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1 Bank of Finland, Research Department, email: jukka.topi@bof.fi.
2 Bank of Finland, Research Department, email: jouko.vilmunen@bof.fi.

The Eurosystem Monetary Transmission Network

This issue of the ECB Working Paper Series contains research presented at a conference on "Monetary Policy Transmission in the Euro Area" held at the European Central Bank on 18 and 19 December 2001. This research was conducted within the Monetary Transmission Network, a group of economists affiliated with the ECB and the National Central Banks of the Eurosystem chaired by Ignazio Angeloni. Anil Kashyap (University of Chicago) acted as external consultant and Benoît Mojon as secretary to the Network.

The papers presented at the conference examine the euro area monetary transmission process using different data and methodologies: structural and VAR macro-models for the euro area and the national economies, panel micro data analyses of the investment behaviour of non-financial firms and panel micro data analyses of the behaviour of commercial banks.

Editorial support on all papers was provided by Briony Rose and Susana Sommaggio.

Address	**Kaiserstrasse 29**
	D-60311 Frankfurt am Main
	Germany
Postal address	**Postfach 16 03 19**
	D-60066 Frankfurt am Main
	Germany
Telephone	**+49 69 1344 0**
Internet	**http://www.ecb.int**
Fax	**+49 69 1344 6000**
Telex	**411 144 ecb d**

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Abstract

We use a panel of quarterly time series observations on Finnish banks to estimate reduced form equations for the growth rate of bank loans. By allowing for individual bank specific effects in the empirical models we specifically seek evidence of a bank-lending channel for the transmission of monetary policy shocks in Finland. On the basis of our estimation results, we conclude that there is weak evidence in favour of the bank-lending channel for monetary policy shocks. Our data overlaps with the post crisis recovery of the Finnish banking sector with specific government support measures still active during the good part of the sample period. We try to capture the effects of these measures through a policy dummy variable in our empirical models. This policy dummy is highly significant, suggesting that the measures may have contributed to the growth rate of bank loans during the sample period.

Key words: Monetary policy, money view, credit view, banking crisis, GMM

JEL classification code: E51, E52, G21

Non-technical summary

Many researchers agree that monetary policy has effects on inflation and the level of short-run real activity. Disagreement seems to exist (and persist) as to what exactly explains the short-run potential of monetary policy. According to the *money view* of policy transmission, embedded in e.g. IS-LM analysis, interest rate and exchange rate shocks impinge directly on components of aggregate demand. Consequently, banks are not special from the point of view of the transmission of monetary policy shocks. In particular, this view builds on perfect capital markets so that all other financial assets are perfect substitutes. In the *credit or lending view* of policy transmission, on the other hand, the effectiveness of monetary policy depends critically on the assumed capital market imperfections (informational problems). These frictions imply that it is more difficult for some agents in the economy to obtain outside, market, funding to finance their consumption and investment plans. So either borrowers' net worth or balance sheet position – broad credit view – or dependence of bank loans – bank lending view – occupies an important role in financing the expenditure plans of these constrained agents.

There is a large amount of empirical evidence from disaggregated data sets that tries to shed light on the relative importance of the different channels for the transmission of monetary policy shocks. In the end, the central question in the empirical context is how important banks are for the transmission of monetary policy shocks. Consequently, empirical specifications e.g. for data on individual banks typically used in applications that seek evidence in favour of the bank lending channel incorporate bank specific information and variables that are allowed to interact with monetary policy shocks. The maintained hypothesis is, then, that for an operative bank lending channel of policy transmission we should observe differences in the response of bank lending and deposits to monetary policy shocks among the banks with different characteristics. That is bank heterogeneity along pre-specified dimensions should show up as differential bank level response of bank lending and deposits to monetary policy shocks.

In this paper we seek evidence in favour of the bank lending channel using a panel of quarterly time series observations, covering the period 1995.1-2000.4, on individual banks in Finland. We estimate dynamic equations for the growth rate of bank loans using Generalized Method of Moment (GMM) estimation in a panel data set. Apart from the autoregression on each bank's loan growth, the variation in the observed growth rate of a bank's loans in what we call the "benchmark" specification is explained by the growth rate of the real GDP, inflation and monetary policy shocks. Among the alternative ways to identify monetary policy indicators or shocks, we decided to work on the quarterly changes in Bank of Finland tender rate, a series that was extended, from the beginning of 1999 onwards, with the changes in the main refinancing rate of the ECB. The postulated specification also allows for unobserved individual heterogeneity, ie. individual specific deterministic trends in the growth rate of loans. This "benchmark" specification is then extended to allow for bank specific factors to affect the growth rate of loans as well as to interact with monetary policy shocks. The estimated coefficients on these interaction terms gives us information about the economic as well as statistical importance of banks in the transmission of monetary policy shocks. The bank specific variables that are used in the estimations are bank size, liquidity and capitalisation. As far as favourable evidence for the bank lending channel is concerned, the estimated coefficients on the interaction terms of these variables with the monetary policy indicator are expected to be positive. The interpretation is that we should observe weaker monetary policy effects among more liquid and better capitalised banks. Also, since the most favoured interpretation of the size variable is that it acts as a proxy for the informational frictions that banks face, the estimated coefficient on the interaction of size with monetary policy shocks is also expected to be positive.

According to the results, bank lending responds positively to changes in real income growth and inflation. Both the estimated dynamic and long-run coefficients on these variables are highly significant. Bank lending also responds strongly to monetary policy shocks; the effect is negative, as expected, and highly significant, both in terms of short-run dynamic as well as long-run static response. Also, the linear effects of size, liquidity and capitalisation on the growth rate of bank loans are as expected; size enters negatively, while liquidity and capitalisation positively with the effects statistically significant. Most of the interaction terms, however, do not enter significantly, although they are, on the whole, correctly signed both in terms of short-run dynamic and long-run static effects. We tentatively conclude that bank heterogeneity is not irrelevant for monetary policy transmission, but that our data is just too noisy for us to identify definite signals. One possible reason is that early in the sample Finnish banks were still very much recovering from the large adverse shocks that hit is after the collapse of the fixed exchange rate system late in 1992. In close relation to this, bank support measures introduced by the government were still active in the first half of the sample. The effects of these policy measures are captured by a policy dummy in our empirical model and it enters the specification highly significantly and with the expected positive sign. Overall, we conclude that there is at most weak evidence in favour of a bank lending channel for monetary policy in Finland.

1. Introduction

Research work on the transmission of monetary policy (shocks) to the economy is growing steadily. After a period of relatively intensive work, typically using structural vectorautoregressions (SVAR), on the transmission of exogenous monetary policy shocks at the aggregate level,[1] research has more recently increasingly moved towards analysing policy transmission at the micro level. Improved availability and quality of panel data sets, perhaps with a healthy good number of time series observations incorporated in them, together with the progress that has taken place in developing statistical methods for panel data, has resulted in an increase the efficiency of statistical inference. Also, use of panel data has provided additional flexibility to model users when they specify their statistical models for the purpose of inference, ie. estimation and hypothesis testing. More substantially, making use of panels has the potential advantage of providing more detailed information about how the distribution of liquidity changes after a monetary policy shock.

Many researchers accept the view that the actions of central banks have effects both on inflation and output (gap). However, disagreement over the reasons still exists today.[2] The traditional theories, exemplified in e.g. standard IS-LM models, focus on the direct effects of interest rates or exchange rates on components of aggregate demand. This is the so called *money view* of the transmission of monetary policy shocks.[3] Under this view, banks are not special, and whatever the share of bank deposits in the relevant monetary aggregate, their supply is taken to be a stable function of the monetary base, expressed in money multipliers.[4]

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[1] For a recent review on the aggregate effects of monetary policy shocks, see Christiano et al. (1998). The authors argue that although the appropriate set of assumptions for identifying the effects of an exogenous shock to monetary policy is still much debated in the literature, there seems to be considerable agreement about the qualitative effects of a monetary policy shock.

[2] Cecchetti (2001, p. 8).

[3] See e.g. Trautwein (2000) for a recent survey on the different transmission channels for monetary policy (shocks).

[4] Trautwein (2000, p. 158), who also notes that there is an asymmetry in standard considerations of the macroeconomic importance of banks' balance sheets; deposit liabilities play a role in determining aggregate demand, if only a subordinate one, by way of liquidity effects or real balance effects. Bank loans (assets) play no specific role, since other financial assets are regarded as perfect substitutes.

Banks are, however, special in the *credit or lending view* of monetary policy transmission[5]. As for the policy effects, the credit view generally emphasises borrowers' balance sheets as well as bank lending.[6] The effectiveness of monetary policy depends, under the credit view, critically on capital market imperfections (informational problems) that make it easier for some agents in the economy to obtain (outside) financing than others. Financial variables such as net worth or the amount of pre-existing debt accordingly influence the costs of external funds and create a mechanism linking financial factors to real economic activity.[7] Consequently, the effects of monetary policy shocks on individual borrowers depend on the strength of their balance sheets.[8] An operative bank lending channel, on the other hand, requires that a significant number of agents are dependent on banks for finance and that monetary policy impulses take effect mainly through the supply of bank loans.[9] Interest rate and capital regulations as well as banks' own balance sheet position presumably underlie the bank lending channel.[10]

In this paper, we try to bring in evidence that bears on the existence of the credit channel of monetary policy in Finland. We approach the issue empirically by estimating reduced form dynamic equations for bank loans, [11] initially proposed by Kashyap and Stein (1995), using a panel of Finnish banks over a relatively short period of time.[12] An important part of our approach is the identification of monetary policy shocks. To this end the set of relevant alternatives range from innovations in a relevant VAR through constructing surprises to dated and documented monetary policy actions to simple differences in the relevant policy instrument used by the central bank. By and large, we opt for the last one.

We want to make a couple of further observations that we think bear on our exercise, or on any comparable exercise on the Finnish banking data from the late 1990's. First of all,

[5] Cecchetti (2001, p. 8).
[6] The list is not exhaustive here so that finer distinctions are possible, see e.g. Trautwein (2000).
[7] See Repullo and Suarez (2000) and the references therein. The authors propose a model of the credit channel of monetary policy based on entrepreneurial moral hazard and bank monitoring. See also Bolton and Freixas (2000), whose model seeks to provide the underpinnings of the credit view of monetary policy.
[8] Repullo and Suarez (2000, p. 1932).
[9] See Kashyap and Stein (1997) for a summary of evidence that lend support to the importance of capital market imperfections and firm dependence of bank financing.
[10] Repullo and Suarez (2000, p. 1932).
[11] Basically the dynamic equations are autoregressive - distributed lag models with exogenous control variables (ARDLX) for deposits and the identified monetary policy shock as well as bank loans and the identified monetary policy shock, respectively.
[12] The cross sections of our sample outnumber, by an order of magnitude, its time series dimension (appr.350 against 20). See Arellano and Honoré (2000) for a survey on recent developments in panel data models, where one of the working hypotheses is "large N small T".

since our data is from the latter half of the 1990s, the first years spanned by it overlap with the post-banking crisis period experienced by the Finnish economy after the fixed exchange rate regime collapsed late 1992. These years are characterised by banking sector re-capitalisation,[13] greatly aided by public support from the government to banks to prevent bankruptcy and the speeding up of the restructuring of the Finnish banking sector.[14] One potential implication here is that the credit supply behaviour of intermediaries may have exacerbated the negative effects on spending caused by weak firm and household balance sheets.[15]

Secondly, although economic growth picked up already in late 1993 or early 1994, we believe that the balance sheets of many firms and, in particular, of households continued to deteriorate still for some time. Hence, the implied relatively low demand for (new) loans may partly explain the slack in loan growth that we observe during the first half of our sample. Also, evidence suggests that firms and households were really hit hard and cash flows were, for some time, heavily used to repay debts, maybe much in excess of what strikes as "optimal".

Finally, we do not think that extending the sample back in time would have provided us with information that matches the current one in terms of quality and comparability of the observations. Restructuring in the banking sector is one factor that weakens comparability. The switch from a fixed exchange rate (or a target zone) regime to a flexible one in late 1992 as well as the switch in monetary policy strategy to inflation targeting a little later is another important factor. In the potentially longer sample the latter would have had repercussions on the identification of exogenous monetary policy shocks. In particular, using the Bank of Finland tender rate to construct monetary policy shocks rests on firmer ground during the time span mostly covered by our sample.

The paper is structured as follows. The next section briefly reviews the boom-bust period of the Finnish economy following financial market liberalisation in the 1980's. The emphasis will be on the credit cycle, starting with the lending boom of the late 1980's, the subsequent financial collapse and banking crisis. Section three discusses the specifications employed in the empirical analysis. The post crisis evolution of the Finnish banking sector

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[13] During the period from the beginning of 1995 till the end of 1998 the equity-to-asset ratio of the banking sector increased by approximately 25 %.
[14] See Vihriälä (1997) for an extensive analysis of the Finnish banking crisis and, in particular, for a discussion of the hypothesis that problems due to moral hazard were present in the crisis.
[15] Kinnunen and Vihriälä (1999, p. 7).

is briefly reviewed in section four. As also observed elsewhere in the context of financial crises, the post crisis period in Finland is characterised by a restructuring of the banking sector. Section four also presents the data, informs the reader about the estimation method used in the empirical analysis and reviews the estimation results. Section five concludes. Tables summarising the data as well as the estimation results are relegated to appendices.

2. The boom-bust period of the Finnish economy

2.1 Lending booms: the interplay of strong credit growth, high asset prices and high perceived net worth

The Finnish boom-bust period from the late 1980's to early 1990's is remarkably similar to the experiences of many other economies, both developed and emerging markets, that deregulated their financial markets in the 1980's and 1990's. What is perhaps different in the Finnish case, relative to the developed economies, is the amplitude of the boom-bust cycle, and, accordingly, of the underlying credit cycle.

Financial market deregulation in Finland was followed by a boom both of the aggregate output and, in particular, of bank lending in the latter half of the 1980's. From the level of about 3 % p.a., the growth rate of the real GDP increased to 5.7 % p.a. in 1989. During the same time, the aggregate unemployment rate went down to approximately 3 %, implying that the labour markets were indeed very tight towards the end of the cycle. The timing of some of the measures to deregulate the financial markets - liberalisation of parts of the capital flows, the lifting of the interest rate ceilings on bank loans – preceded a period of strong cyclical growth of the Finnish economy. The strong cyclical growth performance of the economy was partly initiated and certainly sustained by the large positive terms of trade shocks that occurred after the oil prices went down in the mid 1980's. From the beginning of 1985 to the end of 1989 the terms of trade of the Finnish economy improved almost 25 %, almost 2/3 of which took place only within the first two years.

The rapid cyclical expansion of the Finnish economy was boosted by the accompanying lending boom. From the mid 1980's to the end of the decade, the ratio of aggregate lending to nominal GDP – the inverse of credit velocity - increased about 50 %. During the lending boom, credit was extended, in particular, to the non-tradable sector as the increase in internal funds (of firms) permitted more borrowing. The boom in the non-tradable sector shows up in an increase in the relative price of non-tradables; from the end of 1988 till the end of 1990 the relative price of non-tradables increased by approximately 10 %.[16]

That credit to the private sector increases so quickly is an essential part of a lending boom, which, in turn, has become the cornerstone of recent theories of financial and banking crises.[17] The underlying idea is that since leverage increases and since financing is extended to ever riskier project, banking sector exposure and vulnerability increases as does the likelihood of a banking crisis. The precise origins of lending booms could be diverse. They could arise from a poorly regulated financial market liberalisation, a surge in capital inflow or a terms-of-trade shock that boost domestic investment and consumption.[18] In any case, the outcome was a sharp increase in firm and household indebtedness as well as a steep rise in asset prices. The exchange rate could not be relied upon to smooth out the rapid expansion, since the economy operated under a target zone regime during the period. However, the strong edge of the exchange rate band was shifted downwards in the heyday of the expansion - springtime 1989 - to allow for the (nominal effective) exchange rate to appreciate by approximately 4 %.

At the mature stage of the expansion, monetary policy was tightened[19] and a little later, late in 1990 and especially in early 1991, the economy was hit by large external shocks. On top of the cyclical downturn, there was a collapse in the trade with the former Soviet Union,[20] the outcome of which was an increase in the interest rates, increased pressure against the FIM and eventually, in November 1991, a substantial devaluation[21] of the FIM. However, (speculative) pressure against the FIM continued and the authorities took the

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[16] The real appreciation of the non-tradable sector relieves its debt burden, leaves the sector with more internal funds, thus allowing more borrowing. Investment demand, in particular, rises, driving even further up the price of non-tradable. The analysis in Schneider and Tornell (2000) puts a heavy emphasis on this interplay of the real exchange rate - relative price of non-tradables - and credit which allows the demand for non-tradables to outpace the supply. In the resulting 'self-feeding frenzy', the non-tradable sector fuels its own boom (p. 3).

[17] See e.g. Gourinchas *et al.* (2001).

[18] Gourinchas *et al.* (2001, p. 2). Whether financial market liberalisation was poorly regulated in Finland is still debated. However, the other origins of lending booms alluded to in the main text appear to apply well in the case of Finland.

[19] Towards the end of the 1980's the Bank of Finland introduced a special arrangement or prudential tool, 'speed limits' on the growth of credit, to monitor the rate of growth of bank lending. According to the system design, excessive bank lending was penalised. The system may have not been entirely effective, given the high perceived profitability of extending bank credit.

[20] In June 1991 Finland unilaterally decided to peg the FIM to the ECU. Formerly, the exchange rate was quoted in terms of the trade weighted basket. Soon after the decision to peg to the ECU, the FIM depreciated within the band towards the weak edge of the band.

[21] I.e. realignment of the official band for the FIM.

decision in September 1992 to allow the FIM to float. Thereafter the FIM continued to depreciate so that in the spring of 1993, at its weakest, it had lost almost 40 % of its value in November 1991, prior to the devaluation.

2.2 The collapse: asset values drop, banks' vulnerability increases

In the three year period of 1991-93 output losses amounted to approximately 13 % in the aggregate, while aggregate unemployment rate quintupled from around 4 % in 1991 to 20 % in 1993. Also, stock prices fell by two-thirds and housing prices halved. The latter, in particular, may have increased banks' exposure considerably, since it is, by a large margin, the main household asset and since a fair amount of speculative investment, to a large extent financed by bank lending, was allocated to housing markets and real estate over the boom period.[22] The resulting collapse resembles a lot the basic facts of the Great Depression during the 1930-33 period in the US.[23] The ratio of loans to the nominal GDP dropped over 30 % from the last quarter of 1992 to the end of 1995 period,[24] the (M1) velocity fell 10-15 % during the same period, the currency/deposit ratio increased approximately 25 % while the loan/deposit ratio dropped about 35 % during the period, and, finally, the ex post real interest rates increased from about 7.5 % to 12 % from mid 1991 to mid 1992. Banks saw debt service difficulties mounting, an ever-increasing share of their outstanding credits becoming non-performing as well as the number of bankruptcies multiplying.[25]

Finnish banks experienced growing liquidity and solvency problems. A major commercial bank (Skopbank), which also functioned as the "central bank" of the some of the savings banks, failed already in the fall of 1991. The bank was subsequently taken over by the Bank of Finland. The government started to intervene more heavily, initially in the form of establishing asset management companies to manage the insolvent banks. Later it provided a guarantee that despite the crisis the banks could continue to honour their commitments. More specifically, a state guarantee on the contractual commitments of the Finnish deposit banks was introduced as a result of the Parliamentary resolution in early 1993,

[22] Allen and Gale (1998, 2001), in particular, emphasise and offer a model of credit dependent asset price behaviour, which have the potential of explaining bubbly asset price dynamics.
[23] See e.g. Cooper and Corbae (2001, p. 19).
[24] And continued to fall essentially till the end of 1997.
[25] The number of bankruptcies doubled during the 1990-1992 period are remained persistently high till 1995 (Vihriälä and Kinnunen, 1999, p. 9, Figure 1).

which resolution was rescinded by the Parliament only in December 1998.[26] In addition to the general guarantees the government also provided banks with capital support.

The government took support measures to prevent a generalised "credit crunch" emerging from the difficulties in the banking system. However, despite the bank support commitments[27] amounting to about 16 % of GDP (FIM 80 billion), the amount of bank lending continued to decline. In particular, the growth of the GDP, which, driven by exports, started to recover already in late 1993, was followed by an increase in banks' credit stocks only as late as 1997. Note, interestingly, that the relative price of non-tradables started to edge up around mid 1996, suggesting that domestic demand started then to show (stronger) signs of recovery. However, judging by the subsequent behaviour of the relative price of non-tradables, (excess) demand pressure in the non-tradable sector has never in the post 1996 period been as strong as it was prior to the onset of the recession in early 1990's. This relatively slow expansion of the non-tradable sector shows up, in particular, in the historically high and persistent surpluses in the trade balance and current account since mid 1990's; the average post 1995 trade balance (current account surplus) amounts to about 8 % of the GDP (4.5 %).

After the collapse of the ERM peg in late 1992, the more or less common perception was that high employment and activity levels became increasingly difficult to defend using fiscal policy measures, because public sector indebtedness started to increase at an unsustainable rate. Indeed, the central government debt increased from about 10 % of GDP in 1990 to approximately 70 % of GDP in 1996. Consequently, the focus in fiscal policy shifted towards stabilising the public debt (relative to the GDP). Also, the effectiveness of the conventional fiscal multipliers may be suspect at high and increasing levels of the public debt.[28] Post collapse monetary policy, on the other hand, after adopting the inflation target in February 1993 moved relatively quickly to lower steering rates. After peaking at 18.45 % in late 1992, the Bank of Finland tender rate hovered around 5 % in 1994, increased to 6 % in 1995 before starting, in late 1995 on decisions by the Bank of Finland,[29]

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[26] The Finnish deposit insurance scheme was revised at the start of 1998. Depositors' claims are in the new scheme protected by means of a new deposit guarantee fund. The most significant change from the depositor's perspective is perhaps that instead of full protection, there is now an upper limit – FIM 150 000 - on the guarantee per depositor per bank. For further details, see e.g. Valori and Vesala (1998).
[27] Include capital injections to asset management companies.
[28] See e.g. Sutherland (1997).
[29] From December 1994 onwards the Bank of Finland consistently opted for fixed price tenders in its main liquidity operations. In these tenders the Bank of Finland fixed the price of liquidity so that the quantity of

to fall again, reaching 3 % in fall 1996. Thereafter, till the end of 1998, the path of the Bank of Finland tender remained relatively flat.

The following chart nicely summarises the economic background of our study.

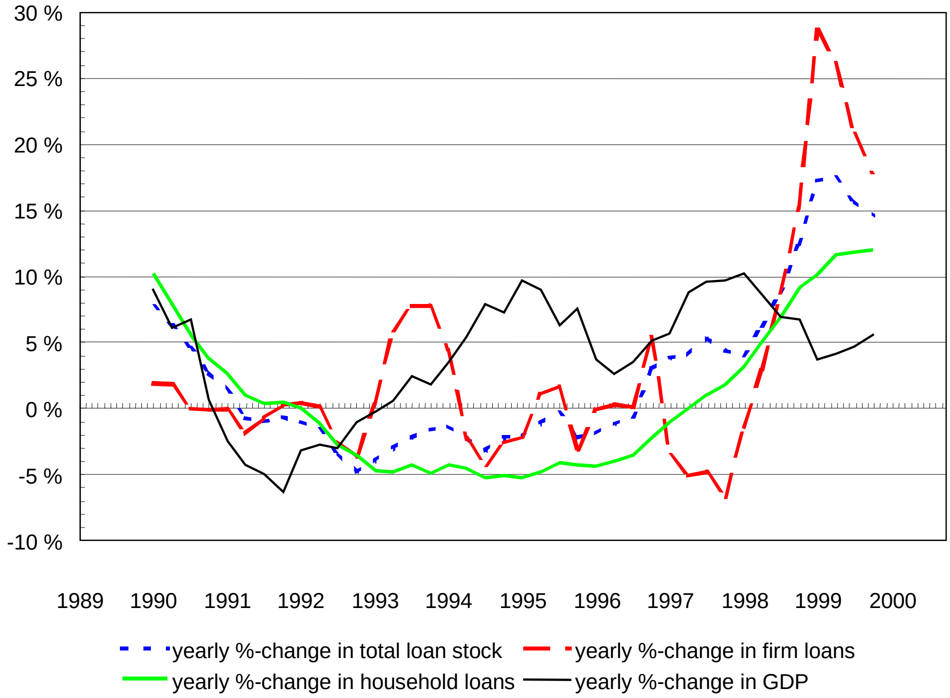

Chart 1. Output and loan growth in Finland.

2.3 Literature on the role of financial factors in macroeconomic adjustment in Finland

As argued above the general pattern observed in the development of some key macroeconomic variables is consistent with an operative financial accelerator in the Finnish growth experience during, in particular, the period from late 1980's to mid 1990's. Moreover, a number of studies have produced econometric evidence suggesting that borrower balance sheets occupied a critical role in the growth cycle. For example, Brunila (1994) finds in a panel of Finnish firms covering most of the boom-bust cycle that their investments in fixed assets was adversely affected by indebtedness, whereas a positive contribution over

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liquidity was determined in the tenders. Previously, the Bank of Finland tended to use fixed quantity tenders, where the price of liquidity was determined in the tenders.

time could be found from cash flow. Honkapohja and Koskela (1999), using a similar panel data set, conclude that the sensitivity of investment to cash flow is higher among firms classified, a priori, as financially constrained. The time series evidence in Kajanoja (1995) agrees with Honkapohja and Koskela.[30]

As far as the role of financial intermediaries in generating the growth cycle is concerned, we need, as is well known, some identification scheme which would enable us to infer from the data that supply rather than demand factors accounted for the behaviour of banks' credit stocks. Saarenheimo (1995) worked on such a scheme in his empirical analysis based on a VAR consisting of bank loans, money, the loan rate and fixed investment. His results suggest that new additions to credit stocks accounted for most of the increase in the level of private fixed investment during the boom years of 1987-1990. The flip side of his results is that during the bust years investment would have been higher were there no shocks to credit. In terms of size credit appears to have affected investment asymmetrically; effects appeared to be larger during the boom years.

Vihriälä's (1997) panel data analysis, on the other hand shows, that savings banks that were weak in terms of capital and costs were much more aggressive in expanding during the boom years, even after controlling for demand factors. He interprets this as stemming from moral hazard, and observes that this distorted supply behaviour accounted for all the difference in credit growth between the aggregate of savings banks and the co-operative banks. However, the evidence on the role of banks' supply behaviour during the crisis years is more ambiguous. No evidence of a credit crunch could be found, although weak asset quality - measured by the share of non-performing assets to total assets - appears to have had an adverse effect on bank lending. Finally, Kinnunen and Vihriälä (1999) examine the role of bank relationships in business closures during the crisis years. Using a unique panel data set, the authors were able to identify those firms that had a relationship with the most troubled part of the banking sector, the Savings Bank of Finland and the Skopbank. They conclude that firms that had a lending relationship with the savings banks concerned were more likely to close in 1992 than other firms that year or same firms in other years. They interpret this result as giving support to the hypothesis that financial

[30] According to the further evidence provided by Honkapohja and Koskela, financial factors appears to have played a role also in the behaviour of private consumption (wealth and liquidity effects) as well as in the dynamic behaviour of prices and wages, which were affected by indebtedness.

factors affect the real economy not only through firm and household finances but also through bank behaviour.

3. Model specifications

The approach taken here to explain observed variations in the growth rate of bank loans in Finland during the latter half of the 1990's builds on the now very standard specification introduced and analysed by Kashyap and Stein (KS, 1995). In the KS specification, the observed variation in growth rate of bank loans is explained by which, in particular, focuses on the effects of the interaction between size and monetary policy shocks on banks' loan supply behaviour, that we estimated takes the following form

$$\alpha(L)\Delta \log L_{it} = \eta_i + \beta(L)L\Delta MP_t + \gamma_Z g\left(Z_{i(t-1)}\right) + \sum_{j=1}^{4} \delta_j \left[\Delta MP_{t-j} \cdot g\left(Z_{i(t-1)}\right)\right] + \theta(L)^T X_t + \upsilon_{it} \qquad (1)$$

where

- The subindex **i** refers to bank i
- $\mathbf{LogL_i}$ denotes the (natural) log of bank's i loans
- **MP** is the monetary policy shock or indicator
- **Z** refers to bank specific explanatory variables (a measure of the size, liquidity and capitalisation of a bank)
- the function **g** denotes transformation of the bank specific variable; in the present study we use deviations of the bank specific variables from their cross sectional means, so that the transformation g is defined as

$$z_{i(t-1)} \equiv g\left(Z_{i(t-1)}\right) = Z_{i(t-1)} - \frac{1}{N}\sum_{i=1}^{N} Z_{i(t-1)}$$

- **X** denotes the vector of control variables (GDP growth, GDP inflation, policy dummy)
- **Δ** is the difference operator

- υ is the error term
- $\alpha(L) = 1 - \alpha_1 L - \alpha_2 L^2 - \ldots - \alpha_p L^p$ is the autoregressive lag polynomial, whose roots are outside the unit circle
- $\beta(L) = \beta_1 + \beta_2 L + \beta_3 L^2 + \beta_4 L^3 + \ldots + \beta_q L^q$ is the distributive lag polynomial for monetary policy shocks
- $\theta(L) = \theta_0^T + \theta_1^T L + \theta_2^T L^2 + \theta_3^T L^3 + \ldots + \theta_r^T L^r$ is the (vector form of the) distributive lag polynomial for the exogenous controls **X**; ^{T} refers to transposition

Our default is to set p=4, q=3 and r=3.[31] Writing out the relevant lag polynomials, putting the lagged dependent variables on the r.h.s. of the test equation and using the transformation of the bank specific variable, we can rewrite the model in a slightly different form which in an unbalanced panel such as ours is valid for for t=5,6,… ,T^i, where T^i denotes the number of time periods available for bank i:

$$\begin{aligned}\log L_{it} &= \alpha_1 \log L_{i(t-1)} + \alpha_2 \log L_{i(t-2)} + \alpha_3 \log L_{i(t-3)} + \alpha_4 \log L_{i(t-4)} \\ &+ \beta_1 \Delta MP_{t-1} + \beta_2 \Delta MP_{t-2} + \beta_3 \Delta MP_{t-3} + \beta_4 \Delta MP_{t-4} \\ &+ \gamma_Z z_{i(t-1)} + \sum_{j=1}^{4} \delta_j \left[\Delta MP_{t-j} \cdot z_{i(t-1)}\right] + \theta(L)^T X_t + \upsilon_{it} \qquad (2)\end{aligned}$$

Consequently, on top of the autoregressive part, the model posits linear effects from monetary policy shocks and bank specific characteristics as well as first order interaction effects of monetary policy shocks and bank specific characteristics on banks' loan growth. The vector of controls, X_t, essentially consists of lagged GDP growth as well as of lagged GDP inflation. These serve as a set of aggregate demand controls or as proxies for demand shocks. It would be highly desirable to incorporate in each bank's loan growth equation control information about the bank's customers, but unfortunately this information is not available to us. In addition to these demand controls, the X-vector also incorporates a policy dummy, denoted by D98 in what follows, that is supposed to capture the effects of the support measures introduced by the government to prevent a generalised

[31] The decision to work on, basically, four lags was based on earlier experimentation with the model. A dynamically more parsimonious model, with e.g. two lags, did not perform as well the present specification. This shows up, in particular, in the fourth lag of the AR- as well as the DL-polynomials (for GDP growth and inflation) being highly significant.

credit crunch from emerging, as argued earlier. Since the Parliament lifted the government guarantee on banks' loan commitments in December 1998, this dummy switches off (to zero) from the beginning of 1999.[32] Note, finally, that the postulated specification does not allow for GDP growth – inflation interaction terms nor interaction between policy shocks and these aggregate controls. This choice merely reflects our modelling assumptions.

Note that there is an underlying identification scheme that enables us to use this specification to quantify the effects of monetary policy shocks on loan supply using and to assess whether there are differential response to these policy shocks among different types of banks. Among other things, this scheme requires that the β - coefficients do not depend on the parameters of an individual customer's demand for loan function. Of course, alternative identification schemes could conceivably be imposed and tested given that an appropriate data set was available.

To be more specific and formal, the static core of the above dynamic specification can be given e.g. the following theoretical interpretation.[33] In a highly simplistic model banks grant loans L^b, issue deposits D^b, purchase bonds B^b and hold reserves R, with the following balance constraint:

$$R + L^b + B^b = D^b$$

The quantity of money is exogenously determined by the multiplier mechanism (reserve requirements): $D^b = R/\alpha$, where α denotes the reserve requirement ratio. Households allocate their savings into bank deposits and bonds, government finances its real expenditure by the reserves it borrows from the banks and by issuing bonds. The money market equilibrium can then simply be written as $R = \alpha D^h(y, r_B)$, where the superscript refers to households, y denotes households' real income and r_B is the interest rate on bonds. The interaction between banks and firms, on the other hand, follows Bernanke and Blinder (1988). Firms have two possibilities for financing their investments; they can either issue bonds or borrow from the banks. Bank loans are imperfect substitutes for bonds. If we

[32] The details are given in section 4, where we present the data as well as the estimation method and results.
[33] The presentation here follows Freixas and Rochet (1997, ch. 6). Note that we mainly want to highlight the relationship policy related (market) interest rate movements and changes in banks' loan supply with this small theoretical model.

denote the interest rate on bank loans by r_L we can write the investment finance constraint of as

$$I(r_B, r_L) = B^f(r_B, r_L) + L^f(r_B, r_L)$$

Investment depend negatively on both interest rates. The supply of bonds by firms, B^f, on the other hand, depends negatively on the interest rate on bonds r_B and positively on the interest rate on bank loans r_L. Finally, loan demand by firms, L^f, depends positively (negatively) on the interest rate on bonds (loans).

Portfolio optimisation by banks results in

$$L^b = \mu(r_B, r_L)R \quad and \quad B^b = \nu(r_B, r_L)R$$

with $\partial\mu/\partial r_B < 0 < \partial\mu/\partial r_L$ and $\partial\nu/\partial r_L < 0 < \partial\nu/\partial r_B$ and with $\mu(r_B, r_L) + \nu(r_B, r_L) = (1-\alpha)/\alpha$. Now, equilibrium in the goods market (IS-curve) is given by $I(r_B, r_L) + G = S(y, r_B)$, where S(.) denotes real savings, while equilibrium in the credit market reads as $L^f(r_B, r_L) = \mu(r_B, r_L)R$. The credit market equilibrium implies that the equilibrium interest rate is given by $r_L = \phi(r_B, R)$ for some function ϕ with $\partial\phi/\partial r_B = [(\partial\mu/\partial r_B)R - \partial L^f/\partial r_B]/[\partial L^f/\partial r_L - (\partial\mu/\partial r_L)R] > 0$ and $\partial\phi/\partial R = \mu/[\partial L^f/\partial r_L - (\partial\mu/\partial r_L)R] < 0$. Consequently, the quantity of loans in a credit market equilibrium, L, is given by

$$L = \mu[r_B, \phi(r_B, R)]$$

where the unsuperscripted loan variable signifies the quantity of loans in equilibrium. In general, then, the equilibrium quantity of loans will depend, through the interest rate function ϕ, on the parameters of the loan demand function (by firms).[34]

Without further restrictions we cannot a priori determine how the equilibrium quantity of loans will respond to an increase in the market rate r_B, let alone identify the supply of loans behaviour through focusing only on the credit market equilibrium. To this end, as-

[34] Note that the equilibrium in the goods and money market will determine output and the market rate in the model.

sume that $\mu_{r_B} + \mu_{r_L} \cdot \phi_{r_B} < 0$[35] and that there is no heterogeneity across firms in the response of their loan demand to changes in either the market rate r_B or the loan rate r_L.[36] The first one of these assumptions is consistent with the idea that there is stickiness in the interest rate structure – or restricted pass through – in the sense that the equilibrium loan rate r_L does not respond too strongly to movements in the market rate r_B.[37] Under these conditions an increase in the market rate r_B, *cet. par.*, leads to a reduction in the equilibrium quantity of (an individual bank's) credit essentially through a dominant adverse loan supply effect. Reasoning along these lines is used in the empirical part of the paper where the maintained is that monetary policy shocks impinge negatively on bank lending.

In what follows, we shall focus entirely on loans, ie. we shall not present, in this paper, results from estimating analogous specifications for bank deposits. We do have a corresponding set of estimation results for deposits too, which can be summarise briefly as follows.[38] As for the effects of monetary policy shocks, the results suggest that differences emerge, on the one hand, whether one uses the tender rate or the money market rate as the indicator for monetary policy shocks and, on the other hand, whether the policy dummy D98 is included in the test equation. *Without the policy dummy* the aggregate a well as long-run effect of policy shocks on deposit growth tends to be negative, as expected. The aggregate and long-run effects of interest rate shocks on deposit growth are, however, positive with the money market rate. *With the policy dummy* these effects are negative on both measures of interest related monetary policy shocks. 1- and 2-step estimator generally agree on these conclusions. However, overall the models perform poorly both in terms of the specification tests as well as in terms of many of the individual coefficient estimates, particular of the aggregate demand controls.

Before we go on to estimate different variants of the above specification, we note that we allow for time invariant individual effects, η_i, to enter the model specification. In a stationary *level* regression, the economic interpretation of the individual effects would be in terms of differential, bank specific long-run loan levels or individual specific random

[35] The subscripts refer to the relevant partial derivatives.

[36] This implies, then, that the partials $\partial L / \partial r_B$ and $\partial L / \partial r_L$ do not depend on firm characteristics.

[37] Given, naturally, the response of a bank's optimal portfolio to changes in the loan rate as embedded in partial μ_{r_L}.

[38] These results are available from the authors upon request.

components (long-run random fluctuations around a fixed mean), depending on the econometric interpretation of the η_is as fixed or random effects. The interpretation in the present context is, however, different, since we are modelling the *growth rate* of bank loans. In this context the η_i parameters are associated with different deterministic trends $\eta_i t$. These trends can be randomly different depending on the assumptions made about the η_is. Anyway, a natural interpretations of the individual effects appears to be, then, that of individually specific deterministic trends.[39]

In some contexts postulating a data generating process that allows for the presence of individually deterministic trends may be useful due to some individually specific "growth" characteristics. However, similar line of reasoning need not, at least not without further qualifications, apply here. The reason is that bank loans cannot grow on a linear trend *relative* to the nominal GDP, which could be the case in the present context, if the individual deterministic trends enter unrestrictedly. This suggests that caution should be exercised when thinking about using the model in e.g. a forecasting context. In particular, economic reasoning suggests that trends in bank loans and in the GDP have to agree, so that on average (ie. in the aggregate) there is no (linear) trend in bank loans relative to the GDP. However, we do not throw away the idea that individual bank specific characteristics impinge upon a bank's loan growth - it is, in itself, a useful modelling assumption - so that we work with the specification in equation (2).

4. Data, estimation method and results

4.1 Data: Evolution of the structure of the Finnish banking system

Some of the features in the evolution of the Finnish banking system may, in the end, introduce qualifications to any bank specific analysis of the credit channel of monetary policy transmission in Finland. The reasons underlying the special nature of the Finnish banking sector are related, in general, to the small size of the Finnish economy and, more specifically so, to the banking crisis of the early 1990s.

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[39] For an overview of non-stationary panel data analysis, see Phillips and Moon (1999), where they also push forward the interpretation of the individual effects as individually deterministic trends. For a very thorough analysis of the linear regression limit theory for non-stationary panel data, see their (1998) paper.

Overall the Finnish banking market has, past and present, been characterised by the existence of both a small number of dominant players and a large number of small local banks. This type of heterogeneity among the banks - a bipolar nature of the banking sector - potentially makes it more difficult to draw general conclusions concerning the comparative behaviour of the banks of different types. To take a concrete example, the small number of large banks may result in giving a (disproportionately) large weight to some random factors impinging on the banking business.

Moreover, there may exist challenging difficulties in associating banks with their effective bank specific characteristics. In case of Finland, this particular difficulty manifests itself most clearly in the OKO Bank Group of co-operative banks (, which includes roughly 240 co-operative banks). *While these co-operative banks act as independent entities in the credit market*,[40] they are presently in closer cooperation, and have been so especially since 1997 when a re-organisation of the group was carried out. At that time, some of the co-operative banks (about 40) rejected the proposed form of co-operation in the OKO Bank Group and established another group for co-operation.

More often than not, the post crisis recovery of economies involved, in particular, restructuring and reorganising the banking sector or, more generally, the financial sector. Finland is no exception to this rule. Perceived over-capacity in the banking sector was reduced and, at the same time, concentration further increased in the banking industry. Before the banking crisis, five major banking groups dominated, in terms of the respective market shares, the banking markets. Currently, the number of major players has gone down to three (Nordea/Merita, OKO Bank Group with local co-operative banks, and Sampo-Leonia). Currently, the aggregate market share of these groups is approximately 80 %. As explained earlier, the most important steps in the reorganisation of the Finnish banking sector were taken when the Savings Bank of Finland was split among the four rival banking groups in 1993, and when Kansallis-Osake-Pankki and Unitas merged into Merita Bank in 1995.

[40] OKO Bank Consolidated consists of the parent bank OKO Bank, the subsidiaries Okopankki Oyj, OP-Finance Ltd, Opstock Ltd and OKO Venture capital Ltd. The OKO Bank Group, on the other hand, is comprised of 244 independent member co-operative banks and Group's statutory central institution, OKO Bank Group Central Co-operative.

Despite these relatively dramatic changes in the Finnish banking sector, it is evident that the individual co-operative banks are independent entities. Consequently they enter the panel of banks as different banks with the end result that the cross sectional dimension of the panel is of an order higher than the time dimension. We are here arguing that under the prevailing corporate structure the OKO Bank Group should not be aggregated and treated as a single bank. In statistical terms, then, the cross sectional heterogeneity among the OKO Bank Group banks can legitimately be utilised in the ensuing statistical analysis on the banks' loan growth. To put this assumption on a slightly firmer ground, we checked the cross sectional distributions of loan growth, size, liquidity and capitalisation among the co-operative banks in the OKO Band Group in the last quarter of each year in the sample. The intuition here is that if the individual co-operative banks are, in effect, economically mere branches, this would show up in a tight, possibly even degenerate support of the distribution of at least some of the variables listed above. The results are encouraging in the sense that the underlying distributions for the OKO Bank Group appear to display sufficient hetergeneity and, actually, look very similar to those of other banks.[41]

Consequently, we end up using quarterly data on Finnish banks as well as on inflation and GDP growth covering the period from the beginning of 1995 to the end of 2000, ie. the sample period is 1995.1 - 2000.4. The maximum number of time periods for a single bank or the maximum length of an individual time series is thus 24 ($T = \max T^I = 24$), whereas the cross sections of the panel include 333-347 banks (N=343-347). Hence, the full capacity of the panel is in the range $T \cdot N=8232$ to 8328, but since ours is an unbalanced panel, the effective number of observations is less. Information on altogether nine banks was removed from the panel. The principal reasons for purging the panel this way were exit, too short time series and, simply, lack of information. More precisely six of the nine banks that were removed visited the sample for only one year. No information was available on two banks and, finally, for one of the banks the panel contained information only from the last quarter of 1998. Furthermore, since some of the individual time series contain observations that are extreme, a rule for purging the data for these extreme values was adopted. Specifically, all cross section observations of loan growth rates (log differences of bank loans) that are located in the lower or upper one percent tail of the distribution are

[41] The graphs of the associated empirical distribution are available from the authors upon request. We estimated our models on data that excluded the co-operative banks altogether and the results are very similar to those using the whole sample of banks. This is particularly so with respect to the effects of monetary policy shocks.

excluded in the estimations. All these measures and characteristics of the data amount to having, effectively, 5500-5600 observations in the estimations. Appendix C provides tables that summarise the main features of our sample on Finnish banks.

There are two main reasons for using such a panel with a relatively small number of time series observations. First of all, this allows us to partially control for the effects of the banking crisis in the sense that the worst years associated with the very onset and early years of the banking crisis are excluded from the sample. The underlying economic idea is that during these extremely exceptional years, monetary policy cannot have effects anything like those in more normal years. Hence, the first half of our sample can be characterised as a period of returning to normality in the banking business. The fact that the sample does overlap with the post crisis recovery of the economy, suggests that when taking a decision on the length of the sample we appear to face a trade-off. That is, we need to weigh the length of the time series against how representative the sample period is (relative to normal times). We think we have stricken a good balance. Secondly, due to restructuring and mergers, the data is not available to us in the same form for time periods prior to 1995. Consequently, a large amount of effort should have been invested in an attempt to extend to sample in comparable terms beyond 1995. We did not take this approach, given the highly exceptional years that we could have included by extending the sample.

There are a number of alternative approaches to identifying monetary policy shocks or to obtaining an indicator of monetary policy. The SVAR literature uses identification schemes to identify monetary policy shocks from estimated (residuals of) vectorautoregressions incorporating, on top of a number of aggregate variables like a measure of the output gap and inflation, a feedback rule - e.g. an interest rate or a money rule - for monetary policy. Initially, we also experimented with such a measure of monetary policy shocks, which was provided to us by the ECB. The relevant shock series, however, only covers the period till the end of 1998, which, in our case, means losing a relatively large number of precious time series observations in an already T-small sample. Hence, alternative measures of policy shocks had to be considered.

We opted for the use of the quarterly change in the Bank of Finland tender rate as the relevant monetary policy indicator. We extended it with the corresponding change in the

ECB's main refinancing rate for the post 1999 period. This procedure may not be ideal or entirely satisfactory, since, as the evidence suggests[42] policy relevant interest rate changes appear to be autocorrelated, particularly at very high frequencies, so that part of observed interest rate changes are anticipated. This appears to be less of a problem in e.g. quarterly data, however. An alternative to using the steering rates is to use a short-term (3M) money market rate as the basis for the policy indicator variable. Money market rates are also highly autocorrelated, so that once again a pure change in this interest rate may not be the ideal approach to measuring exogenous policy shocks. Furthermore, the time series properties of the money market rate differ considerable from those of the tender rate and this could show up in the comparative results. Anyway, money market rates have been used in this type of analyses, so that we also experimented with this alternative measure of policy shocks.

It turned out that the estimated long-run effects of monetary policy shocks on banks' loan growth are of the expected (negative) sign. However, the dynamic effects and, more so, long-run effects (aggregate effects) in particular of GDP growth are not entirely satisfactory in the case where the three months money market rate as the policy indicator.[43] Consequently we decided to report, in the main text, estimation results for the models using quarterly change in the Bank of Finland tender rate as our monetary policy indicator. Estimation results using quarterly changes in the three months money market rate as the policy indicator are given in Appendix B.

Although they often generally agree, the two indicators produce differences in the details of the estimation results. Sometimes the short-term money market rate performs better in terms of specification tests, but more poorly in terms of estimated effects of some of the variables. One possible explanation for these differences in the estimated short-run dynamic effects of policy shocks is in that the generating mechanism underlying the money market appears to differ considerably from the one underlying the tender rate. Observed time series on the tender rate could conceivably be modelled as realisations of a jump process, or at least of a slowly moving process that is also subject to discrete changes. These

[42] See e.g. Jääskelä and Vilmunen (1999) and the references therein. The authors focus on the Finnish case - the Bank of Finland tender rate - and argue, that, in the space of random policy steps in particular, consecutive interest rate changes are highly correlated. This correlation is less pronounced in calendar time, however. From the point of view of markets, it appears that (anticipated) interest rate changes are less correlated over longer (forecast) horizon.

[43] See the tables in Appendix B.

discrete changes either occur infrequently or tend to punch in time. The exact nature of the process underlying tender rate changes depends critically on the monetary policy operating procedures of the relevant central bank, especially on the nature of the liquidity management system and the role of interest rate targeting (signalling policy changes through the interest rate) therein. Short-term money market rates, on the other hand, are more likely to be generated by a (combined jump-) diffusion type process.

As mentioned above, Finnish government took measures that would reduce the risk of a credit crunch emerging as an outcome of the banking crisis. The economic argument here is that this policy measure must have affected banks' loan supply behaviour, which, consequently, has to be taken into account in the actual estimations. We do this by incorporating a dummy variable in the model specifications that we estimate. This dummy takes a value of one as long as the state guarantee for banks' loan commitments was in effect and zero thereafter. More formally, this means that our dummy, D98, say, is defined as D98=1, for $1995.1 \leq t \leq 1998.4$, and D98=0, for $t \geq 1999.1$.

4.2 Estimation method

The specifications are estimated by Generalised Method of Moments or GMM. Since the lagged dependent variable is included in the estimated model (with unobserved individual heterogeneity), ordinary least squares (OLS) estimation potentially suffers from not being consistent in T-finite samples, no matter how large the cross sectional dimension is. The (N-) asymptotic bias in the Least Squares (LS) estimator can, furthermore, be substantial in T-small samples (like ours).[44] More specifically, since the OLS does not control for the possibility of unobserved individual specific effects, it may result in upward-biased estimates of the autoregressive coefficients if these individual specific effects are important. The Within Groups estimator is OLS after transforming the data to deviations from cross sectional means. Consequently, it eliminates the individual specific effects but results in downward-biased estimates of the autoregressive coefficients in T-small panels. GMM in first differences eliminates individual specific effects by differencing the equations, and then uses lagged values of endogenous variables as instruments. If the error term in (growth) levels is serially uncorrelated, then the error term in first differences is MA(1), so that instruments dated t-2 and earlier should be valid in the differenced equation. Under

[44] See e.g. the analysis in Hsiao (1986, p. 71 ff.).

this assumption consistent parameter estimates can be obtained. If, on the other hand, the error term in (growth) levels is itself MA(1), then only instruments dated t-3 and earlier will be valid, and so on.[45] In the present application, GMM estimation is carried out by using the DPD procedure[46] in PcGive10.0.

4.3 Estimation results

We begin by presenting the estimation results for the "benchmark" model, which is an autoregressive distributed lag (ARDL) model for banks' nominal loan growth using the monetary policy indicator - quarterly changes in the Bank of Finland tender rate - real GDP growth rate and inflation rate as explanatory variables. This serves as a useful starting point for the subsequent analysis, where we present the results from estimating more complex models. In these richer models linear effects of bank specific variables (size, liquidity and capitalisation) as well as first order interaction effects from these bank specific variables and the policy shock also enter the equation to be estimated. Taking this last step to extend the model and hopefully finding statistically significant bank specific effects, we gain information about the existence of a bank lending channel in the transmission of monetary policy shocks to the economy.

Apart from the negative effects of monetary policy shocks – interest rate shocks – on banks' loan supply alluded to above, we would expect the following coefficient estimates from our analysis:

- GDP growth and inflation should enter positively: the relevant distributed lag coefficients should at least sum to a positive number
- the linear effects of bank liquidity and capitalisation is expected to be positive ($\gamma_Z > 0$ for Z = liquidity and capitalisation), whereas we expect size to enter negatively due to the underlying (implicit) assumption that Finnish bank loan markets exhibit stationary size distribution ($\gamma_Z < 0$ for Z = size)
- the effects of monetary policy is expected to be weaker among larger, more liquid or better capitalised banks; here the underlying assumption is that size is a proxy for information frictions or problems (adverse selection, moral hazard) so that smaller

[45] See Bond *et al.* (1997) and, especially, Bond and Arellano (1991).
[46] Arellano and Bond (1988).

banks, being more opaque, have greater difficulties in restructuring their portfolio of loans and other assets ($\delta_Z > 0$ for all Z)

- the dummy for the government guarantee of banks loan commitments is expected to enter positively implying that the policy measure had a positive contribution to banks' loan growth during its life ($\theta_{D98} > 0$)

Table A1 in Appendix A summarises the estimation results for this "benchmark".[47] Centered seasonal dummies (as well as a general constant) were also included in the estimated model, but their estimates are not reported in Table A1. The constant did not enter significantly, whereas some of seasonal dummies did. As such, using either of the two estimators, most of the estimated coefficients appear reasonable, both in terms of size and sign. In particular, all of the coefficients on monetary policy are of the expected negative sign, as well as of the appropriate size. Also, the implied sum of the distributed lag coefficients of monetary policy shocks, GDP growth and inflation, as given by the 2-step estimates

Aggregate effects of policy shocks, GDP growth and inflation (2-step)

Variable	Policy shocks	GDP growth	Inflation
Sum of coeffs	-4.477^{***}	0.7215^{**}	1.0056^{***}

indicate that the estimated aggregate effects of monetary policy shocks, changes GDP growth and inflation are highly significant.[48]

The estimated degree of persistence in loan growth appears plausible; the sum of the estimated AR-coefficients about 0.2, implying that shocks to banks' loan growth die out rapidly. Note that the estimated coefficient on the fourth lag is clearly dominant in size, which may be an indication of seasonal variation in loan growth. Three of the estimated lags for GDP growth are positive - two of them significantly so - while the first lag enters negatively and significantly. Overall, then, the estimated dynamic and, in particular, long-

[47] Table A2 uses the money market rate in the "benchmark" specification. Otherwise, we report both the so called 1-step estimates and 2-step estimates as given by PcGive10.0. In the present application, they are very similar . The two differ in the way the possibly individual specific weighting matrix (in the GMM estimate) is constructed. The asymptotic variance matrices are heteroscedasticity consistent in both cases. See e.g. Arellano and Bond (1991) for an extended analysis and illustrations.

[48] The 1-step estimates for the aggregate effects are similar, as can be readily verified from Table B1. However, we present the results from the pure significance tests of the aggregate effects only in the case of the 2-step estimation, since the 2-step is our main estimator.

run or aggregate effects of GDP growth on banks' loan growth are satisfactory.[49] Similar remarks apply for the inflation rate. It interesting to note that the aggregate effects of inflation on banks' loan growth may be just an inch too high for the long-run elasticity of loan growth w.r.t. inflation to be unity. This outcome would sustain the view that, plausibly, it is the variation in the long-run growth of real credit that our model aims to explain.

The dummy for the state guarantee of banks' (deposit and non-deposit) commitments, D98, appears to enter very significantly. It also has the expected positive sign, implying that the policy measures taken to counteract the adverse effects of the crisis on banks' loan supply appear to have been successful in the sense of contributing positively to banks' loan growth.

There is a marginal difference between the GDP growth dynamics as implied by the 1- and 2-step estimates.[50] The latter puts less weight on the first lag and more weight on longer lags of GDP growth than the former, to the extent that the aggregate effects of GDP growth on banks' loan growth are higher with the 2-step estimate.

As for the specification itself, the Wald[51] statistics suggest that the independent variables are jointly significant, while the robust autocorrelation tests, AR(1) and AR(2) tests respectively[52], do not provide evidence to suggest that the assumption of serially uncorrelated errors in the equation for the growth rate of bank loans is inappropriate in the present context. The 1-step AR(2) is somewhat marginal, of course, but does not reject the null of serially uncorrelated errors in the growth equation at the 5 % significance level. The Sargan test, on the other hand, appears to cast some doubt on the validity of this assumption so that it may not, in the end, be the most appropriate one. However, simulations in Arellano and Bond (1991) suggest that the 1-step Sargan statistics tends to reject the over-

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[49] An earlier version of the paper estimated, using OLS and GMM, loan growth equations by not allowing for bank specific effects at all in the test equations. These equations performed very poorly. Firstly, the estimated GDP elasticities were significantly *negative* and, in absolute terms, twice as large as the inflation elasticities reported here. The implied leading root of the AR polynomial for the loan growth was much higher, implying considerably more persistence. Also, the Sargan test statistics was either very marginal (borderline critical) or, more often so, clearly critical. We concluded that explicit control for unobserved heterogeneity is extremely important in our case and re-specified the model in order to apply the Arellano - Bond procedure.

[50] Of course, as Table A1 readily tells us, there is the bigger difference between the 1- and 2-step estimates in that the former is more critical about the specification we are using.

[51] Wald tests for the joint significance of all the regressors, excluding dummies. The corresponding Wald test for the joint significance of the dummies is not reported.

[52] The famous m_1 and m_2 tests of Arellano and Bond (1991).

identifying restrictions too often in the presence of heteroscedasticity. The 2-step Sargan test broadly agrees with this in the present context; the p-value for the observed test statistics is 0.132, so that the null (of valid over-identifying restrictions) is not rejected even at the 10 % significance level. Of course, it is conceivable that these somewhat conflicting test results - a sign of instability across the different instrument sets - reflects the failure of the strict exogeneity assumption (for the GDP growth and inflation) rather than serial correlation per se.

There is an interesting difference between the result reported in Table A1, where the Bank of Finland tender rate is used as the policy indicator, and the case where the three months money market rate stands as the policy variable (Table A2). First of all, the estimated model performs better in terms of the specification tests when the three months money market rate is used. This is particularly so with the 1-step GMM estimation. Also, some of the coefficients are more precisely estimated with the money market rate in the model as the source of policy shocks. Secondly, some of the estimated coefficients are more reasonable and plausible when the Bank of Finland tender rate enters as the policy variable. This is particularly so with the estimated coefficients on GDP growth. With the tender rate only the first lag of GDP growth enters negatively and the aggregate effect - also the long-run effect of - GDP growth on banks' loan growth is positive. Using the three months money market rate, however, two of the lags, first and fourth, generally enter with a negative coefficient with the coefficient on the first lag being the dominant one so that on aggregate (in the long-run), GDP growth appears to impinge negatively on banks' loan growth.

Thirdly, the estimated dynamic effects of inflation on banks' loan growth are less satisfactory with the money market rate in the sense that in this case there are more negative coefficients on the lags. Also, the aggregate effects of inflation on banks' loan growth are somewhat smaller in this latter case. With the money market rate more generally, smaller response on loan growth to changes in explanatory variables can be observed in our estimations.[53] Moreover, the results indicate that the model with the money market rate may, in the end, be more parsimonious in terms of, especially, the distributed lag lengths.

[53] It is quite conceivable that the money market interest rate is more correlated with both the GDP growth and the inflation rate, and that this shows up in lower coefficient estimates for these variables.

Overall, we conclude that the estimation results of the "benchmark" model provide a satisfactory starting point for further analysis. Consequently, we proceed to extend the model to include bank specific variables on top of those incorporated in the benchmark. We will consider three such bank specific variable, namely size, liquidity and capitalisation. The underlying economic argument for experimenting with these variables is, first of all, that banks are not in general irrelevant for the transmission of monetary policy. Secondly, the implied heterogeneity among the banks along these dimensions is important from the perspective of the effects of monetary policy shocks on the economy.

Table B1 reports the 2-step estimation results from adding a particular bank specific variable, each in turn, in the "benchmark" specification. The corresponding results using the 1-step estimator can be found in Table B2, while tables B3 and B4 report these estimates using the money market rate as the policy variable. The bank specific variables in these extended specifications enter as deviations from the relevant cross sectional average as defined earlier by the transformation g.

The second column of the tables (Model I) adds in a size variable, where size is defined in terms of the log of a bank's assets, as well as its interaction with (all four lags of) the monetary policy indicator. The third and fourth columns (Model II and Model III) present the corresponding results for adding in a liquidity variable and a capitalisation variable, in each case allowing for the interaction of the added variable with the monetary policy indicator. Liquidity is here measured in terms the sum of cash, short-term inter-bank deposits and government bonds, while capitalisation is defined in terms of each bank's equity-to-asset ratio. The following table summarises the aggregate effects of monetary policy shocks, changes in GDP growth and inflation on banks' loan supply in these extended models, ie. the estimated sums of the distributed lag coefficients

Aggregate effects of policy shocks, GDP growth and inflation (2-step)

Σcoeffs\Variable	**Policy shocks**	**GDP growth**	**Inflation**
Model I	-4.290***	0.6676**	0.8759**
Model II	-4.509***	0.7547**	1.015***
Model III	-4.315***	0.6747**	0.9299**

Once again, a (general) constant as well as seasonal dummies were also included in the estimated model, although their parameter estimates are not reported.[54] As far as "benchmark" variables are concerned, the general conclusion about their parameter estimates in Table B2 (and B3) is similar to what was mentioned above in the context of the "benchmark" model itself.[55] Also, although almost all of the estimated coefficients on the first order interaction terms enter insignificantly, they appear to be correctly signed. Since e.g. the size variable has the well-favoured interpretation of being a proxy for the information frictions faced by different banks – smaller banks being more opaque, thus facing higher costs of external funding – smaller banks being more opaque, thus facing higher costs of external funding – our results suggest that monetary policy shocks do not have statistically significant differential effects on banks' loan growth due to the heterogeneity in these information costs. However, given that the coefficients are correctly signed, we can speculate that the information costs may not be irrelevant, but that our data is just too noisy for us to be able to pick significant differential effects. Similar line of reasoning seems to apply to liquidity and capitalisation. Heterogeneity in terms of liquidity and capitalisation may not be irrelevant, but the signal of their potential importance in our sample is just too weak. The fact that the estimated aggregate interaction effects are sometimes marginal or even borderline significant (liquidity and capitalisation) appears give some support to these conjectures.

As for the estimated *linear* effects of the bank specific variables, they are also correctly signed. Liquidity and capitalisation both support stronger loan growth, whereas the bank size impinges negatively banks' loan growth. We interpret this latter result to indicate that the market for bank loans in Finland has a stationary size distribution or has a tendency to converge to a stationary size distribution. Under the alternative outcome, ie. positive size effect on loan growth, the interpretation would be, when taken to its logical limit, that bank loan dynamics would have a tendency to generate a monopoly. Or, alternatively, that markets for bank loans exhibit local scale economies due e.g. small size of a typical bank. Of course, it is conceivable that loan markets in economies indeed are driven by forces that generate monopolies, but we feel we are standing firmer on the ground in concluding in favour of the existence of a nontrivial size distribution in these markets. Finally, note

[54] Overall, the constant is not significant, while some of the seasonal dummies are.
[55] A curiosity about the results in Table 4.2 is that the AR polynomial is here even more special in that only the fourth lag enters significantly.

further that the bank support dummy D98 continues to enter significantly and with a correct sign.

As for the specifications themselves, the test statistics do not run against the specification, although this time the outcomes of the specification tests are not as supportive as in the "benchmark" case.[56] Once again, using the money market rate as the policy indicator, there is much less evidence against the specifications (Appendix B, tables B3 and B4), but there is the "cost" alluded to above from working with the money market rate, namely that of being given poor coefficient estimates for some of the explanatory variables.

Across the board, the conclusion that appears to emerge from these estimates is that the results are marginally more satisfactory in the case where either the liquidity or the capitalisation variables is added to the "benchmark" specification. One of the reasons is that the leading root of the AR polynomial on loan growth essentially implies no persistence in the loan growth process whereas in the "benchmark" case as well as in the other two cases persistence is nontrivial and much more plausible in size. Secondly, a closer look at the estimated individual AR coefficient estimates indicates that the first three are negative and the fourth is positive. Only the fourth lag enters significantly and turns out to dominate the others in size. So the dynamics of the estimated "benchmark" model with size are not entirely satisfactory, either in the sense that only the fourth lag remains after deleting all the insignificant lags or in the sense of having dynamics that alternate in sign. However, on balance, we feel justified in drawing the conclusion from our estimations that there is weak evidence in favour of the existence of a credit or bank lending channel in Finland.[57]

[56] The 1-step estimate are once again more critical about the specification (see Appendix B). In particular, the tests are now more marginal and often reject the relevant null hypotheses at conventional significance level.

[57] As argued earlier in the main text, one reading of the data may give the impression that the (log of the inverse of the) credit velocity, $\log[L_{it} / P_t Y_t]$, is, over a longer period of time, relatively stable. Since some of the implied restrictions on our model to transform it into a model for this velocity do not appear to be too grossly at odds with the estimation results, we also estimated an empirical model for the growth rate of the credit velocity. We were, in particular, keen on learning how our postulated specification performs in the specification tests. Much to our surprise, these tests strongly rejected the postulated model of credit velocity for the Finnish banking data. More specifically, the direct tests on error autocorrelation, i.e. AR(1) and AR(2) test, were highly critical of the null of serially uncorrelated errors. The Sargan tests for the validity of the overidentifying restrictions were also highly critical and gave strong support for the autocorrelation tests. Finally, the observed t-values on some of the variables, most notably of the (near) unit root variables, were extremely high, being symptomatic of spurious regression among trending variables. Consequently, we simply rejected this alternative specification as a framework for analysis of the effects of monetary policy shocks on the loan supply of Finnish banks.

5. Summary and discussion

We feel that on the basis of our statistical analysis on the Finnish banking data we can draw some positive and perhaps also promising conclusions concerning the importance of banks in the transmission of monetary policy shocks in the Finnish economy. In a strict sense, of course, we cannot draw on any consistent set of evidence from our estimates in favour of a (broad) credit channel, where the emphasis is mainly on the strength of the borrowers' balance sheets. However, on the basis of the estimated behaviour of the aggregate demand controls, we are positive that we have been able to provide evidence of demand factors playing an important role in growth of the stock of bank loans in Finland; real income growth contributes positively to banks' loan growth. Inflation also appears to impinge positively on banks' loan growth, with the aggregate or long-run effect being generally larger than that of GDP growth. More arguably, the long-run inflation elasticites suggest that our specification captures factors affecting the growth rate of the real stock of bank loans in Finland.

Our results also seem to suggest that bank specific variables like size, liquidity and capitalisation have contributed to the growth of bank loans in the 1990's. The direct, linear effects of banks' liquidity and capitalisation on banks' loan growth are consistently positive and statistically significant. These imply that banks' liquidity and degree of capitalisation are important factors affecting the supply of bank loans. As far as the effects of size on banks' loans are concerned, the results indicate that the market for bank loans in Finland has a stationary size distribution. That is, bank's size impinges negatively and statistically significantly on the growth rate of its loans. We think this result is reasonable. A priori, of course, we could not rule out the alternative scenario, where size enters positively in the loan growth equation. Such a result could conceivably have been interpreted to indicate a tendency for the bank loan dynamics to generate monopolies. Another interpretation of our results would suggest local economies of scale in the loan markets populated by relatively small sized banks.

The bank specific factors have probably also induced heterogeneity among banks in their response to policy shocks. The evidence on this last point is not, however, entirely compelling. In particular, the interactions of monetary policy shocks and bank characteristics do not, in most cases, enter the model in a statistically significant way. There is some indication that at least some of these interactions could be important, but here we lack consistency in the results. As far as the size of the coefficients on these interactions is concerned, they appear to be plausible on both economic and statistical terms.

Finally, the dummy for Parliamentary guarantee on banks' deposit and non-deposit commitments enters the model significantly. In terms of the underlying policy measures, the results indicate that these measures had a positive contribution to the increase in the growth rate of banks' loans.

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APPENDIX A

Banks' loan growth and monetary policy shocks: money market rate

Table A1 The effects of monetary policy on the growth rate of loans: "Benchmark" GMM estimation results with the tender rate

Estimated coefficients[1,2]		
Variable	**1-step**	**2-step**
loan $growth_{t-1}$	0.0602 (*0.0261*)**	0.0542 (*0.0292*)*
loan $growth_{t-2}$	0.0206 (*0.0221*)	0.0157 (*0.0230*)
loan $growth_{t-3}$	0.0117 (*0.0190*)	0.0093 (*0.0196*)
loan $growth_{t-4}$	0.1265 (*0.0205*)***	0.1158 (*0.0211*)***
ΣAR coeffs	0.2190**	0.1950**
gdp $growth_{t-1}$	-0.2676 (*0.0894*)**	-0.1954 (*0.0936*)**
gdp $growth_{t-2}$	0.2495 (*0.0926*)**	0.2613 (*0.0955*)**
gdp $growth_{t-3}$	0.4704 (*0.1285*)***	0.4736 (*0.1398*)***
gdp $growth_{t-4}$	0.1801 (*0.1585*)	0.1820 (*0.1733*)
Σgdp coeffs	0.6324**	0.7215**
$infl_{t-1}$	-0.1836 (*0.1081*)*	-0.1849 (*0.1178*)*
$infl_{t-2}$	0.5963 (*0.1421*)***	0.5344 (*0.1532*)***
$infl_{t-3}$	0.5944 (*0.1673*)***	0.5786 (*0.1828*)**
$infl_{t-4}$	0.0724 (*0.1144*)	0.0775 (*0.1206*)
Σinfl coeffs	1.0795***	1.0056***
$mopo_{t-1}$	-2.2352 (*0.7736*)**	-2.0125 (*0.8518*)**
$mopo_{t-2}$	-0.9147 (*0.8744*)	-1.1818 (*0.9778*)
$mopo_{t-3}$	-0.7391 (*0.2307*)**	-0.6833 (*0.2484*)**
$mopo_{t-4}$	-0.6577 (*0.3456*)*	-0.5996 (*0.3608*)*
Σmopo coeffs	-4.5467***	-4.4772***
D98	0.0020 (*0.0004*)***	0.0024 (*0.0004*)***
Wald (joint) $\chi^2(20)$ (*p-value*)	1218 (*0.000*)***	1094 (*0.000*)***
Sargan $\chi^2(221)$ (*p-value)*	366.1 (*0.000*)***	244.6 (*0.132*)
AR(1) test N(0,1) (*p-value)*	-13.97 (*0.000*)***	-10.93 (*0.000*)***
AR(2) test N(0,1) (*p-value)*	-1.946 (*0.052*)*	-0.6394 (*0.523*)

1 *, ** and *** mean significant at 10, 5 and 1 % significance level respectively in a pure significance test
2 Estimated heteroscedasticity consistent standard errors in parenthesis

Table A2 "Benchmark" with the money market rate

Estimated coefficients[1]

Variable[1]	**1-step**	**2-step**
loan growth$_{t-1}$	0.0651 (*0.0256*)**	0.0639 (*0.0284*)**
loan growth$_{t-2}$	0.0200 (*0.0219*)	0.0142 (*0.0233*)
loan growth$_{t-3}$	0.0202 (*0.0193*)	0.0193 (*0.0197*)
loan growth$_{t-4}$	0.1248 (*0.0202*)***	0.1158 (*0.0211*)***
ΣAR coeffs	0.2301	0.2132
gdp growth$_{t-1}$	-0.3408 (*0.1098*)**	-0.2862 (*0.1142*)**
gdp growth$_{t-2}$	0.2010 (*0.0939*)**	0.2114 (*0.0984*)**
gdp growth$_{t-3}$	0.2350 (*0.1524*)	0.2232 (*0.1661*)
gdp growth$_{t-4}$	-0.1436 (*0.1748*)	-0.1640 (*0.1903*)
Σgdp coeffs	-0.0484	-0.0156
infl$_{t-1}$	-0.1406 (*0.0608*)**	-0.1124 (*0.0618*)**
infl$_{t-2}$	0.6831 (*0.1366*)***	0.6841 (*0.1482*)***
infl$_{t-3}$	0.3245 (*0.2192*)	0.3328 (*0.2364*)
infl$_{t-4}$	-0.1932 (*0.1434*)	-0.1779 (*0.1508*)
Σinfl coeffs	0.6730	0.7266
mopo$_{t-1}$	-1.9512 (*0.3005*)***	-1.9932 (*0.3257*)***
mopo$_{t-2}$	-0.2193 (*0.5809*)	-0.3359 (*0.6292*)
mopo$_{t-3}$	-0.2946 (*0.3467*)	-0.3568 (*0.3705*)
mopo$_{t-4}$	-0.4060 (*0.3447*)	-0.3710 (*0.3600*)
Σmopo coeffs	-2.8711	-3.0569
D98	0.0020 (*0.0004*)***	0.0022 (*0.0004*)***
Wald (joint) $\chi^2(20)$ (*p-value*)	1249 (*0.000*)***	1179 (*0.000*)***
Sargan $\chi^2(221)$ (*p-value)*	345.1 (*0.000*)***	238.4 (*0.201*)
AR(1) test N(0,1) (*p-value)*	-14.04 (*0.000*)***	-11.08 (*0.000*)***
AR(2) test N(0,1) (*p-value)*	-1.342 (*0.180*)	-0.3017 (*0.763*)

1 See Table A1 for comments and explanations

APPENDIX B

Banks' loan growth, size, liquidity and capitalisation: 1-step, 2-step and the policy indicator

Table B1 Monetary policy shocks, the growth rate of loans, bank size, liquidity and capitalisation: 2-step GMM estimation results

Estimated coefficients[1]

Variable/Model[1]	Model I	Model II	Model III
loan growth$_{t-1}$	-0.0006 (*0.0307*)	0.0439 (*0.0297*)	0.0339 (*0.0290*)
loan growth$_{t-2}$	-0.0278 (*0.0240*)	0.0094 (*0.2330*)	0.0044 (*0.0229*)
loan growth$_{t-3}$	-0.0241 (*0.0196*)	0.0007 (*0.0198*)	0.0020 (*0.0198*)
loan growth$_{t-4}$	0.0930 (*0.0211*)***	0.1095 (*0.0212*)***	0.1092 (*0.0211*)***
ΣAR coeffs	0.0405	0.1635**	0.1495**
gdp growth$_{t-1}$	-0.1808 (*0.0949*)*	-0.2060 (*0.0918*)**	-0.1850 (*0.0945*)**
gdp growth$_{t-2}$	0.2320 (*0.0917*)**	0.2555 (*0.0956*)***	0.2433 (*0.0943*)***
gdp growth$_{t-3}$	0.4353 (*0.1346*)***	0.4778 (*0.1385*)***	0.4483 (*0.1377*)***
gdp growth$_{t-4}$	0.1801 (*0.1644*)	0.1974 (*0.1694*)	0.1681 (0.1721)
Σgdp coeffs	0.6666**	0.7247**	0.6747**
infl$_{t-1}$	-0.2080 (*0.1121*)*	-0.1912 (*0.1151*)*	-0.1910 (*0.1177*)
infl$_{t-2}$	0.4573 (*0.1424*)***	0.5297 (*0.1525*)***	0.4997 (*0.1529*)***
infl$_{t-3}$	0.5513 (*0.1752*)***	0.5905 (*0.1807*)***	0.5503 (*0.1818*)***
infl$_{t-4}$	0.0753 (*0.1169*)	0.0859 (*0.1193*)	0.0709 (*0.1186*)
Σinfl coeffs	0.8759**	1.015***	0.9299**
mopo$_{t-1}$	-1.7335 (*0.3174*)**	-1.9778 (*0.8427*)	-1.8979 (*0.8439*)**
mopo$_{t-2}$	-1.2696 (*0.9213*)	-1.2218 (*0.9626*)	-1.1805 (*0.9650*)
mopo$_{t-3}$	-0.7021 (*0.2323*)***	-0.7194 (*0.2474*)	-0.6648 (*0.2464*)***
mopo$_{t-4}$	-0.5843 (*0.3542*)*	-0.5903 (*0.3568*)	-0.5720 (*0.3615*)*
Σmopo coeffs	-4.290***	-4.509***	-4.315***
size$_{t-1}$	-0.0584 (*0.0127*)***		
liquidity$_{t-1}$		0.0495 (*0.01841*)***	
capital$_{t-1}$			0.2007 (*0.0883*)**
interaction$_{t-1}$[2]	-0.1625 (*0.1518*)	-0.3360 (*2.471*)	0.9585 (*5.6242*)
interaction$_{t-2}$	0.1764 (*0.1825*)	4.240 (*2.832*)	6.647 (*6.255*)
interaction$_{t-3}$	0.0137 (*0.1032*)	-2.594 (*1.620*)	0.8638 (*4.607*)
interaction$_{t-4}$	0.0619 (*0.1059*)	3.133 (*1.396*)**	1.673 (*3.376*)
Σinteraction coeffs	0.0895	4.443*	10.14*
D98	0.0023 (*0.0004*)***	0.0024 (*0.0004*)***	0.0024 (*0.0004*)***
Wald (joint) $\chi^2(25)$ (*p-value*)	1102 (*0.000*)***	1135 (*0.000*)***	1162 (*0.000*)***
Sargan $\chi^2(221)$ (*p-value*)	246.9 (*0.076*)*	243.9 (*0.139*)	246.6 (*0.114*)
AR(1) N(0,1) (*p-value*)	-10.71 (*0.000*)***	-10.85 (*0.000*)***	-10.86 (*0.000*)***
AR(2) N(0,1) (*p-value*)	-0.6761 (*0.499*)	-0.6953 (*0.487*)	-0.7109 (*0.477*)

1 See Table A1 for comments and explanations

2 Interaction$_{t-j}$ refers to the jth coefficient δ_j, j=1,2,3,4, in the sum $\sum_{j=1}^{4} \delta_j \left[\Delta MP_{t-j} \cdot z_{i(t-1)}\right]$

Table B2 Full model 1-step GMM with the tender rate

Estimated coefficients[1]

Variable/Model[1]	**Model I**	**Model II**	**Model III**
loan growth$_{t-1}$	-0.0057 (*0.0274*)	0.0527 (*0.0267*)**	0.0348 (*0.0261*)
loan growth$_{t-2}$	-0.0314 (*0.0235*)	0.0168 (*0.0226*)	0.0013 (*0.0220*)
loan growth$_{t-3}$	-0.0273 (*0.0193*)	0.0036 (*0.0189*)	-0.0021 (*0.0189*)
loan growth$_{t-4}$	0.0953 (*0.0211*)***	0.1228 (*0.0207*)***	0.1151 (*0.0205*)***
ΣAR coeffs	0.0309	0.1939	0.1491
gdp growth$_{t-1}$	-0.2212 (*0.0885*)**	-0.2676 (*0.0889*)***	-0.2582 (*0.0897*)***
gdp growth$_{t-2}$	0.2312 (*0.0879*)***	0.2452 (*0.0933*)***	0.2331 (*0.0918*)**
gdp growth$_{t-3}$	0.4039 (*0.1260*)***	0.4654 (*0.1281*)***	0.4403 (*0.1289*)***
gdp growth$_{t-4}$	0.1381 (*0.1543*)	0.1832 (*0.1572*)	0.1601 (*0.1581*)
Σgdp coeffs	0.5520	0.6262	0.5753
infl$_{t-1}$	-0.1851 (*0.1033*)*	-0.1883 (*0.1084*)*	-0.1882 (*0.1070*)*
infl$_{t-2}$	0.5104 (*0.1339*)***	0.5830 (*0.1430*)***	0.5653 (*0.1403*)***
infl$_{t-3}$	0.5178 (*0.1647*)***	0.5887 (*0.1661*)***	0.5611 (*0.1681*)***
infl$_{t-4}$	0.0383 (*0.1117*)	0.0694 (*0.1140*)	0.0574 (*0.1140*)
Σinfl coeffs	0.8814	1.053	0.9956
mopo$_{t-1}$	-2.036 (*0.7263*)***	-2.198 (*0.7753*)***	-2.1815 (*0.7618*)***
mopo$_{t-2}$	-0.8309 (*0.8445*)	-0.9243 (*0.8695*)	-0.8774 (*0.8651*)
mopo$_{t-3}$	-0.7176 (*0.2212*)***	-0.7229 (*0.2313*)***	-0.7027 (*0.2280*)***
mopo$_{t-4}$	-0.5376 (*0.3381*)	-0.6392 (*0.3436*)*	-0.6187 (*0.3449*)*
Σmopo coeffs	-4.122	-4.484	-4.380
size$_{t-1}$	-0.0616 (*0.0113*)***		
liquidity$_{t-1}$		0.0482 (*0.0177*)***	
capital$_{t-1}$			0.2790 (*0.0825*)***
interaction$_{t-1}$	-0.1358 (*0.1598*)	-1.3815 (*2.236*)	0.3718 (*5.486*)
interaction$_{t-2}$	0.1660 (*0.2047*)	4.437 (*2.471*)*	7.480 (*6.179*)
interaction$_{t-3}$	0.0576 (*0.1164*)	-2.998 (*1.487*)**	-1.963 (*4.409*)
interaction$_{t-4}$	0.0525 (*0.1245*)	2.523 (*1.330*)*	1.464 (*3.696*)
Σinteraction coeffs	0.1403	2.581	7.353
D98	0.0021 (*0.0004*)***	0.0020 (*0.0004*)***	0.0024 (*0.0004*)***
Wald (joint) $\chi^2(25)$ (*p-value*)	1296 (*0.000*)***	1269 (*0.000*)***	1350 (*0.000*)***
Sargan $\chi^2(221)$ (*p-value*)	359.3 (*0.000*)***	366.7 (*0.000*)***	364.6 (*0.000*)***
AR(1) N(0,1) (*p-value*)	-13.47 (*0.000*)***	-13.84 (*0.000*)***	-13.99 (*0.000*)***
AR(2) N(0,1) (*p-value*)	-2.070 (*0.038*)**	-2.246 (*0.025*)**	-1.996 (*0.046*)**

1 See Table A1 for comments and explanations

Table B3 Full model 1-step GMM with the money market rate

Estimated coefficients[1]

Variable/Model[1]	**Model I**	**Model II**	**Model III**
loan growth$_{t-1}$	-0.0023 (*0.02729*)	0.0582 (*0.0261*)$^{*'}$	0.0402 (*0.0256*)**
loan growth$_{t-2}$	-0.0350 (*0.0238*)	0.0156 (*0.0223*)	0.0003 (*0.0218*)
loan growth$_{t-3}$	-0.0202 (*0.0193*)	0.0123 (*0.0192*)	0.0068 (*0.0191*)
loan growth$_{t-4}$	0.0918 (*0.0210*)***	0.1211 (*0.0203*)***	0.1139 (*0.0203*)***
ΣAR coeffs	0.0343**	0.2072**	0.1612**
gdp growth$_{t-1}$	-0.3012 (*0.1091*)***	-0.3374 (*0.1090*)***	-0.3295 (*0.1099*)***
gdp growth$_{t-2}$	0.2175 (*0.0903*)**	0.2029 (*0.0933*)**	0.1884 (*0.0934*)**
gdp growth$_{t-3}$	0.2315 (*0.1463*)	0.2361 (*0.1509*)	0.2125 (*0.1520*)
gdp growth$_{t-4}$	-0.1302 (*0.1685*)	0.1355 (*0.1734*)	-0.1541 (*0.1733*)
Σgdp coeffs	0.0176**	0.2301**	-0.0827**
infl$_{t-1}$	-0.1403 (*0.0585*)**	-0.1420 (*0.0603*)**	-0.1446 (*0.0598*)**
infl$_{t-2}$	0.6470 (*0.1317*)***	0.6769 (*0.1356*)***	0.6550 (*0.1366*)***
infl$_{t-3}$	0.3353 (*0.2117*)	0.3261 (*0.2168*)	0.3011 (*0.2182*)
infl$_{t-4}$	-0.1745 (*0.1385*)	-0.1969 (*0.1425*)	-0.2062 (*0.1421*)
Σinfl coeffs	0.6675**	0.6641**	0.6053**
mopo$_{t-1}$	-1.903 (*0.2940*)***	-1.938 (*0.3000*)***	-1.913 (*0.2990*)***
mopo$_{t-2}$	-0.3437 (*0.5589*)	-0.2445 (*0.5751*)	-0.2170 (*0.5754*)
mopo$_{t-3}$	-0.4078 (*0.3342*)	-0.3018 (*0.3426*)	-0.2763 (*0.3447*)
mopo$_{t-4}$	-0.4174 (*0.3344*)	-0.3869 (*0.3424*)	-0.3809 (*0.3415*)
Σmopo coeffs	-3.072**	2.872**	-2.808**
size$_{t-1}$	-0.0617 (*0.0115*)***		
liquidity$_{t-1}$		0.0478 (*0.0175*)***	
capital$_{t-1}$			0.2774 (*0.0829*)***
interaction$_{t-1}$	-0.1107 (*0.082*)	0.3775 (1.*202*)	3.042 (*2.864*)
interaction$_{t-2}$	0.0812 (*0.0990*)	1.269 (*1.240*)	2.508 (*2.675*)
interaction$_{t-3}$	-0.0289 (*0.0786*)	-1.496 (*1.107*)	1.880 (*2.414*)
interaction$_{t-4}$	0.1086 (*0.0991*)	2.452 (*1.037*)**	-0.2032 (*2.279*)
Σinteraction coeffs	0.0502	2.603	7.227
D98	0.0020 (*0.0004*)***	0.0020 (*0.0004*)***	0.0020 (*0.0004*)***
Wald (joint) $\chi^2(25)$ (*p-value*)	1352 (*0.000*)***	1286 (*0.000*)***	1366 (*0.000*)***
Sargan $\chi^2(221)$ (*p-value*)	337.4 (*0.000*)***	343.4 (*0.000*)***	341.1 (*0.000*)***
AR(1) N(0,1) (*p-value*)	-13.41 (*0.000*)***	-13.96 (*0.000*)***	-14.06 (*0.000*)***
AR(2) N(0,1) (*p-value*)	-1.330 (*0.183*)	-1.651 (*0.099*)*	-1.355 (*0.175*)

1 See Table A1 for comments and explanations

Table B4 Full model 2-step GMM with the money market rate

Estimated coefficients[1]

Variable/Model[1]	**Model I**	**Model II**	**Model III**
loan growth$_{t-1}$	0.0009 (*0.0306*)	0.0558 (*0.0284*)**	0.0392 (*0.0279*)
loan growth$_{t-2}$	-0.0314 (*0.0249*)	0.0080 (*0.0235*)	-0.0003 (*0.0233*)
loan growth$_{t-3}$	-0.0161 (*0.0195*)	0.0101 (*0.0199*)	0.0110 (*0.0198*)
loan growth$_{t-4}$	0.0887 (*0.0212*)***	0.1099 (*0.0209*)***	0.1064 (*0.02114*)***
ΣAR coeffs	0.0421**	0.1838**	0.1563**
gdp growth$_{t-1}$	-0.2715 (*0.1107*)**	-0.3029 (*0.1128*)***	-0.2786 (*0.1139*)**
gdp growth$_{t-2}$	0.2130 (*0.0924*)**	0.2021 (*0.0995*)**	0.2034 (*0.0986*)**
gdp growth$_{t-3}$	0.2238 (*0.1526*)	0.2126 (*0.1679*)	0.1934 (*0.1667*)
gdp growth$_{t-4}$	-0.1477 (*0.1772*)	-0.1791 (*0.1922*)	-0.1938 (*0.1896*)
Σgdp coeffs	0.0176**	-0.0673**	-0.0756**
infl$_{t-1}$	-0.1240 (*0.0601*)**	-0.1090 (*0.0607*)*	-0.1055 (*0.0624*)*
infl$_{t-2}$	0.6544 (*0.1319*)***	0.6914 (*0.1487*)***	0.6747 (*0.1493*)***
infl$_{t-3}$	0.3580 (*0.2168*)*	0.3322 (*2381*)	0.3020 (*0.2374*)
infl$_{t-4}$	-0.1392 (*0.1414*)	-0.1789 (*0.1524*)	-0.1908 (*0.1499*)
Σinfl coeffs	0.7492**	0.7357**	0.6804**
mopo$_{t-1}$	-1.9354 (*0.3000*)***	-2.001 (*0.3298*)***	-2.003 (*0.3261*)***
mopo$_{t-2}$	-0.4565 (*0.5876*)	-0.2940 (*0.6403*)	-0.2866 (*0.6309*)
mopo$_{t-3}$	-0.4762 (*0.3457*)	-0.3796 (*0.3750*)	-0.3325 (*0.3717*)
mopo$_{t-4}$	-0.4498 (*0.3429*)	-0.3553 (*0.3583*)	-0.3386 (*0.3605*)
Σmopo coeffs	3.318**	3.030**	2.960**
size$_{t-1}$	-0.0573 (*0.0126*)***		
liquidity$_{t-1}$		0.0434 (*0.0183*)***	
capital$_{t-1}$			0.1958 (*0.0868*)**
interaction$_{t-1}$	-0.1419 (*0.0760*)*	1.054 (*1.370*)	4.243 (*3.009*)
interaction$_{t-2}$	0.0713 (*0.0855*)	0.9728 (*1.395*)	2.980 (*2.645*)
interaction$_{t-3}$	-0.0391 (*0.0676*)	-1.229 (*1.130*)	2.389 (*2.533*)
interaction$_{t-4}$	0.0984 (*0.0839*)	2.968 (*1.043*)***	-1.163 (*2.857*)
Σinteraction coeffs	-0.0113	3.766	8.449
D98	0.0021 (*0.0004*)***	0.0023 (*0.0004*)***	0.0023 (*0.0004*)***
Wald (joint) $\chi^2(25)$ (*p-value*)	1268 (*0.000*)***	1201 (*0.000*)***	1277 (*0.000*)***
Sargan $\chi^2(221)$ (*p-value*)	236.7 (*0.223*)	240.0 (*0.181*)	240.1 (*0.425*)
AR(1) N(0,1) (*p-value*)	-10.72 (*0.000*)***	-11.08 (*0.000*)***	-10.99 (*0.000*)***
AR(2) N(0,1) (*p-value*)	-0.4613 (*0.645*)	-0.3814 (*0.703*)	-0.3793 (*0.704*)

1 See Table A1 for comments and explanations

APPENDIX C

Table C. Descriptive statistics on the Finnish banking sector 1995-2000						
	1995	**1996**	**1997**	**1998**	**1999**	**2000**
Observations	347	346	343	340	337	333
Loans						
Mean	143 153	139 656	142 384	160 149	173 236	195 983
Median	21 324	22 113	22 195	23 509	26 315	27 645
P25	11 994	12 257	12 683	13 080	14 788	15 937
P75	39 147	40 477	41 509	45 611	50 652	54 381
Max	23 550 647	22 313 706	22 195 902	24 949 840	26 228 131	28 755 218
Min	651	608	438	537	431	390
Std.Dev.	1 324 520	1 262 960	1 273 644	1 444 393	1 517 680	1 742 364
Deposits						
Mean	149 237	145 503	152 235	156 222	165 937	172 668
Median	27 789	27 568	28 738	29 896	31 240	33 361
P25	16 154	16 081	17 378	18 153	18 550	19 632
P75	49 639	50 805	53 357	56 791	59 711	61 494
Max	22 609 479	21 314 093	22 325 488	22 909 110	23 413 413	25 054 403
Min	1 603	1 436	1 933	1 803	1 689	0
Std.Dev.	1 297 410	1 227 823	1 288 682	1 323 902	1 369 998	1 442 910
Total assets						
Mean	289 571	285 769	306 031	307 705	338 240	380 274
Median	34 606	34 591	36 471	37 921	39 620	42 453
P25	20 869	21 624	22 327	22 524	23 694	25 236
P75	62 456	62 735	66 905	68 388	72 920	77 902
Max	45 715 954	44 571 638	49 195 440	50 582 984	52 471 370	61 141 488
Min	1 861	1 657	2 181	2 036	1 908	1 916
Std.Dev.	2 684 095	2 642 598	2 906 583	2 941 895	3 132 433	3 630 006
Liquid assets/total assets						
Mean	0,111	0,132	0,132	0,123	0,104	0,087
Median	0,096	0,118	0,125	0,111	0,090	0,068
P25	0,055	0,056	0,054	0,046	0,035	0,030
P75	0,158	0,190	0,186	0,180	0,152	0,125
Max	0,418	0,504	0,803	0,458	0,421	0,683
Min	0,004	0,003	0,000	0,005	0,000	0,000
Std.Dev.	0,077	0,094	0,095	0,089	0,080	0,076
Capital/total assets						
Mean	0,066	0,075	0,085	0,091	0,098	0,107
Median	0,062	0,072	0,081	0,087	0,094	0,103
P25	0,049	0,053	0,059	0,063	0,067	0,076
P75	0,080	0,095	0,110	0,114	0,120	0,127
Max	0,138	0,156	0,177	0,437	0,639	0,719
Min	0,026	0,029	0,003	0,021	0,028	0,030
Std.Dev.	0,021	0,027	0,032	0,038	0,048	0,055

Note:
Observations: the number of banks with loans reported;
End-of-the-year observations;
Loans, deposits and total assets in million euros.

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