-lending channel has important distributional consequences as not all the agents are equally affected (Cecchetti 1995). Clearly, as the bank-lending channel works through banks and bank dependent borrowers, the cost of tight monetary policy might fall disproportionately on households and small and medium sized firms¹¹, which tend to be more bank-dependent than large firms. Moreover, as the availability of alternative sources of financing is related not only to the creditworthiness of investment projects, but also to the characteristics of creditors in the world of asymmetric information, the most profitable investment might not receive funding, leading to a socially inefficient allocation of capital¹². This is in sharp contrast to the standard interest rate channel, where only the least socially productive investment projects remain unfunded after monetary policy contraction. (Cecchetti 1995)

Although credit rationing is not necessary for a meaningful lending channel, it provides another example of the bank-lending channel (Kashyap *et al.* 1994). If the supply of bank loans is disrupted, banks might be forced to ration credit and as a result some bank-dependent borrowers might be excluded from the bank credit list, which in turn affects investment activity. Note that this example is realistic, as it is the quantity rather than the price of credit, which is usually adjusted in response to monetary policy.¹³

It is informative to also illustrate the bank-lending channel graphically (see Figure 1). The figure below stresses the important role of credit market imperfections in the bank-lending channel. First, bank loans and bonds should be imperfect substitutes for some borrowers in the credit market. To put it differently, the presence of credit market frictions should make some borrowers bank dependent. Second, monetary policy should influence loan supply through its

¹¹ These distributional consequences are not only important for borrowers, but also for banks. The drain on deposits in the banking sector will have a larger impact on less liquid small banks than on well-capitalized and highly liquid large banks. This asymmetric impact from monetary policy on banks will be the main idea behind the empirical tests of the bank-lending channel.

¹² The stylized fact that small firms tend to be more innovative, but find it harder to attract direct market financing than large firms provides a realistic example of the socially inefficient allocation of capital.

¹³ The reason is that the sharp rise in interest rates to ration credit would not only encourage riskier investment behaviour, but also attract riskier borrowers. Tighter creditworthiness standards combined with the slight rise in interest rates are more reasonable steps to follow (Kamin 1998).

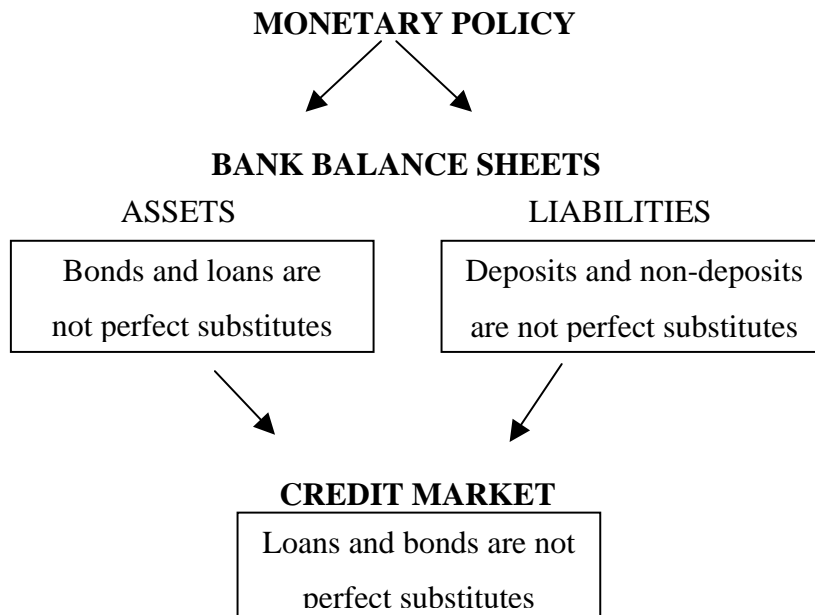


Figure 1. Credit market imperfections and the bank-lending channel

impact on bank balance sheets. This requires that banks themselves suffer from imperfect information problems that make it impossible for them to replace the lost deposits with other funds without any additional cost. Consequently, a monetary policy that affects reserves and thus deposits in the banking system would also affect loan supply. In addition, a monetary policy via open market operations could also influence loan supply through the asset side of bank balance sheets as banks might change their desired portfolio composition following a change in the relative returns of bonds and loans due to monetary policy. Although this aspect of the bank-lending channel has received little attention in the literature, it could be an important loan supply effect in practice. Finally, it is also important that banks themselves are not indifferent about investing in bonds and loans.

1.2. The Determinants of the Bank-Lending Channel

The significance of the bank-lending channel depends on the following two key factors:

- 1) the number of bank-dependent borrowers;
- 2) the quantitative impact of monetary policy on the supply of bank loans.

The most frequently cited reason for the existence of bank-dependent borrowers is that banks are natural providers of credit, specialising in overcoming informational problems and other frictions¹⁴ in the credit market¹⁵ (see for example Mishkin 2001b or Bernanke 1995). Acquiring costly information on borrowers by engaging in long-term customer

¹⁴ The list of frictions in the credit market consists of asymmetric information about the risks and returns on lending, search costs in finding suitable lenders, transaction costs in writing financial contracts, imperfect corporate control and tax advantages favouring particular sources of finance (for detailed information see for instance Hall (1999)).

¹⁵ Note that the presence of imperfections is crucial for the existence of banks. According to the Modigliani and Miller theorem, the financing structure is irrelevant in a frictionless world. Therefore, in order to have banks and bank-dependent borrowers one needs to accept the presence of imperfections in the credit market.

relationships and scrutinising the checking account balances of their borrowers gives banks an obvious comparative advantage in addressing informational problems in the credit market¹⁶ (Baum 2002). In addition, as demonstrated by the models of Diamond (1984) and Stiglitz and Weiss (1983), banks also have advantages in reducing moral hazard and risk-taking behaviour of borrowers (Mishkin 2001b). It follows that bank-dependent borrowers are those that suffer most from asymmetric information problems. Small, non-rated borrowers or those with poor credit ratings tend to belong to this category.¹⁷

Another frequently mentioned reason for the existence of borrowers reliant on banks is that there are high fixed costs¹⁸ associated with direct financial market participation. Banks can economise on those costs, thereby making them the natural providers of finance for borrowers who are particularly subject to these costs. For large firms, the fixed transaction costs of direct financing might be small relative to their overall financing needs. Moreover, establishing reputation, obtaining bond ratings and publishing annual reports help significantly reduce these informational costs. Yet, direct financing still remains relatively costly for small firms, first-time borrowers and households. (Hall 1999) Evidence from empirical studies of US manufacturing firms confirms that small and medium sized firms rely heavily on banks (Bean 2001).

An additional justification, closely related to the previous arguments, is associated with the general institutional evolution of the national financial markets. There are marked differences in the availability of non-bank sources of finance across states. Naturally, countries with relatively less developed bond and stock markets tend to have more bank dependent borrowers than those with well-developed financial markets, facilitating direct capital market access. Variations in the national financial structures could stem from the differences in tax systems and other legal regulations (Cecchetti 1999). La Port (1998) argues that the type of corporate law in place plays an important role in determining the national financial system. For instance, countries with poor legal protection for shareholders and creditors tend to have relatively less advanced capital markets with few opportunities for raising cheap non-bank finance, thereby increasing the special role of banks in financial intermediation. To summarise, the existence of bank dependent borrowers is influenced by the evolution of the national financial market, which in turn is affected by country-specific characteristics, including its legal and tax system.

Despite the obvious appeal of the reasoning on the existence of bank dependent borrowers above, it remains unclear why financial intermediation has to take place through deposit-taking intermediaries (i.e. banks) rather than through non-depository institutions (e.g. finance companies) (Kashyap *et al.* 1994). The Diamond-Dybvig model (1983) demonstrates that a synergy between deposit taking and loan making can arise out of the fundamental mismatch between individuals' desire to hold liquid assets and the economy's need to invest in illiquid long-term projects. However, this mismatch is true only to a certain extent as not all the projects are long-term and not all the

¹⁶ Bank loan agreements are taken as “good news” by the stock market, which is consistent with the fact that banks provide an information gathering function (Kashyap 1994).

¹⁷ In addition to small and medium sized businesses, households are very likely to be in this group.

¹⁸ Note that the argument is partly overlapping with the previous one, as high fixed costs can be a result of imperfections in the credit market.

deposits are short-term. Another explanation is offered by Kashyap *et al.* (1994), who propose that the answer may lie partly in government regulations, which may encourage the combination of these two activities. More recently, Kashyap *et al.* (2002) show that the synergy arises because both deposit taking and lending require a costly buffer of liquid assets, thus combining these two functions allows a bank to economise on these costs. The argument assumes that credit line services comprise a large share of total lending and that deposit and credit line withdrawals are not highly correlated.

The second factor influencing the significance of the bank-lending channel is more controversial. The impact of a monetary shock on the supply of bank loans depends initially on the effect of monetary policy on deposits in the banking sector and then on the response of banks to the reduced amount of deposits¹⁹ (Bernanke 1995). It is usually assumed that the relationship between any tightening of monetary policy and the amount of deposits is negative (Haan 2001). For example, open market sales or discount loans by the Fed tend to drain reserves and hence deposits from the banking system through multiple deposit contraction²⁰.

Kashyap *et al.* (1994) argue that there are mainly three ways a bank can respond to the reduced amount of deposits²¹. It can:

- 1) reduce the amount of loans;
- 2) sell some of its security holdings;
- 3) raise more non-deposit financing (e.g. CDs, bonds, equity).

For the significant lending channel, it is required that the first option is used at least to a certain extent. Taking into account that there is a certain amount of liquidity required to meet random depositors' withdrawals, the ability of the banks to employ the second option is limited. Moreover, large buffer stocks are costly for the banks as they offer a return close to the rates the banks pay on deposits. In addition, the tax code could make it inefficient for banks to hold securities due to the possibility of double taxation on the bank's shareholders. (Kashyap and Stein 1997)

The ability of the banks to substitute deposits with other sources of funds requires that reservable and non-reservable forms of finance are close substitutes. Romer and Romer (1990) argue that it is relatively easy and inexpensive for banks to obtain non-deposit financing in well functioning capital markets²². However, as non-deposit forms of finance are not insured, unlike deposits, the standard problems of asymmetric information between a bank and investors arise (Stein 1998). As a result, the cost of

¹⁹ The direct effect of monetary policy on loan supply is ignored by the standard bank-lending channel.

²⁰ Note that the effect of open market sales on deposits depends on whether the buyers of bonds kept money in currency or in deposits. In the first case, there is no effect on deposits whereas in the second case there is. Note also that the change in the amount of deposits in the banking sector does not necessarily result from monetary policy. For instance, there could be a shift from currency to deposits resulting in the changes in reserves and hence deposits. (Mishkin 1998)

²¹ In fact there is also a fourth possibility. If banks hold excess reserves, then a decrease in deposits reduces bank reserves, having no effect on other parts of the balance sheet. However, these excess reserves are very costly, as they do not earn any interest. Thus, it is unlikely that banks have large amounts of excess reserves (Mishkin 1998).

²² Kashyap and Stein (1995) point out that the argument of Romer and Romer (1990) relies entirely on the Modigliani-Miller theorem about the irrelevance of capital structure in a frictionless world. Therefore, the question of substitutability of different forms of financing boils down to a question of the validity of the Modigliani-Miller theorem, and that in turn hinges on the absence of frictions in the credit market.

non-deposit funding is higher than the cost of deposit funding, which makes banks reluctant to maintain the initial quantity of bank loans. Note also that the cost difference may be especially significant for smaller banks, which tend to suffer the most from informational problems.

It is worth noting that the recent financial deregulation and innovation have increased opportunities for banks to draw on non-deposit funding (Bernanke 1995). By contrast, the overall fall in state ownership in the banking sector has reduced state guarantees and therefore implicitly decreased the opportunities for banks to obtain cheap funding. On balance, how these developments have affected the substitutability of deposit and non-deposit forms of finance is to a large extent an empirical issue.

Table 1 below collects the most important factors influencing the strength of the bank-lending channel. In addition to the most direct factors influencing the number of bank dependent borrowers and the qualitative effect of monetary policy on the supply of bank loans discussed above, there is also a list of other determinants that affect the strength of the bank-lending channel. All these factors are measurable and thus help determine the significance of the bank-lending channel in practice.

Table 1. Factors influencing the significance of the bank-lending channel

Number of bank dependent borrowers	Quantitative impact of monetary policy on loan supply
• Importance of the banking sector	• Structure of the banking system
Investors' protection and capital market development	Concentration and size
Importance of banks for firms' financing	Financial strength
• Number of small and medium sized firms	State influence
• Number of households and individuals in the credit market	Ownership structure
	• Bank networks
	• Relationship banking
	• Loan portfolios
	Maturity of loans
	Interest rate type
	• Regulatory requirements
	Capital adequacy
	Deposit insurance
	• Bank failures

The importance of the banking sector in general and the role of banks for the financing of firms in particular, are the obvious determinants of the number of bank dependent borrowers. As already discussed above, the role of the banking sector depends heavily on capital market developments, which in turn could be related to regulatory issues such as investor protection. The role of the banking sector can be measured by comparing the ratio of bank assets to GDP with the ratios of stock market capitalization and outstanding debt to GDP. In addition, the importance of bank loans for the financing of firms is crucial. This is determined using:

- 1) the amount of external funds in the financial structure of firms;
- 2) the share of bank loans in the overall external financing.

In principle, both these indicators can be directly measured. However, in practise the data on the first indicator might not be readily available. The data on the second indicator is usually available, but it might be hard to distinguish the share of bank loans in external financing.

The remaining factors influencing the number of bank dependent borrowers are the number of small and medium sized firms and the share of households in the credit market. Both of these categories of economic agents are likely to be bank dependent due to high cost of direct market finance compared with their small size and overall financing needs. Partly, these high costs are due to the fact that non-bank lenders find it hard to evaluate the creditworthiness of these agents.

The second key factor, the impact of monetary policy on the supply of bank loans, depends significantly on the characteristics of the banking system. Cecchetti (1999) among others argues that the stronger the banking sector, the less likely it is that monetary policy could have a significant impact on loan supply. The financial strength of the banking system can be measured using loan loss provisions, the net interest rate margin, operating costs and return on assets. Moreover, it is likely that smaller, less liquid and poorly capitalized banks are more exposed to credit market imperfections and thus find it harder to attract non-deposit finance than bigger, liquid and well-capitalized banks. Therefore, the size of banks and their market concentration, their share of liquid assets among total assets and the capitalization of banks could be important in determining the impact of monetary policy on loan supply.

In addition, the influence of the state and the ownership structure could also play an important role. The strong presence of government in the banking market could effectively reduce the informational problems between banks and potential investors. Publicly owned or guaranteed banks are therefore more likely to suffer a disproportionate drain of funds after monetary tightening, and distributional effects in their loan reactions are hence unlikely to occur (Ehrmann *et al.* 2003).

By the same token, bank networks and foreign owned banks with close links to their parent institutions are likely to mitigate the impact of monetary policy on loan supply. In both cases the head institutions could serve as liquidity-providers in times of monetary tightening, thus limiting the role of monetary policy in determining loan supply. Furthermore, it implies that the characteristics of a single-member bank need not be relevant in assessing the degree of informational friction a bank faces. Instead, the position of a network as a whole might become more relevant. (Ehrmann *et al.* 2003)

Another factor influencing the response of banks to monetary policy is relationship banking. If banks practise relationship banking, banks shelter their customers from the effects of monetary policy. Provided that small banks are especially likely to maintain tight relationships with their clients, it might well be that smaller banks react less strongly to monetary policy than larger banks. This is in sharp contrast to the usual prediction that small banks cut back their lending more than large banks following a monetary tightening. Yet, it remains unclear exactly how these small banks maintain their loan portfolios if they experience a drain on deposits.

Loan maturity and interest rate type could also influence the effectiveness of monetary policy. If most loans are short-term and/or come with a floating interest rate, then the

banks' response in terms of loan supply to a monetary shock will be rapid, making monetary policy more efficient.

The impact of monetary policy on the supply of bank loans might also depend on the regulatory framework (Kashyap *et al.* 1994). Risk-based capital requirements can tie the ability of the banks to extend loans to their level of equity. If it is costly for a bank to adjust the amount of equity, due to the imperfections in the credit market²³, then the amount of bank lending may be constrained by such regulations. In such cases, banks may hold an excess amount of liquid assets due to the lack of capital to support more loans. As a consequence, it can happen that monetary policy has no impact on a bank's desire to invest in loans. Kashyap *et al.* (1994) conclude that these risk-based capital requirements dilute the effectiveness of the lending channel.²⁴

However, the previous argument does not take into account that monetary policy itself may act as a shock to a bank's equity and capital (Van den Heuvel 2002). In the presence of a "capital-adequacy ratio" and constraints on issuing new equity, banks may contract potentially profitable lending even if they have excess liquidity. This happens if a monetary shock results in a significant amount of loan losses, thus reducing a bank's capital and making the capital requirements binding. Although this so-called "bank-capital channel" and the bank-lending channel share common features and lead to a similar outcome, they should not be confused with each other. The lending channel relies on the imperfect substitution between reservable deposits and alternative sources of financing, while the bank-capital channel stresses the role of imperfections in the equity market. It could well happen that after a tight monetary shock, banks are able to substitute the reduced amount of deposits with other sources of financing, but are unable to cover a fall in capital which forces them to reduce their loan supply.

Another regulatory issue concerning the strength of the bank-lending channel is the size of deposit insurance. Clearly, the higher the amount of effective deposit insurance, the less important the quality of the bank's loan portfolios for potential depositors. It follows that deposits at small or less capitalized banks are not necessarily riskier than at large or well-capitalized banks provided that there is a high degree of deposit insurance. Moreover, the high level of deposit insurance could result in significant cost differences between insured deposits and uninsured non-deposit funds. Although banks themselves have to make an obligatory payment on the amount of deposits to guarantee the required funds in case of bankruptcy, this additional cost remains rather low. Consequently, the higher the effective deposit insurance, the stronger the bank lending channel.

²³ One of the most frequently mentioned imperfections is related to the adverse selection problem of the sort first identified by Akerlof (1970). To the extent that managers favour their current stockholders at the expense of potential future investors, they will wish to sell new shares at times when their private information suggests that these new shares are most overvalued. As a result, equity issues are rationally interpreted by the market as bad news, which in turn can make managers of good firms reluctant to sell equity in the first place. This implies that even firms that are badly in need of new equity due to highly profitable investment opportunities may be unable or unwilling to raise it. (Stein 2003)

²⁴ This leads to a confusing result that a large share of poorly capitalized banks (i.e. with low level of equity) weakens the bank-lending channel. However, we may also recall an earlier finding that poorly capitalized banks find it harder to attract non-deposit funding, implying a more effective bank-lending channel. To solve the problem, Van den Heuvel (2002) argues that it is important to take into account the distribution of equity across banks, not just the mean. He states that the bank-lending channel is likely to be weaker when 1) among adequately capitalized banks equity is at high levels or 2) the fraction of poorly capitalized banks is large.

Finally, the number of bank failures in the past could also reflect the magnitude of informational asymmetries in the banking sector. It is believed that informational problems are less pronounced when the number of bank failures is small (see Ehrmann 2003). As a result, the higher the number of bank failures in past, the stronger the bank-lending channel.

2. Descriptive Evidence on the Bank-lending Channel in Estonia

2.1. The Structure of the Financial Sector

Banks play an important role in financial intermediation in Estonia (see Table 2 and Figure 2 for a graphic illustration). The ratio of the financial assets of banks to GDP has been relatively high compared to those of insurance and investment funds. At the same time, bond and stock markets continue to play a modest role in corporate sector funding. Although the stock market capitalization has shown a modest upward trend, the market is relatively thin—dominated by the stocks of commercial banks and driven mainly by the interests of foreign investors. Bond market capitalization is not only insignificant, but has also decreased nominally over time.

Table 2. Financial intermediation (% of GDP)

Assets	1997	1998	1999	2000	2001	2002	2003
Banks' financial assets	53	46	50	52	56	60	61
Gross premiums of insurance	1.7	1.7	1.7	1.6	1.8	1.9	2.2
Leasing and factoring portfolio	8.2	8.5	8.9	11.6	14.6	19.4	20.7
Assets of investment funds	2.4	0.5	1.5	1.7	3.1	4.1	6.0
Capitalization							
Bond market	6.3	5.0	4.2	4.1	4.5	3.0	2.6
Stock market	20	11	37	34	27	34	40

Source: *Financial Stability Review 2003*

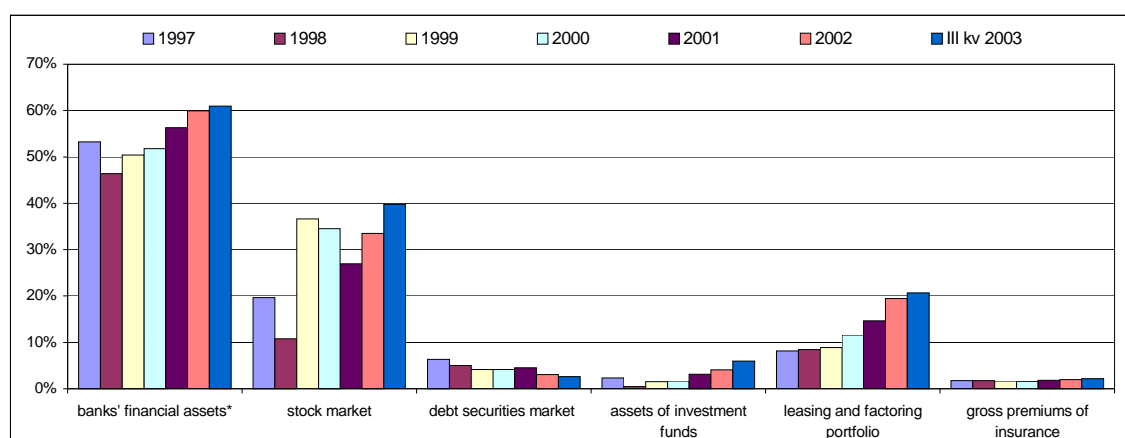


Figure 2. Structure of financial intermediaries (% of GDP)

Source: *Financial Stability Review 2003*

The bank-centred financial structure in Estonia becomes especially evident if one takes into account that in addition to issuing loans, banks also participate actively in the other financial activities (see Table 3). The rapidly growing leasing companies and

investment funds are almost entirely owned by banks, contributing to the overall significance of banks in the financial structure of Estonia. All in all, the low development of the financial markets and the dominant role of banks in financial intermediation suggest a significant role for the bank-lending channel in Estonia.

Table 3. Participation of banks in other financial activities (%)

	1998	1999	2000	2001	2002
Leasing	96	98	99	100	99
Life insurance	17	44	74	71	73
Non-life insurance	7	11	39	36	39
Investment funds	90	90	92	97	95
o/w pension funds		100	100	95	74
Turnover of Tallinn Stock Exchange ¹	60	79	71	76	85

¹ The turnover here covers the share of transactions intermediated by banks – stock exchange members in total turnover of transactions. *Source: Eesti Pank 2002b*

Despite the rapid financial deepening based on bank loan and leasing portfolios, the overall financial intermediation in Estonia is still relatively low compared to the euro area and the US, but rather similar to Latvia and Lithuania (see Tables 4a and 4b). But despite the low level of financial intermediation, it seems that Estonia has a similar financial structure to the euro area, where firms rely heavily on banks and less on direct market financing as opposed to the US where there are well-developed bond and stock markets.

Table 4a. Financial structures in the US, euro area and Baltics (% of GDP), 2001

	US	Euro area	Estonia	Latvia	Lithuania
Bank total assets	78	267.1	70.8	72.7	32
Bank loans to corporate sector	18.8	42.6	18.4	5.1	9.9
Debt securities issued by corporate sector	28.9	6.5	1.2	-	-
Stock market capitalization	137.1	71.7	27.3	9.2	10

Sources: Eesti Pank 2002a; Ehrmann et al. 2003.

Table 4b. Financial structures in the US, euro area and Baltics (% of GDP), 1999

	US	Euro area	Estonia	Latvia	Lithuania
Bank total assets	99	181	62	50	26
Bank loans to corporate sector	12.6	45.2	19.4	13.7	9.1
Debt securities issued by corporate sector	25.7	3.6	1.2	-	-
Stock market capitalization	193	90	37.1	5.9	11

Sources: Eesti Pank 2002a; Ehrmann et al. 2003.

2.2. The Importance of Bank Credit in Private Sector Financing

Domestic bank credit to the private sector has grown steadily over time, amounting to approximately 60% of GDP in 2003 (see Table 5). In recent years, this growth has been mainly due to credit expansion to households, which are very likely to be bank

dependent. Also, bank credit to non-bank financial institutions has increased sharply over time. The share of leasing funding has increased as well, becoming a more and more important source of financing for households and the corporate sector.

Table 5. Stock of bank credit and leasing (% of GDP)

	1996	1997	1998	1999	2000	2001	2002	2003
Credit to private sector	23.2	32.9	32.1	34.3	38.3	40.7	47	62
Corporate sector	16.3	21.2	20.5	19.4	18.3	18.4	19	23
Households	3.5	6.5	5.8	7.1	7.9	9.6	12.9	18
NBFI	3.4	5.1	5.8	7.9	12.1	12.8	14.8	21.8
Leasing	3.2	7.6	8.0	8.2	10.6	12.9	15.9	19.3
Corporate sector			6.5	7.0	8.5	9.4	11.8	13.6
Households			0.7	0.7	1.6	2.6	3.6	4.6

Source: Database of Eesti Pank

However, to assess the share of bank dependent borrowers, one must identify the proportion of bank credit in the overall financing structure of the private sector. Unfortunately, this sort of data is not readily available; one needs to combine different data sets to evaluate the share of bank credit in the overall funding.

According to the aggregate data, the Estonian private sector tends to rely heavily on internal and foreign sources (see Table 6). This aggregate data suggests that the net aggregate borrowing of the private sector from banks has turned negative in recent years implying that banks owe the private sector more than the private sector owes banks. However, this information is misleading and does not help us find the relative share of bank credit in private sector investment funding. The problem of aggregation across the corporate sector plus the inclusion of households makes it impossible to distinguish the net savers from the net borrowers. It could well be that a significant number of small and medium sized enterprises rely heavily on bank credit in their investment funding, while a relatively small number of big firms together with a large number of households are net depositors resulting in the negative aggregate net credit to the private sector.

Table 6. Private sector funding (% of gross fixed capital formation)

	1996	1997	1998	1999	2000	2001
Domestic sources	8.2	16.1	8.1	-19.4	-1.3	-8.0
Bank credit (net credit to private sector)	8.2	16.1	8.1	-19.4	-1.3	-8.0
Credit to private sector	45.7	58.7	13.9	16.2	37.1	26.9
Liabilities to private sector	37.5	42.5	5.9	35.6	38.4	34.9
Equity issues	-	-	-	-	-	-
Leasing	-	-	-	-	-	-
Foreign sources	29.6	34.0	39.6	41.1	27.7	31.6
FDI	11.8	11.8	43.1	20.5	28.8	26.8
Loans	6.1	18.4	6.2	9.1	-7.7	13.0
Bond issues	1.0	7.8	-3.5	-8.9	1.1	-0.6
Trade credit	-1.2	-3.2	-6.6	-1.8	5.2	-4.2
Other liabilities	12.0	-0.7	0.3	22.2	0.4	-3.3
Internal financing	62.1	49.9	52.3	78.2	73.6	76.4

Source: Eesti Pank 2002a

Another source of information suggests that bank financing is rather important for the corporate sector (see Figures 3 and 4). The net position of financial assets and liabilities

for enterprises has become even more negative over time, while the net position for households has been positive, but this positive position is decreasing. This suggests that both households and corporations indeed rely on bank financing.

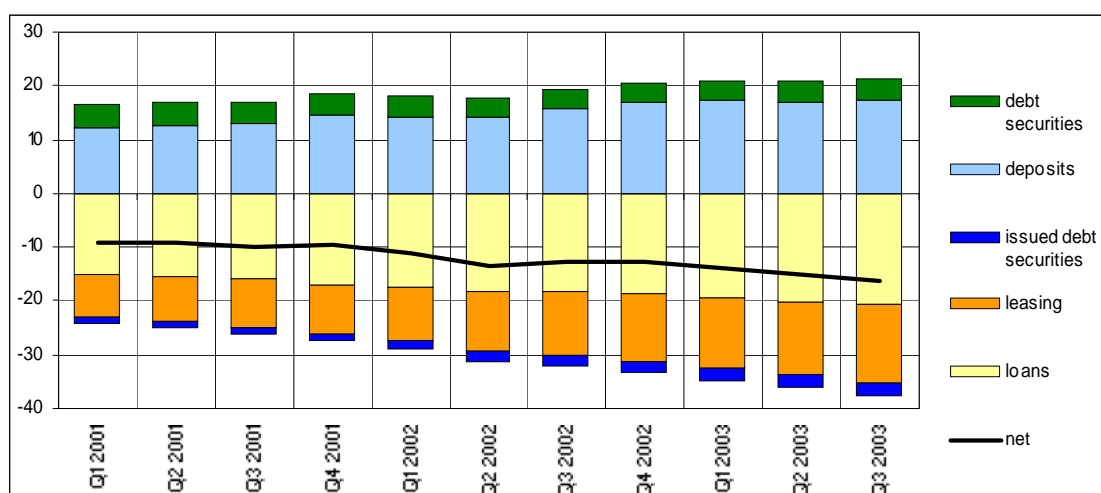


Figure 3. Financial assets and liabilities of enterprises vis-à-vis domestic banks and leasing companies (EEK bn) *Source: Financial Stability Review 2003*



Figure 4. Financial assets and liabilities of households vis-à-vis domestic banks and leasing companies (EEK bn) *Source: Financial Stability Review 2003*

In addition, bank loans and leasing, foreign direct investment and other foreign sources seem to play an equally important role for the corporate sector in its external financing, though there are some sectoral differences (see Figure 5). In domestic sources of financing, bank loans and leasing are clearly the most important sources of financing for the corporate sector, while debt securities play a minor role (see Figure 6).

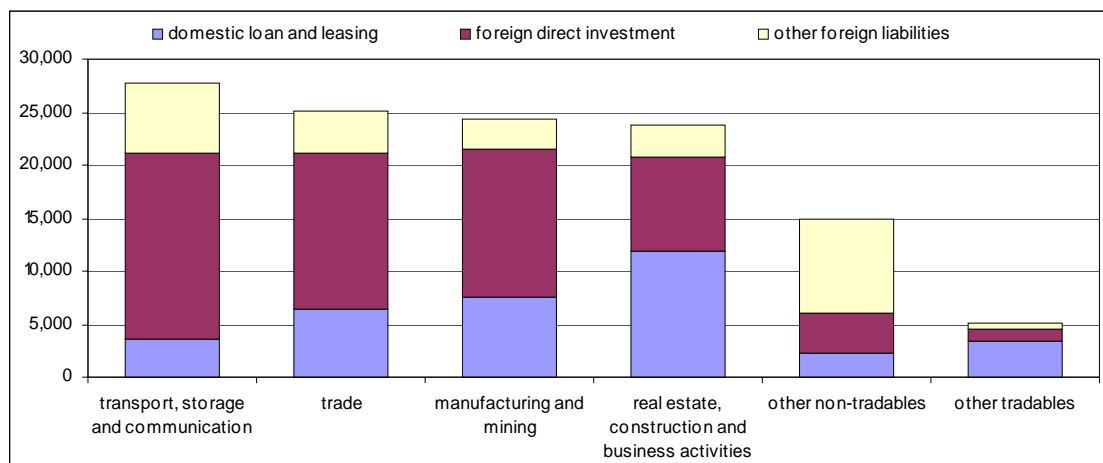


Figure 5. Financing of enterprises by domestic and foreign sources, as of June 2003 (EEK m) Source: *Financial Stability Review 2003*

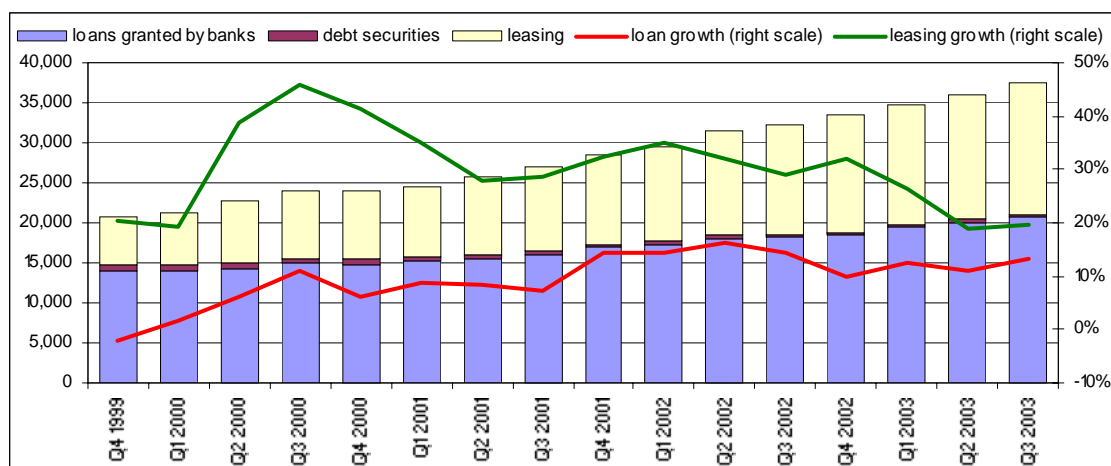


Figure 6. Domestic credit to the corporate sector (EEK m) Source: *Financial Stability Review 2003*

Although the information on all sources of private sector financing is limited (especially internal sources like retained earnings), the available data suggests that a significant share of aggregate investment and spending relies on bank credit.

2.3. The Structure and Strength of the Banking Sector

Estonia has a relatively concentrated banking sector with a small number of banks. After the banking crisis of 1997–1998, the number of banks fell from 11 to 6. As a result of this restructuring, the market concentration has sharply increased. The market share of the top three domestic banks has been more than 90% since 1998. Moreover, foreign ownership of domestic banks has steadily increased since the crisis period. At the same time, state ownership has been insignificant. During the last four years, state ownership has been absent, while the share of foreign ownership has been around 85%.

Table 7. Structure of the Estonian banking sector

	1996	1997	1998	1999	2000	2001	2002	2003
Number of banks	13	11	6	7	7	7	7	7
o/w state owned banks	1	0	1	1	0	0	0	0
Number of banks per million people	9	8	4	5	5	5	5	5
Market concentration C3	58.8	69.7	93.0	92.4	91.1	91.1	91.7	91.2
Foreign ownership	33.4	44.2	60.7	61.6	83.6	85.7	86.73	85.66
Asset quality (%)								
Non-performing loans to loan portfolio	2.29	1.17	1.36	1.73	1.05	1.33	0.80	0.38
Loan loss provisions to loan portfolio	2.02	1.98	3.98	2.91	1.54	1.47	1.04	0.80
Liquidity (%)								
Reserves and securities to total assets	25	21	27	29	27	24	23	16
Loans to total assets	53	52	58	57	59	59	61	70
Deposits to total assets	60	53	52	56	60	62	60	54
Loans to deposits	87	100	111	101	98	95	102	129
Demand deposits to liabilities	50	40	37	42	42	45	42	41
Maturity and type (%)								
Share of fixed interest rate loans	52	62	78	71	72	73	63	68
Share of long-term loans	70	76	87	86	86	86	92	93
Capital adequacy (%)								
Required capital adequacy	8	8	8/10	10	10	10	10	10
Capital adequacy ratio (solo)	12.36	13.59	16.99	16.05	13.17	14.39	15.26	14.51
Capital to total assets	9.72	10.28	16.24	15.47	12.60	13.27	12.14	11.12

Source: *Eesti Pank 2002b*

In an international comparison, Estonia seems to belong to the same group as Spain and Greece, whose banking sectors can be characterized by a small number of banks (less than 10 banks per million people) and high market concentration (see Cecchetti 1999).

The financial strength and asset quality among banks has been high and increasing over time. In recent years, return on assets has been around 2%, return on equity about 20% and the net interest margin approximately 3–4%. In addition, the share of bad loans has been decreasing. These ratios have magnitudes close to the average among new EU member states, but are significantly better than the EU-15 average.

The liquidity position of the banks has been relatively high, as reserve requirements have been covered using liquid assets by more than 1.5 times on average. However, the share of liquid assets has shown a steady decline, which is a result of eased liquidity constraints and the consistent stabilization of the banking sector.

Total loans and total deposits have been moving relatively closely together during the entire sample period (see Figure 7). However, since 2002–2003 the amount of loans increased sharply relative to deposits. The increasing ratio of loans to deposits implies

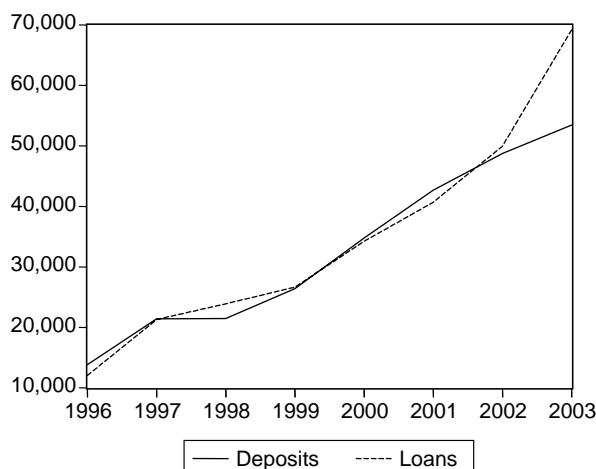


Figure 7. Total deposits and total loans of the banking sector (EEK m)

that banks use more non-deposit funding to finance the rapidly growing loan demand. Since Estonia does not have an active domestic financial market, most of the market-based funding is related to foreign countries, including the parent banks of local banks. This increased gap between loans and deposits is a clear indication of the relaxed financial constraints for banks, possibly related to EU accession, decreasing risk premiums and the high credit rating of the country and individual banks. All this has naturally resulted in active financing by the parent banks.

In an international comparison, Estonian banks rely less on deposits than the other new EU member states, but still more than an average EU-15 bank (see Figure 8). The Nordic banks, which own the majority of the Estonian banking sector, seem to have the highest share of market-based resources.

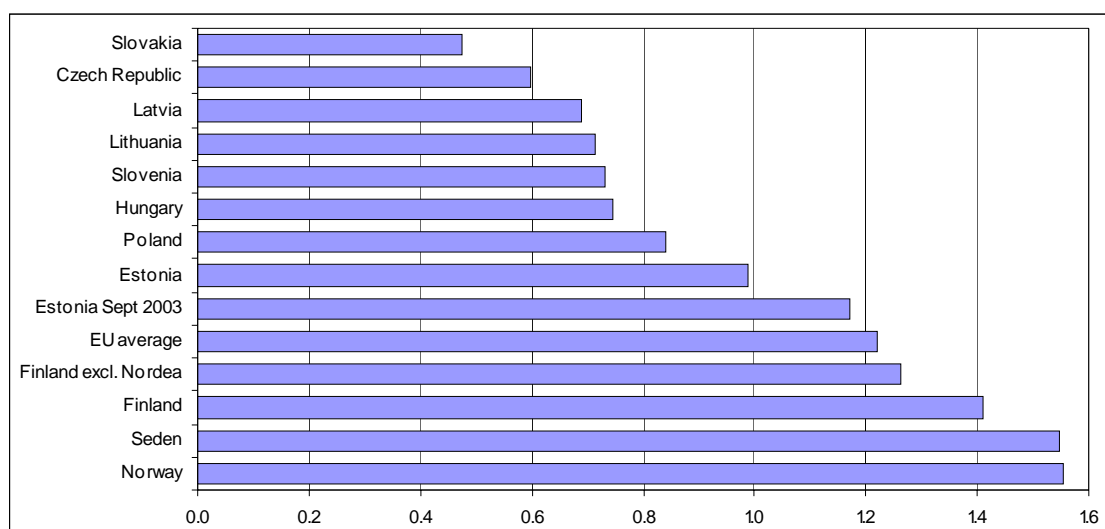


Figure 8. Loans to deposits ratio in European banking, 2002 *Source: Eesti Pank 2002*

Figure 9 illustrates an earlier statement about the intensified foreign external borrowing of the Estonian banking sector. The share of institutional foreign borrowing increased

from 22% at the end of 2001 to 30% in 2003. It is estimated that at least half of these resources originated from the parent banks.

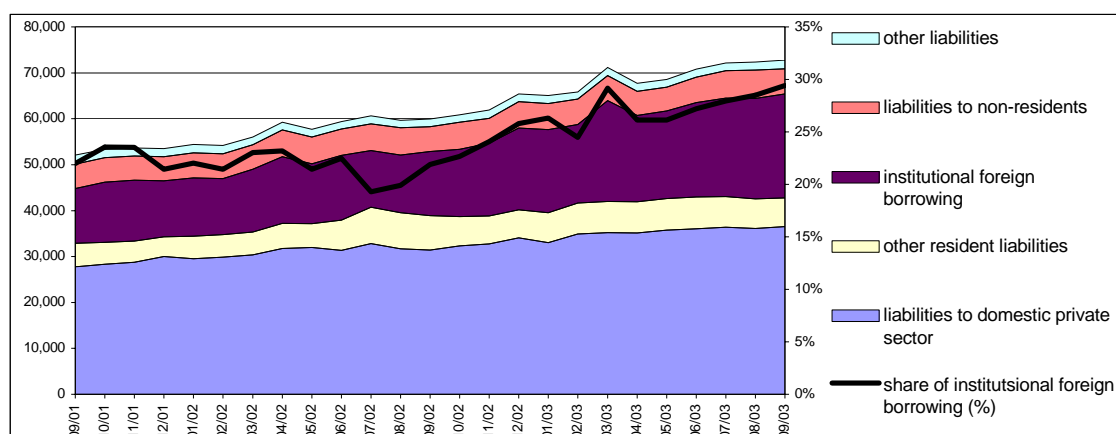


Figure 9. Banks' liabilities (EEK bn; left scale) and share of institutional foreign borrowing (right scale) *Source: Eesti Pank 2002*

In the light of vanishing financing constraints, increasing foreign borrowing and the gap between the growth of deposits and loans, there is a temptation to argue that the importance of the bank-lending channel in Estonia has markedly decreased. However, although the potential for the banks to draw on market-based funding has indeed increased, this does not include the information about the relative price of deposits and other funds. Indeed, despite consistently cheapening foreign credits, the price of domestic deposits is still 1.5–2 times more favourable (see Financial Stability Review 2003).

The share of long-term and fixed interest rate loans suggests that banks might not be able to pass a monetary policy shock immediately on to loan contracts. In addition, the high level of capitalization strengthens the banks' ability to replace insured deposits with uninsured sources.

Estonia also has a well-established deposit insurance system. The current maximum level of compensation is 40 000 kroons, while the average institutional deposit is at least 100 000 kroons (2 556 euro). However, the board of the Deposit Guarantee Fund has approved a schedule for achieving the EU minimum level of guarantees (20 000 euro) by the end of 2007. The guarantee fund is financed by credit institutions. The current maximum obligatory contribution is 0.125% of the total amount of deposits taken by a credit institution or an Estonian branch of a foreign credit institution. The combination of deposit insurance and low obligatory payments into the guarantee fund from banks confirms an earlier finding that insured deposits are the cheapest form of financing for all types of banks in Estonia.

Table 8 summarizes the main conclusions from the descriptive evidence about the significance of the bank-lending channel in Estonia. The fact that bank loans are special for a significant share of borrowers seems to be well established in Estonia. The latter is supported by the dominant role of banks in financial intermediation and the low development of stock and debt markets. As for the impact of a monetary policy shock on loan supply there are many factors weakening the role of the bank-lending channel in Estonia. The high asset quality among banks and the sufficient share of liquid assets in their total assets increase the financial strength of the banks, allowing them to mitigate

the impact of monetary policy. In addition, the high share of loans with a long maturity and a fixed interest rate is likely to dilute monetary policy transmission in Estonia. Also, the regulatory requirements seem to be contributing to a declining role for the bank-lending channel in Estonia.

Even more important, the high market concentration and the presence of foreign ownership both reduce the potential effect of monetary policy on loan supply for banks. The fact that the parent institutions of Estonian banks serve as liquidity-providers in times of monetary tightening has become especially evident during the last two years.

The only factors strengthening the bank-lending channel are the relatively large number of bank failures and the absence of state ownership in the past. However, the significance of these factors is declining over time.

Yet, the fact that the cost of foreign resources tends to be more expensive than domestic deposit financing leaves the question of the significance of the bank lending channel still open. All in all, it is not clear from the descriptive evidence how loan supply among banks reacts to a monetary policy shock that drains the reserves from the banking sector.

Table 8. Significance of the bank-lending channel in Estonia

Factor	Strengthening	Weakening
• Importance of the banking sector		
Importance of bank financing	X	
Investors protection and capital markets	X	
• Number of bank dependent borrowers	X	
• Structure of the banking system		
Concentration and size		X
Financial strength		X
State influence	X	
Foreign ownership and bank networks		X
• Loan portfolios		
Maturity of loans		X
Interest rate type		X
• Regulatory requirements		
Capital adequacy		X
Deposit insurance		X
• Bank failures	X	

3. Econometric Evidence of the Importance of the Bank-Lending Channel in Estonia

3.1. Identification

The significance of the bank-lending channel can be tested using both aggregate and disaggregated data. The recent research in this area, however, prefers microeconomic data. Studies based solely on macroeconomic data are likely to suffer from the identification problem, that is, the difficulty of disentangling loan supply effects from loan demand effects²⁵. For instance, an empirical finding that a monetary contraction is followed by a decline in aggregate bank lending is consistent with the bank-lending channel. However, this evidence cannot rule out the possibility that it is a decline in loan demand rather than in loan supply that drives the result (Kashyap and Stein 2000). Consequently, this evidence is not sufficient to prove the presence of the bank-lending channel.

One solution to this identification problem among others used in this paper, relies on the cross sectional implications of the bank lending channel (see Kashyap and Stein 1995, 1997). The empirical test uses individual bank balance sheet data and is based on the idea that a monetary policy shock should have an asymmetric impact on bank lending if the bank-lending channel is at work. The differences in bank responses to the same policy shock occur due to variations in:

- 1) the financial strength of bank balance sheets;
- 2) the ability of the banks to replace insured deposits with external finance.

Clearly, the stronger the bank balance sheets, the easier it is for banks to maintain their loan portfolios after a tightening of monetary policy. Similarly, the easier it is to replace insured deposits with external finance, the smaller the impact of a monetary policy shock on loan supply for banks.

As the ability of the banks to replace deposits with other forms of financing is strongly related to the creditworthiness of banks, the sensitivity of loan supply to monetary policy can be measured by bank specific indicators of creditworthiness and financial strength. However, these supply-related characteristics should be independent of loan demand to avoid the identification problem in this framework.

Theoretical and empirical literature distinguishes the following three bank specific characteristics (Brimissiomis 2001):

- Size—small banks find it harder to attract non-deposit funding after a monetary contraction because they face higher informational costs and thus higher external finance premiums than large banks.
- Capitalization—poorly capitalized banks have less access to non-deposit funds, which forces them to cut back on loans more than well-capitalized banks.
- Liquidity—liquid banks can draw on their excess reserves of cash and securities to protect their loan portfolio, while this is less possible for illiquid banks.

²⁵ For an excellent overview of the issues in interpreting the evidence on the bank-lending channel using aggregate data see Kashyap and Stein (1995).

Clearly, each of these measures has its advantages and disadvantages. Size is the most common indicator of the ability of banks to generate outside financing. However, size itself could be irrelevant when other measures (such as liquidity and capitalization) are present (see Worms 2001). Furthermore, banks with different sizes might not experience a homogenous response to loan demand shocks. If the customers of small banks reduced their loan demand more than the customers of large banks after a monetary policy tightening, then size would be a bank-specific loan demand rather than loan-supply related characteristic and thus would not help identify loan supply effects from those of loan demand.

Another measure frequently used is the degree of capitalization. It seems likely that suppliers of external funds are more willing to lend to well-capitalized banks than to poorly capitalized banks. However, Worms (2001) argues that the degree of capitalization could reflect the riskiness of a bank's loan portfolio. In such a case it is not clear why well-capitalized banks should obtain cheaper external financing than poorly capitalized banks. However, if risk based capital requirements are considered the problem disappears.

Finally, the degree of liquidity could determine how banks react to monetary policy. The idea here is that liquid banks should be less affected by a monetary policy shock as they can rely on their liquid assets to maintain the loan portfolios. However, a disadvantage of liquidity as a bank specific characteristic is that it could be endogenous: those banks that find it hard to replace deposits with other forms of financing will probably also hold large stocks of liquid assets. In this case, liquidity might be an insignificant factor of loan supply even though the bank-lending channel is clearly present.

In addition, an important common problem with all these measures appears when banks form networks or have close relations with their parent institutions. In this case, the relevant entity is the entire network and there is no theoretical justification why an individual bank specific characteristic should be an important determinant of a bank's loan supply. For instance, the liquidity position of a bank should be irrelevant when a parent bank stands ready to provide any additional resources whenever necessary. Surprisingly, empirical studies show that size and capitalization tend to be insignificant, while liquidity seems to be an important determinant of loan supply among banks even in the presence of bank networks (see e.g. Angeloni *et al.* 2003). One possible explanation for this finding is that a sufficiently strong monetary policy shock might also affect stronger banks in the network in such a way that prevents them from acting as liquidity providers to their weaker partner banks. In addition, the cost of these external resources could be different from the cost of internal resources.

3.2. Model Specification and Estimation Strategy

The econometric model used in this paper relates the growth of bank lending across banks to a monetary policy indicator plus some control variables. The most general model based on panel data has the following form (see Ehrmann 2003):

$$(1) \Delta \log(L_{it}) = a_i + \sum_{j=1}^l b_j \Delta \log(L_{it-j}) + \sum_{j=0}^l c_j \Delta r_{t-j} + \sum_{j=0}^l d_j \Delta \log(GDP_{t-j}) + \sum_{j=0}^l e_j \text{infl}_{t-j} + f_1 x_{it-1}$$

$$\sum_{j=0}^l g_{1j} x_{it-1} \Delta r_{t-j} + \sum_{j=0}^l g_{2j} x_{it-j} \Delta \log(GDP_{t-j}) + \sum_{j=0}^l g_{3j} x_{it-j} infl_{t-j} + \varepsilon_{it}$$

with $i = 1, \dots, N$ and $t = 1, \dots, T$ where N denotes the number of individual banks, T is the number of time periods and l is the number of lags. L_{it} is the amount of loans by bank i in quarter t to private non-banks. Δr_t represents the first difference in the nominal interest rate used as a measure of monetary policy, $\Delta \log(GDP_t)$ is the annual growth rate of real GDP and $infl_t$ is the annual inflation rate. Inflation and the real growth rate of GDP are included to control for economic activity and cyclical patterns.

A bank specific characteristic is given by x_{it-1} and it is assumed that it will affect the growth rate of loans in this model in a linear fashion. Note that this characteristic enters the model with only one lagged value. This is just a simplification that avoids having too many parameters to be estimated (see Ehrmann 2003). In addition, the bank specific characteristic is also allowed to interact with the nominal interest rate and control variables (real GDP growth and inflation). Interaction with the control variables allows: 1) banks with different values of the bank characteristic to respond differently to business cycles and 2) the bank characteristic to have a different impact on banks in each phase of the business cycle.

The term of interaction with monetary policy measures is captured by $x_{it-1} \Delta r_{t-j}$. This allows for a testing of the asymmetric effects of monetary policy on individual banks. The test for the bank-lending channel amounts to checking whether the long run coefficient of this interaction term is statistically significant from zero or not. If this coefficient does not differ significantly from zero, then there are no loan supply effects from monetary policy based on this methodology.

Depending on the available data, equation (1) is usually given minor modifications. For instance, some authors also consider double interaction terms, where two or more bank specific variables interact with each other (see Ehrmann 2003). Another modification frequently used is to include all the right-hand side variables starting with the first lag. This reduces the possibility of an endogeneity problem. Some studies include time dummies instead of the control variables of GDP and inflation to check the robustness of the results. In addition, there are studies, which replace the time varying control variables with variables that also capture the cross-sectional differences in lending opportunities across banks (see e.g. Westerlund 2003).

Due to the bank specific effects, the model is estimated in first differences. However, there will be correlation between the transformed lagged endogenous variables and transformed error term, leading to the biased and inconsistent results if the OLS estimator is used. Thus, the model is usually estimated using the GMM suggested by Arellano and Bond (1991), according to which the lagged levels of the dependent variable are used as instruments for the equation in the first difference. More recently, Blundell and Bond (1998) demonstrated that if some exogenous variables are not correlated with the bank specific effects, additional moment conditions are available for the level equation. This estimator is called the GMM-SYS.

In addition to the GMM, the instrumental variable method proposed by Anderson and Hsiao (1982) could also be used. This method is less efficient than the GMM, but has superior finite sample properties, especially when N is small and T is large (see Judson and Owen 1999).

The estimation strategy in this paper is the following. First, the effect of monetary policy on deposits is studied. For this purpose, the growth rate of loans is replaced with the growth rate of deposits in equation (1). Second, the response of bank loan supply to monetary policy tightening is estimated. Equation (1) is employed for this purpose. In both cases the monetary policy interaction with the control variables will be excluded due to the small sample size.

Four lagged values of right hand side variables are included in the loans and deposits equations. The real growth rate of GDP and inflation are used as control variables. In addition, these control variables are replaced with a complete set of time dummies to test the robustness of the results. While this has the drawback that the level effect of monetary policy is also captured by these time dummies, it does guarantee perfect control of the time effect on the endogenous variable and therefore enhances the power of the test on the interaction terms (see Worms 2001).

Finally, the growth rate of total assets is replaced with the time varying control variables. This also allows us to capture the cross sectional differences in bank lending opportunities and in their ability to attract deposits. The choice of total assets is not unique, but it is the most suitable choice used in the data set.

3.3. Data Description

The individual balance sheet data from five banks is used in the analysis. These five banks are domestic, but three of them have a high share of foreign ownership. An Estonian branch of a foreign institution and a domestic bank, which started its business in late 1999, are excluded from the analysis due to missing data and the short time series. The data is quarterly and covers the period, 1996:4–2004:1. The following bank specific data is used: loans, deposits, total assets, the degree of liquidity, and capital adequacy (see the definition of variables). The data is taken from the database of Eesti Pank.

There were three important mergers during the sample period: Ühispank and Põhja-Eesti Pank in 1997, and Tallinna Pank in 1998, Hansapank and Hoiupank in 1998. These mergers were treated using a backward aggregation of entities involved in the merger.

The main characteristics of the sample data are presented in Table 9. Despite a fall in its share in the entire stock of domestic loans, the amount of loans to the domestic non-financial

Table 9. Loans and resources of the banking sector in the sample (%)

	1996	1997	1998	1999	2000	2001	2002	2003
Domestic loans								
to private sector excl. banks	78	77	83	78	69	63	64	62
o/w household	19	28	25	27	31	34	39	45
Deposits and other liabilities								
Share of deposits	93	80	76	77	82	80	81	76
Deposits								
o/w foreign	15	17	19	19	22	19	20	20
from private sector excl. banks	63	67	69	73	77	78	74	73
o/w foreign	15	16	13	14	16	17	15	13
from banks	10	9	8	6	7	5	8	10
o/w foreign	47	60	91	96	93	84	92	96
from domestic private sector excl. banks								
o/w demand deposits	75	73	63	65	65	62	62	64
Other liabilities								
o/w foreign		80	84	90	92	92	87	90
to banks	49	77	85	79	55	58	64	59
o/w foreign		92	93	100	100	100	100	97
Loans	77	66	50	51	43	43	41	34
o/w foreign banks		77	81	85	82	82	89	94
Bonds	23	34	50	49	57	57	59	66
o/w foreign banks		60	79	73	34	40	47	39

Source: Database of Eesti Pank

private sector is still high. More interestingly, the importance of households relative to firms has consistently increased in bank loan portfolios amounting to 45% of the entire non-financial private sector loan portfolio in 2003.

Bank resources consist of a large share of deposits (around 80%), which is mainly drawn from the domestic non-banking private sector. The deposits from the banking sector are mainly obtained from abroad. Although there is an increasing trend in deposits from the foreign banking sector, the share of these deposits in the overall deposits remains less than 10%.

Unlike deposits, the other liabilities of banks are almost entirely foreign owned. A relatively large share of these liabilities is held by foreign banks, which finance the local banks mainly through loans. In addition to the loans from foreign banks, bond financing is another significant source of financing for local banks.

Data on bank deposits and other liabilities in Table 9 confirms once again that local banks indeed are supported by their foreign parent banks. However, it remains unclear whether these foreign resources are cheaper than local deposits and whether a fall in deposits induces a reduction in loan supply.

Consistent with the sample data characteristics, the natural choice for the loan variable in the model was the stock of loans to the domestic non-financial private sector (see Box 1). The

loans to the public sector are excluded due to the implicit government guarantee behind them. To obtain more specific results, the analysis makes also a distinction between the stock of loans to households and corporations.

As for the deposits, the analysis uses the stock of deposits from the domestic non-financial private and public sector. More specifically, this stock of deposits is split between demand and time deposits. This distinction is important as demand deposits are expected to be more responsive to a monetary policy shock than time deposits.

Box 1. Definition of variables

- Loans: stock of loans to domestic non-financial private firms and households
- Deposits: stock of deposits from the domestic non-financial private and public sector
- Size: log of total assets of bank i at time t minus the average log of total assets of all banks at time t
- Capital adequacy: Capital divided by total risk-weighted assets of bank i at time t minus the average capital divided by the total assets in the whole sample
- Liquidity: liquid assets (cash and marketable securities) divided by the total assets of bank i at time t minus the average liquid assets divided by the total assets in the whole sample
- Monetary policy measure: 3-month TALIBOR and/or 3-month EURIBOR²⁶

To identify the loan supply effects, three bank specific characteristics are used: size (*Size*), liquidity (*Liq*) and capital adequacy (*Cap*). These measures are calculated in the following way :

$$Size_{it} = \log A_{it} - \frac{1}{N_t} \sum_i \log A_{it}$$

$$Liq_{it} = \frac{L_{it}}{A_{it}} - \frac{1}{T} \sum_t \left(\frac{1}{N_t} \sum_i \frac{L_{it}}{A_{it}} \right)$$

$$Cap_{it} = \frac{C_{it}}{A^*_{it}} - \frac{1}{T} \sum_t \left(\frac{1}{N_t} \sum_i \frac{C_{it}}{A^*_{it}} \right)$$

Size is measured using the log of total assets, A . Liquidity is defined as the ratio of liquid assets L to total assets, and capital adequacy is given by the ratio of capital, C , to risk weighted assets, A^* . All these measures are normalized to make the average measure of a characteristic to add up to zero over all the observations. This allows us to interpret the coefficients of the monetary policy indicator directly as the overall measure of monetary policy effect on loans. Note that size is normalized with respect to the average of a specific time period, while the other two measures are normalized with respect to the entire sample average. This calculation eliminates undesirable trends in the size measure (see Ehrmann 2003).

There are mainly two possible candidates for a monetary policy indicator in Estonia: the 3-month TALIBOR and the 3-month EURIBOR. Theoretically, these two measures should be highly correlated due to the currency board arrangement in Estonia²⁷. Indeed, the correlation is high at normal times. However, as the Russian and Asian crises demonstrated, the

²⁶ As the sample starts from 1996:4, then the German mark Libor is used before 1999.

²⁷ Estonia introduced the fixed exchange rate vis-à-vis the German mark using a currency board arrangement in 1994. Since 1999, the kroon has been fixed to the euro.

TALIBOR could diverge significantly from the EURIBOR. This implies that the TALIBOR is also significantly affected by real economic shocks and thus is not exogenous. Moreover, the EURIBOR is a better measure of a bank's effective cost of financing than the TALIBOR as the liquidity management of Estonian banks is carried out outside Estonia. For these reasons, the analysis here uses the 3-month EURIBOR, which can be treated as an exogenous monetary indicator.²⁸

3.4. Estimation Results

The results of the effect of the EURIBOR on demand and time deposits from the domestic private and public sector are presented in Tables 10 and 11. Before starting to interpret the results, it is worth noting that the estimated coefficients in the equations, with the real GDP growth and inflation as control variables, tend to have very large standard errors. This suggests that control variables that are varying only over time are not able to check for the cross-sectional differences across banks. The equations with the asset variable perform better, though many parameters, especially those of the monetary policy, are still insignificant.

The results show that the three-month EURIBOR does not have a statistically significant effect on domestic demand deposits (excluding one case). Apart from the estimation problems and noisy data, this result might be due to the following reasons. First, there were no large movements in the EURIBOR during the sample period. The maximum value of the EURIBOR was 5% and the minimum, 2% during the period under consideration. Second, the three-month EURIBOR might be a poor indicator of a monetary policy stance. For instance, a small increase in the EURIBOR might not necessarily result from monetary tightening, but from a shock to monetary demand. If this is the case, then the reserves in the banking sector do not necessarily fall as a result of a demand driven increase in the EURIBOR. Finally, a tightening of monetary policy in the euro area might not necessarily result in the loss of reserves in the Estonian banking sector. For instance, the effect of monetary contraction in the euro area could be easily offset by other factors such as large scale FDI. The control variables might not capture the effect of all these factors.

²⁸ Of course, there is no perfect measure of monetary stance. As already discussed earlier, it could happen that interest rates do not increase much even during tight monetary policy periods (see more on this from Kashyap and Stein 2000).

Table 10. Effect of the EURIBOR on domestic demand deposits

Demand deposits	Size	Size	Size	Liq	Liq	Liq	Cap	Cap	Cap
Euribor (st. error)		5.476 (5.370)	6.708 (43.21)		3.95 (4.248)	2.03 (24.84)		17.56* (2.633)	0.734 (29.54)
Real GDP (st. error)			-21.80 (18.08)			-15.64 (13.55)			-4.495 (9.829)
CPI (st. error)			7.414 (27.4)			7.79 (26.70)			-10.37 (16.68)
Assets (st. error)		-0.122 (0.162)			-0.186 (0.188)			-0.522 (0.218)	
Char (st. error)	0.028 (0.161)	-0.031 (0.029)	-0.017 (0.213)	0.210 (0.748)	0.318 (0.206)	0.079 (0.603)	2.203* (0.705)	1.292* (0.202)	2.028* (0.704)
Char*MP	-4.75	-6.42	-4.34*	45.24	62.18*	30.75*	154*	213*	136*
F-prob	[0.0720]	[0.0869]	[0.0386]	[0.286]	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Wald (joint)	[0.019]	[0.479]	[0.707]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
p-val Sargan	[0.953]	[0.560]	[1.000]	[0.934]	[0.636]	[1.000]	[0.925]	[0.613]	[1.000]
AR(1)	[0.069]	[0.097]	[0.090]	[0.067]	[0.083]	[0.088]	[0.041]	[0.096]	[0.064]
AR(2)	[0.143]	[0.734]	[0.708]	[0.215]	[0.293]	[0.265]	[0.862]	[0.522]	[0.251]

Notes: * denotes a 5% level of significance. The first equation with each characteristic is estimated in first differences using GMM including a complete set of time dummies. The instruments for this equation are the 2–6 lagged values of the dependent variable. The second and third equations with each characteristic are estimated in first difference using GMM-SYS. In addition to the instruments of 2–6 lagged values of the dependent and control variables for difference equations, the EURIBOR is used as an instrument for a level equation. First step estimation is used in all equations. IV estimation leads to similar results.

Despite the fact that the impact of monetary policy on demand deposits is insignificant and cannot be estimated precisely, the long run coefficients of different bank specific characteristics and their interaction with the monetary policy measure provide useful information about the behaviour of demand deposits across banks. All three different model specifications imply that the capital adequacy ratio of the banks is an important determinant of demand deposits, while the liquidity position and size of the banks are less important. The estimation results show that banks with a higher capital adequacy ratio are more likely to experience a smaller outflow of deposits than those with a lower capital adequacy ratio. This is consistent with the fact that depositors are concerned about the health and risk level of the banks.²⁹ Recall for a moment, that the current maximum level of deposit insurance is 40,000 kroons, but the average deposit of any public or private institution is at least 100,000 kroons. As for the liquidity and size, the parameters are insignificant or have incorrect signs. Although the interaction terms in the liquidity equations are statistically significant and have theoretically correct positive signs, the characteristic alone is insignificant. In the case of size, the characteristic alone is insignificant and the interaction terms are significant, but have negative incorrect signs.

The results from the time deposit equations are slightly different from those of the demand deposit equations. The long-run coefficient of the monetary policy indicator is significant and positive in the equations with a control variable that varies across banks and time. This empirical finding, that the size of time deposits increases in response to an increase in the

²⁹ People can still remember the times of the banking crises in the recent past, when many people lost their deposits.

EURIBOR, suggests that the changes in the EURIBOR are passed on to the changes in the interest rate for deposits. Indeed, there is a positive correlation between the interest rates on time deposits and the EURIBOR (see Appendix for a graphic illustration). The corresponding correlation coefficient is 0.67 for the period 1999–2004.

As for the bank specific characteristics, the capital adequacy ratio seems to be the most important determinant of time deposits, though the evidence is not as strong as in the case of demand deposits. The capital adequacy characteristic alone is not significant at 5%, but is significant at the 10% level of significance. Moreover, the interaction term with the monetary policy indicator has an expected sign and is highly significant. In the size and liquidity equations, the characteristic alone is either insignificant at any conventional level or the interaction term has an incorrect sign.

Table 11. Effect of the EURIBOR on domestic time deposits

Time deposits	Size	Size	Size	Liq	Liq	Liq	Cap	Cap	Cap
Euribor (st. error)		13.89* (6.99)	15.74 (15.3)		19.58* (5.01)	9.510 (12.74)		20.88* (6.049)	18.69 (12.16)
Real GDP (st. error)			-6.562* (2.47)			-7.029* (2.22)			-4.880* (1.291)
CPI (st. error)			-0.066 (4.542)			4.457 (4.097)			0.035 (3.661)
Assets (st. error)		0.162 (0.204)			-0.006 (0.202)			-0.103 (0.227)	
Char (st. error)	0.434* (0.110)	0.011 (0.020)	0.010 (0.015)	0.029 (0.491)	-0.100 (0.07)	-0.031 (0.156)	0.547 (0.326)	0.299 (0.156)	0.291 (0.150)
Char*MP	-0.49	-1.89	-3.10	131*	139*	135*	102*	136*	104*
F-prob	[0.8133]	[0.6927]	[0.4695]	[0.000]	[0.000]	[0.000]	[0.003]	[0.000]	[0.008]
Wald (joint)	[0.797]	[0.976]	[0.999]	[0.000]	[0.060]	[0.000]	[0.000]	[0.000]	[0.000]
p-val Sargan	[0.943]	[0.633]	[1.000]	[0.949]	[0.005]	[1.000]	[0.962]	[0.883]	[1.000]
AR(1)	[0.039]	[0.046]	[0.048]	[0.043]	[0.044]	[0.044]	[0.040]	[0.041]	[0.040]
AR(2)	[0.245]	[0.236]	[0.148]	[0.310]	[0.094]	[0.469]	[0.200]	[0.075]	[0.176]

Notes: * denotes a 5% level of significance. The first equation with each characteristic is estimated in first differences using GMM including a complete set of time dummies. The instruments for this equation are the 2–6 lagged values of the dependent variable. The second and third equations with each characteristic are estimated in first difference using GMM-SYS. In addition to the instruments of 2–6 lagged values of the dependent and control variables for difference equations, the EURIBOR is used as an instrument for a level equation. First step estimation is used in all equations. IV estimation leads to similar results.

All in all, the evidence of the effect of the EURIBOR on domestic demand and time deposits suggests that there are significant differences in the behaviour of deposits across banks. The most important determinant of deposits seems to be the capital adequacy ratio of the banks. As a consequence, a monetary policy shock that leads to a drain of deposits from the banking sector has the highest effect on the deposits of less capitalized and more risky banks.

The results from the loan supply equations for households and firms are presented in Tables 13 and 14, respectively. As with the deposit equations, the regressions using control variables that vary only over time tend to have large standard errors for the parameters of the monetary policy indicator. Although the specification with the alternative control variable yields more

efficient results, the overall impact of monetary policy on the amount of bank credit is still insignificant. The explanations for the insignificant impact of monetary policy on the amount of bank credit are similar to those related to the insignificant impact of monetary policy on deposits. The most plausible explanation apart from econometric issues is that there are important non-monetary economic factors—possibly related to economic transition and catching-up, which tend to offset or weaken the direct effect of the monetary policy of the European Central Bank on the Estonian economy. This result is surprising given the high integration of the Estonian economy into the euro area.

As for loans to households, the results show that liquidity is a significant determinant of loan supply, while size and capital adequacy are not. Liquidity is statistically significant at the 5% level in all three specifications. Moreover, the monetary policy interaction term with liquidity is significant at the 5% level in two equations and at the 10% level in the third equation. As for the other two characteristics, size is not statistically significant when interacting with the monetary policy indicator, while capital adequacy is insignificant without interaction. This empirical finding, that liquidity is an important determinant for the loan supply of the banks, is consistent with the evidence from the euro area. The studies for most countries in the euro area show that liquid banks contract their loan supply less than illiquid banks in response to monetary policy tightening (see Ehrmann *et al.* 2003).

Table 12. Effect of the EURIBOR on the supply of loans to households

Loan to households	Size	Size	Size	Liq	Liq	Liq	Cap	Cap	Cap
Euribor (st. error)		-0.029 (1.447)	-17.86 (19.3)		-0.474 (2.012)	-15.55 (17.7)		-0.285 (2.207)	-23.37 (22.11)
Real GDP (st. error)			3.780 (7.09)			3.394 (5.33)			7.63 (8.48)
CPI (st. error)			-8.858 (10.28)			-9.682 (8.29)			-15.66 (12.3)
Assets (st. error)		0.088 (0.094)			0.101 (0.103)			0.261 (0.125)	
Char (st. error)	0.3886 (0.099)	0.479* (0.151)	0.373* (0.09)	0.714* (0.263)	0.609* (0.134)	0.733* (0.194)	0.448 (0.422)	-0.851 (0.757)	-0.26 (0.48)
Char*MP	0.202	0.69	0.36	25.71*	33.47	20.92*	68.30*	49.8*	59.84*
F-prob	[0.9004]	[0.6217]	[0.8113]	[0.0096]	[0.097]	[0.028]	[0.000]	[0.019]	[0.005]
Wald (joint)	[0.000]	[0.000]	[1.000]	[0.000]	[0.000]	[0.089]	[0.000]	[0.006]	[0.000]
p-val Sargan	[0.875]	[1.000]	[1.000]	[0.480]	[1.000]	[1.000]	[0.877]	[1.000]	[1.000]
AR(1)	[0.078]	[0.076]	[0.089]	[0.082]	[0.081]	[0.077]	[0.067]	[0.056]	[0.091]
AR(2)	[0.271]	[0.473]	[0.313]	[0.338]	[0.841]	[0.277]	[0.171]	[0.455]	[0.121]

Notes: * denotes a 5% level of significance. The first equation with each characteristic is estimated in first differences using GMM including a complete set of time dummies. The instruments for this equation are the 2–6 lagged values of the dependent variable. The second and third equations with each characteristic are estimated in first difference using GMM-SYS. In addition to the instruments of 2–6 lagged values of the dependent and control variables for difference equations, the EURIBOR is used as an instrument for a level equation. First step estimation is used in all equations. IV estimation leads to similar results.

As with loans to firms, the empirical evidence is less clear-cut than in the case of loans to households. While size is not an important factor due to the insignificant parameters and incorrect signs, the distinction between liquidity and capital adequacy is ambiguous. Both characteristics have one equation where the characteristic alone is significant and one where the interaction with the monetary policy indicator is significant. Although both parameters might be important determinants of loan supply, it is likely that liquidity matters more than capital adequacy for the following reasons. First, previous analysis of loans to households provides clear-cut evidence that liquidity is an important factor of loan supply, while capital

adequacy is not. Second, in the presence of bank networks or close connections with large parent banks, the relevant capital adequacy measure is not that of the individual bank, but that of the whole group or network. Moreover, the capitalization of Estonian banks has been consistently high, while the liquidity position has been falling. Furthermore, unlike capital adequacy, liquidity could also matter in the presence of bank networks, as there could be a cost difference between external and internal resources even inside the network. All in all liquidity seems to play a more important role in loan supply than capital adequacy.

Table 13. Effect of the EURIBOR on the supply of loans to firms

Loans to firms	Size	Size	Size	Liq	Liq	Liq	Cap	Cap	Cap
Euribor (st. error)		-1.320 (1.053)	5.641 (6.49)		-2.61 (1.566)	3.401 (4.77)		2.086 (1.39)	10.10 (7.177)
Real GDP (st. error)			-2.663 (4.06)			-1.805 (3.69)			-1.33 (2.913)
CPI (st. error)			2.42 (1.73)			2.341 (1.67)			1.108 (1.785)
Assets (st. error)		0.454 (0.098)			0.342 (0.130)			0.227 (0.109)	
Char (st. error)	0.034 (0.134)	-0.045* (0.022)	-0.05 (0.030)	-0.297 (0.442)	0.604* (0.109)	0.651* (0.136)	0.167 (0.373)	0.561 (0.39)	0.822* (0.260)
Char*MP	21.16*	-1.64*	-3.27	52.49*	5.42	21.31*	75.64*	57.9*	73.81*
F-prob	[0.0145]	[0.0092]	[0.0541]	[0.0000]	[0.667]	[0.071]	[0.000]	[0.002]	[0.000]
Wald (joint)	[0.550]	[0.422]	[1.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
p-val Sargan	[0.493]	[0.990]	[1.000]	[0.707]	[0.977]	[1.000]	[0.527]	[0.985]	[1.000]
AR(1)	[0.062]	[0.091]	[0.076]	[0.069]	[0.096]	[0.083]	[0.068]	[0.090]	[0.083]
AR(2)	[0.161]	[0.359]	[0.147]	[0.173]	[0.317]	[0.153]	[0.149]	[0.294]	[0.133]

Notes: * denotes a 5% level of significance. The first equation with each characteristic is estimated in first differences using GMM including the complete set of time dummies. The instruments for this equation are the 2-6 lagged values of the dependent variable. The second and third equations with each characteristic are estimated in first difference using GMM-SYS. In addition to the instruments of 2-6 lagged values of the dependent and control variables for difference equations, the EURIBOR is used as an instrument for a level equation. First step estimation is used in all equations. IV estimation leads to similar results.

To summarize, the empirical analysis above provides evidence in favour of the bank-lending channel in Estonia. First, well-capitalized banks seem to experience a smaller outflow of deposits after monetary contraction. Second, the liquidity position of banks seems to be an important determinant of loan supply suggesting that more liquid banks are able to maintain their loan portfolios, while less liquid banks must reduce their loan supply in response to monetary policy tightening.

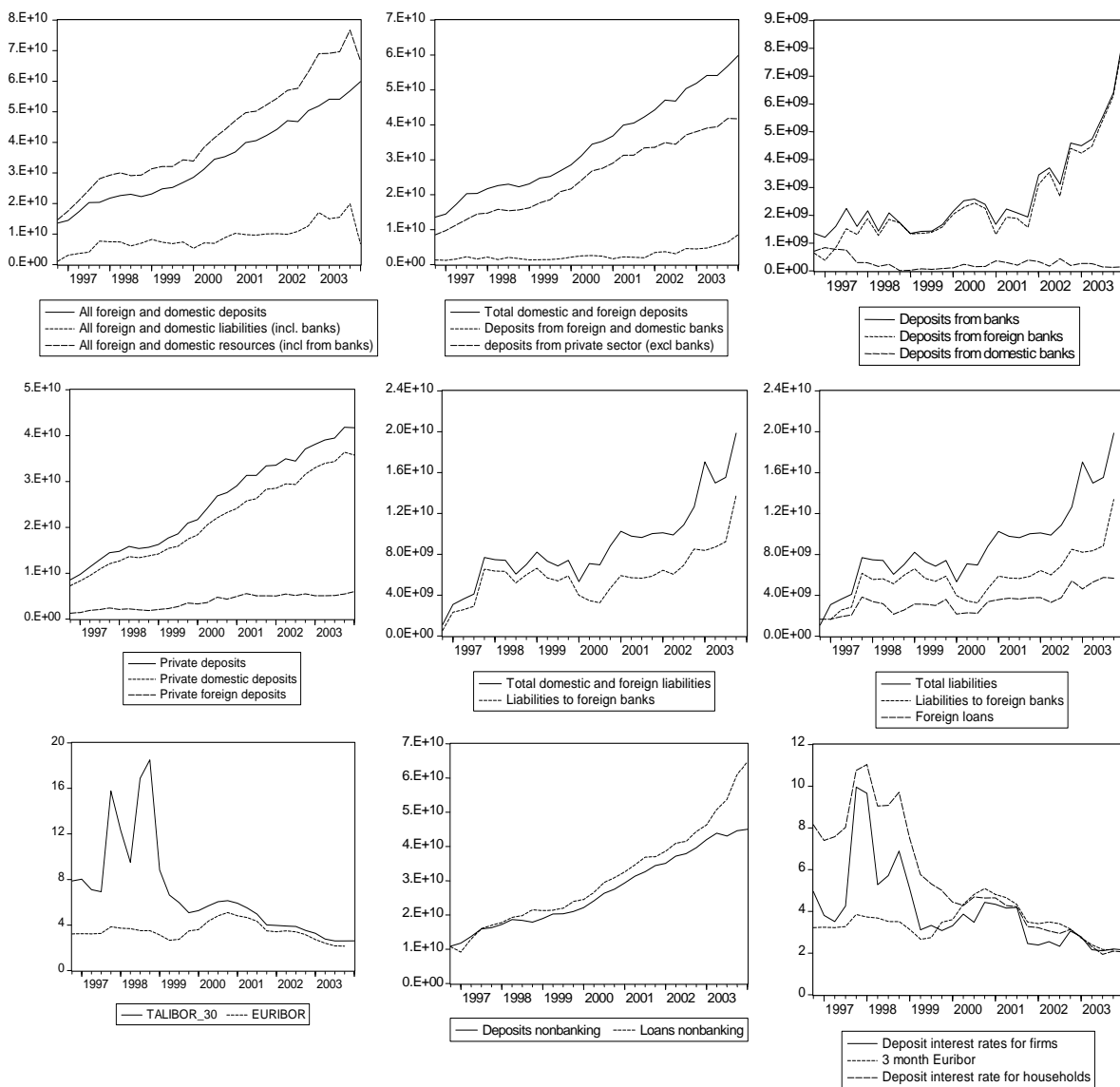
Conclusions

The main goal of this paper is to determine the significance of the bank-lending channel in Estonia. Descriptive and empirical analyses are carried out to provide evidence of the bank-lending channel in Estonia. The results from the descriptive evidence suggest that there is a significant share of bank dependent borrowers in Estonia. The dominant role of banks in financial intermediation and the low development of stock and debt markets make direct capital market finance costly, especially for households and small and medium sized firms. The impact of a monetary policy shock on the loan supply of the banks, however, seems to be less clear. The high market concentration and the presence of foreign ownership weaken the potential effect of monetary policy on the loan supply of the banks. The fact that the parent institutions of Estonian banks serve as liquidity-providers in times of a monetary tightening has become especially evident in the last two years. Nevertheless, the cost of these external resources tends to be higher than the cost of internal resources. All in all, it is not clear from the descriptive evidence how the loan supply of the banks reacts to a monetary policy shock that drains the reserves from the banking sector.

The empirical analysis provides evidence in favour of the bank-lending channel in Estonia. First, well-capitalized banks seem to experience a smaller outflow of deposits after a monetary contraction. As a consequence, a monetary policy shock that leads to a drain of deposits from the banking sector has the highest effect on the deposits of less capitalized and more risky banks. Second, the liquidity position of banks seems to be an important determinant of loan supply suggesting that more liquid banks are able to maintain their loan portfolios, while less liquid banks must reduce their loan supply after monetary policy contraction. This finding is consistent with the evidence from the euro area, where liquidity is also the most important determinant of loan supply.

This analysis can be extended in a number of important ways. First, the analysis of deposits could also incorporate the effect of the monetary policy on deposits from abroad. Although the share of these deposits is small, it seems likely that the monetary policy of the ECB could have a significant impact on them. Second, an analysis of the behaviour of the liabilities of the banks, especially those of the parent banks, could provide additional information about the strength of the bank-lending channel in Estonia. Third, the analysis of loan supply could be repeated when better control variables that vary over time and across banks become available. Finally, the analysis of the bank-lending channel could also incorporate the direct effect of monetary policy on the loan supply of the banks, not only the indirect effect through deposits.

Appendix. Data description



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