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MICRODATA EVIDENCE ON THE BANK LENDING CHANNEL IN THE NETHERLANDS*

BY

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Summary

This study contributes to the empirical evidence on the lending channel in the Netherlands using individual bank data. The main conclusion is that a lending channel is operative in the Netherlands. However, it is only operative for unsecured lending and not for secured lending, possibly because loans with government guarantees get special treatment by banks. Effects of monetary tightening on unsecured lending are more negative for smaller, less liquid and less capitalised banks, in line with the lending channel theory. The contribution of this study is that it gives evidence that the monetary policy impact on bank lending also depends on the market segment in which a bank is active. The evidence suggests that the policy impact is weaker on credit to households than it is on lending to firms.

Key words: bank lending, monetary policy transmission

1 INTRODUCTION

This study presents an empirical analysis of the role of banks in the monetary transmission process in the Netherlands, using individual bank data for the period 1990-1997. Generally speaking, banks can play different roles in the transmission process. The traditional 'money view' focuses on the liability side of the banks' balance sheets, where the aggregated amount of deposits constitutes the largest part of the national money supply. The central bank is assumed to be able to control this quantity of money on the banks' balance sheets through monetary policy. If the central bank manages to diminish the money supply, the real interest rate is expected to rise, dampening real demand. The alternative 'credit view' assumes that there are imperfections on the financial markets which increase the price of bank loans – the external finance premium – and/or lower the availabil-

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ity of bank credit, depending on the monetary policy stance.[1] The credit view considers two channels through which monetary policy affects the real economy. First, the 'balance sheet channel,' which works through the balance sheets of potential borrowers. A monetary policy tightening, by increasing the interest rate, deteriorates the net worth position and credit worthiness of the private sector, prompting the banks to raise hurdle rates on loans, resulting in a rise in the external finance premium on new bank loans. The second channel, the 'bank lending channel,' focuses on the asset side of the banks' balance sheets, especially on the supply of bank credit. It assumes that a monetary policy tightening, by draining the liquidity position of banks, forces some banks to diminish their supply of credit.

The principal focus in the present empirical study is on the bank lending channel, hence on the reaction of the loan supply to a monetary shock, particularly the differential response of certain types of banks. The idea behind this is that some types of banks are more capable than others to offset a monetary policy-induced decrease in deposits (or an increase in the cost of funding), because they can find non-deposit funding easily or draw on their buffer of liquid assets.[2]

The standard explanation of the working of the lending channel is illustrated in Figure 1. Monetary tightening conducted by e.g. open market operations drains deposits from the banking system, which consequently has to cut its supply of loans (Figure 1a). When banks lower their supply of loans, bank-dependent firms and households have to diminish their expenditures, thereby reducing aggregate output. An important precondition for this bank lending effect is that banks are not able to shield their lending activities from negative monetary shocks completely by using security holdings as a buffer. Another precondition for the bank lending view to hold under these circumstances is that non-deposit funding is not a perfect substitute for deposit funding by the banks. Figure 1b shows how a drawing down on the securities portfolio and/or an increase in non-deposit funding can be used to finance a restoration of the loan supply in response to a monetary tightening. The bottom line is that these offsetting balance sheet movements on the asset and liabilities side make the net effect of monetary tightening on the loan supply uncertain, as schematically shown in Figure 1c.

1 For more details on the role of market imperfections in the monetary transmission process, see e.g. Bernanke and Gertler (1995). On the implications of the different views of the monetary transmission mechanism for monetary policy, see Taylor (2000).

2 This and other studies of the lending channel focus on the reaction of banks to monetary policy changes. Hence, it deals with the 'first part' of the lending channel. The second part, the reaction of the bank borrowers (the private non-financial sector) lies beyond its scope. It is conceivable that the private sector has alternative financing sources at its disposal, so that a cut in bank credit supply can be compensated by non-bank funding sources. For the Netherlands this is generally not the case as bank loans are the main form of external financing for the private sector in the Netherlands (e.g. Fase and de Bondt (2000), Saunders and Schmeits (2002)).

a. Bank lending channel at work

Loans	⇓	**Deposits**	⇓

b. Offsetting portfolio and liabilities responses

Loans	⇑		
Securities	⇓	**Non-deposits**	⇑

c. Total effect on loans uncertain

Loans	?	**Deposits**	⇓
Securities	⇓	**Non-deposits**	⇑

Figure 1 – Balance sheet of banks after monetary tightening

For the Netherlands there is some early evidence on the bank lending channel from VAR analyses. This type of analysis generally indicates that the lending channel is not very relevant in the Netherlands from a macroeconomic viewpoint. According to Garretsen and Swank (1998), van Ees et al. (1999) and Kakes (2000, chapter 6) the lending channel is partly offset because banks use their holdings of securities as a buffer to shield their loan portfolios from negative monetary shocks. However, the analysis by de Bondt (1999b) does not confirm this buffer function. A problem with credit aggregates is the distinction of supply and demand effects. Searching for a means of identifying a loan-supply shift, the empirical literature has more recently shifted from VAR toward the analysis of cross-sectional differences in bank lending behaviour across different types of banks. This approach, using microdata on banks, follows Kashyap and Stein's (1995, 1997) research for the US. The results from the application of this approach to the Netherlands are somewhat mixed. De Bondt (1999a) finds some evidence for a credit channel in the Netherlands, while Schuller (1998) does not.

The present study contributes to the empirical evidence of the bank-lending channel for the Netherlands, using individual bank data. The investigation concerns the response of bank lending to monetary shocks, together with the differences in responses between several bank types (small and large, low and high liquidity, low and high capitalisation). The contributions of the present study are the following. First, consolidated quarterly data representing the Dutch banking population are used. Previous studies for the Netherlands have analysed Bank-Scope data, which are biased towards large-sized banks, are only available at an

annual frequency, and cover unconsolidated data.[3] Second, the present study extends the analysis to several segments of the bank credit market. Specifically, a distinction is made between loans with and without government guarantees, households and firms, and long-term and short-term. The relevance of such distinctions is underpinned by a factor analysis of the sample.

The paper is organised as follows. Section 2 introduces the model. Section 3 discusses the data. Section 4 presents the empirical results, after which section 5 concludes.

2 MODEL

The goal of the analysis is to estimate the impact of monetary policy on bank lending and to assess the differences between the effects depending on banks' characteristics. As Ehrmann et al. (2001) show, the research strategy can be explained by means of a generalisation of the textbook IS-LM model described in Bernanke and Blinder (1988). The money and loan markets are formalised in a very simplified way. For the sake of argument the demand for deposits, which arises in particular from the transactions motive, is not modelled. It is assumed that at equilibrium, deposits (D) equals money (M) and both depend only on the monetary policy interest rate (r) in the following way:

$$M = D = -a_1 r + a_2 . \tag{1}$$

The demand for loans (L^d) is assumed to depend on real output (y), the price level (p) and the interest rate on loans (r_l):

$$L^d = b_1 y + b_2 p - b_3 r_l . \tag{2}$$

The supply of loans (L_i^s) depends on the amount of money available and the interest rate on loans:

$$L_i^s = c_i M + c_2 r_l , \tag{3}$$

where it is assumed that banks are relying on deposit funding to different degrees, depending on bank characteristic (x_i):

$$c_i = c_0 - c_1 x_i . \tag{4}$$

3 Schuller (1998) and de Bondt (1999a) use data from BankScope. See Ehrmann et al. (2001) on the disadvantages of using BankScope for the present type of analysis.

Clearing the loan market, using equations (1) and (4), yields the reduced form of the model in terms of the policy rate, the price level and real output:

$$L_i = \frac{-a_1 b_3 c_0 r + a_1 b_3 c_1 x_i r + b_1 c_2 y + b_2 c_2 p - a_2 b_3 c_1 x_i + a_2 b_3 c_0}{b_3 + c_2} \tag{5}$$

which can be simplified to (leaving out the constant term):[4]

$$L_i = \beta r + \gamma x_i r + \delta y + \mu p + \eta x\,. \tag{6}$$

From (1) and (3) follows that, in this model, the impact of monetary policy on the *supply* of loans L_i^s is measured by $-a_1(c_0 - c_1 x_i)$. However, the parameter that is identified in (6) is $\beta + \gamma x_i = -\dfrac{a_1 b_3}{b_3 + c_2}(c_0 - c_1 x_i)$. Strictly speaking, this parameter only says something about the responsiveness of a bank's loan supply to monetary policy if it can be presumed that the interest elasticity of loan demand, b_3, is more or less equal across all banks. In other words, this assumption of a homogeneous reaction of loan demand across all banks is crucial for the identification of pure loan supply effects of monetary policy. However, the richness of the information contained in panel data can be used to achieve 'identification through heterogeneity' (Gilchrist and Zakrajšek (1995)). They argue that if one manages to define a bank characteristic variable x_i that on *a priori* grounds is expected to be a proper measure of the sensitivity of bank loan supply to monetary policy, the estimated value for the parameter γ will be interpretable as evidence for the existence of a lending channel.

The econometric specification that is estimated in this study is based on equation (6) with two modifications. First, output and prices are interacted with the bank characteristic variable as well, to allow banks with varying characteristics to respond differently to macroeconomic developments. Second, dynamics are introduced by including lags and a lagged dependent variable, and estimating the model in fourth-lag differences ($\Delta_4 z_t = z_t - z_{t-4}$). Finally, logarithms are taken where appropriate. The empirical specification reads:

$$\begin{aligned}\Delta_4 \log L_{it} = {} & \sum_{j=1}^{L} \alpha_j \Delta_4 \log L_{it-j} + \sum_{j=1}^{L} \beta_j \Delta_4 r_{t-j} + \sum_{j=1}^{L} \gamma_j x_{it-j} \Delta_4 r_{t-j} \\ & + \sum_{j=1}^{L} \delta_j \Delta_4 \log y_{t-j} + \sum_{j=1}^{L} \phi_j x_{it-j} \Delta_4 \log y_{t-j} + \sum_{j=1}^{L} \mu_j \Delta_4 \log p_{t-j} \\ & + \sum_{j=1}^{L} \rho_j x_{it-j} \Delta_4 \log p_{t-j} + \sum_{j=1}^{L} \eta_j x_{it-j} + \nu_i + \varepsilon_{it}\end{aligned} \tag{7}$$

4 Note that the lending rate has been eliminated in this reduced form expression. Fase (1995) shows that in more general cases the lending rate requires additional modelling.

where L is loans and subscript it denotes bank i and (quarterly) period t, respectively; $i = 1, ..., N$ and $t = 1, ..., T$. The monetary policy indicator, r, is the short-term (three-month) interest rate;[5] p_t the consumer price index, y_t real gross domestic product. The model allows for fixed effects across banks, as indicated by the bank-specific intercept ν_i. ε_{it} is the error term. The bank-specific characteristic variable is x_{it}, assumed to be an inverse measure of the sensitivity of bank loan supply to monetary policy. The principal focus of the empirical analysis (section 4) will be on the values that will be estimated for coefficients β and γ. Monetary tightening is expected to lead to a decrease in lending and thus β is expected to be negative. Large, liquid and well-capitalised banks are expected to be more able to shield their loan portfolio from monetary shocks by drawing on their liquid holdings of securities and/or by attracting non-deposit funding. Hence, γ is expected to be positive.

Bank-characteristic variables are required to measure the susceptibility of a bank's lending activity to changes in the monetary policy stance. The literature on the bank lending channel has suggested several bank characteristic variables:
• The size of a bank. Small banks encounter more asymmetric information problems on the capital market than large banks and therefore may find it more difficult to raise uninsured, i.e. non-deposit, funds in response to monetary tightening (Kashyap and Stein (1995)).
• The degree of liquidity. Liquid banks can draw on their reserves of cash and securities to protect their loan portfolio, while this is less possible for illiquid banks (Kashyap and Stein (2000)).
• The degree of capitalisation. Poorly capitalised banks have less access to non-deposit funds and are therefore forced to cut their loan supply by more than well-capitalised banks (Peek and Rosengren (1995)).

These three bank characteristic variables are adopted in this study. The measures for size, liquidity, and capitalisation (*Size*, *Liq*, *Cap*) are defined as follows:

$$Size_{it} = log\, A_{it} - \frac{\sum_i log\, A_{it}}{N}$$

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

$$Cap_{it} = \frac{C_{it}}{A_{it}} - \left(\sum_t \frac{\sum_i C_{it} / A_{it}}{N} \right) / T$$

5 The interest rate is being criticised as a monetary policy indicator for not being wholly exogenous or unanticipated. A more exogenous indicator could be a residual from an identified VAR. Such a variable has been tried in this analysis but the results were poor.

The log of total assets, A_{it}, measures bank size. Liquidity is defined as the ratio of liquid assets L_{it} (cash, interbank deposits, and government securities) to total assets. Capitalisation is given by the ratio of capital and reserves, C_{it}, to total assets.[6] The three criteria are normalised with respect to their averages across all banks so that they sum up to zero over all observations. Parameter β is therefore directly interpretable as the overall monetary policy effect. In the case of size, the normalisation is not just over the sample mean over the whole sample period, but over the means per quarter as well, so that trends in bank size are removed.

Next to these three variables, three alternative characteristics variables will be introduced that are based on a factor analysis on the data (section 3.2). They are measures of the market orientation of each bank.

3 DATA

Data are taken from balance sheets of Dutch banks reporting to the Netherlands central bank for the compilation of aggregate monetary statistics. The sample used in this study covers the period between 1990Q4 and 1997Q4. The original, unbalanced panel dataset contains 143 banks. Due to mergers the number of banks in the unbalanced sample starts from 105 in 1990Q4 and slowly declines to 88 in 1997Q4 (see Figure 2). In 1998Q1, which coincides with the European harmonisation of the monetary statistics, the number of reporting banks drops sharply to

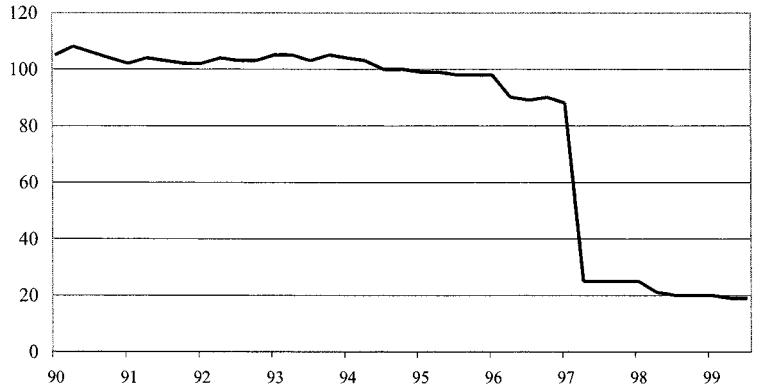

Figure 2 – Number of banks included in monetary statistics of the Netherlands

6 This measure of capitalisation is rather crude as it does not take into account the loan portfolio structure and its risk characteristics. It may therefore not fully capture a risk-based measure such as for example the Basle capital requirement. Unfortunately, we have neither data on Basle Tier 1 and Tier 2 capital nor credit ratings at our disposal for our sample of banks to facilitate more accurate measurement.

a mere 25.[7] Moreover, the definitions of many balance sheet items were harmonised and the statistical unit changed from 'bank' to 'monetary financial institution' (MFI) at that time. This generated a statistical break in most balance sheet series. Therefore, the sample for this study contains data from 1990Q4 up to and including 1997Q4.

The following subsections discuss the sample selection and explore the sample structure using factor analysis. The latter helps to determine which classifications of banks may be relevant for the empirical part of this study.

3.1 *Sample Selection*

When possible, mergers and acquisitions were corrected backwards by aggregation of the merging banks. If not, the time series were curtailed so that the remaining series referred to one and the same bank. In eight cases, where there were multiple mergers in a row, banks had to be deleted from the sample completely. After this cleaning, the dataset contained 135 banks.

Among the 135 banks in this sub-sample were 107 commercial banks (including four co-operative banks), seventeen savings banks, and eleven securities banks. These three groups of banks aim at partly overlapping and partly different segments of the deposit and loan markets. The commercial banks are really universal banks, involved in all market segments. Among those are the largest banks. One of the most striking characteristics of the Dutch banking sector is its high degree of concentration. The seven largest banks in the sample take account of no less than 79% of total assets. They operate in both the wholesale and the retail market and have large amounts of households' deposits. Savings banks are typically smaller banks and are heavily involved in the retail market. They lend mainly to households (especially mortgage loans) and less to firms, compared to commercial banks, and they lend often with government guarantees. In the Netherlands there is a system of government guarantees on mortgage loans for lower-income households, aimed to promote house-ownership. Also government guarantees back bank loans to semi-state-owned companies such as hospitals. Savings banks hold relatively large portfolios of government securities and fund their activities to a large extent with households' deposits, especially savings deposits. Securities banks on the other hand are more involved in the corporate market, especially in the pre-financing of the issuance and/or purchase of securities by firms. They hold their clients' securities as collateral.

Due to the openness of the Dutch financial market, there are a lot of foreign banks in the sample: no less than 62 out of the total of 135. Foreign banks are

7 According to Eurosystem guidelines a statistical coverage of at least 95% of the balance sheet total of the banking sector was agreed upon. In the Dutch case this meant that around 60 banks no longer needed to be included in the monetary statistics.

relatively small, accounting for only 11% of the Dutch market.[8] These banks are typically involved in wholesale banking. They neither lend to households nor do they attract deposits from them. Among their depositors are many foreign firms.

Figure 2 shows that none of the separate quarterly observations counted more than 110 banks, so it is clear that there are quite a number of banks entering and leaving the sample within a relatively short period. Therefore, additional banks were dropped for which the time series were too short to be included in the econometric estimation. More specifically, 36 banks for which the available time series were shorter than 12 quarters were deleted from the sample. After this selection step the sample counted 99 banks. This sample will be used in the empirical analysis.

3.2 *Market Segmentation: Factor Analysis*

As the majority of the banks in the sample are universal banks, which are more or less involved in all segments of the market, a factor analysis can help to determine to which market segment a bank belongs the most. Factor analysis aims at finding a 'common factor,' x_k, which is an unobservable, hypothetical variable that contributes to the variance of several (at least two) observed variables, y_j. The equation of the common factor model is (Mulaik (1972)):

$$y_{ij} = \sum_{k=1}^{q} x_{ik} b_{kj} + e_{ij}\,, \tag{8}$$

where i denotes the observation. There are q common factors in this equation, which are conveniently assumed to be uncorrelated with each other. b_{kj} is the regression coefficient for predicting observed variable j using the kth common factor. e_{ij} are residuals and are defined to be uncorrelated both with each other and with the common factors. In matrix notation it reads:

$$Y = XB + E\,. \tag{9}$$

B is the factor pattern, which lends itself to interpretation of the meanings of the common factors, as will become clear below.

Variables are chosen for their potential usefulness as proxy for banks' susceptibility to the credit channel. First, the list of variables starts with bank size, capital ratio and liquidity ratio, where the latter is split into its components: cash, securities, and interbank deposits. Second, the set is extended with other variables, especially representing market segment orientation: loans to households, loans to non-financial firms, loans with government guarantees, deposits of households, deposits of non-financial firms and deposits of foreigners, all scaled by

8 The balance sheet data of the foreign banks only relate to their activities in the Netherlands.

total assets. The goal of factor analysis is to cluster variables into factors on the basis of correlations among variables and factors. Variables that are strongly correlated are formed into a first factor with the condition that this factor is not orthogonal to the second factor, and so on. To improve interpretation of the factor loadings that are obtained from the analysis, an orthogonal rotation is performed to obtain a simple structure so that the rotated factors become uncorrelated. This standard procedure in factor analysis reduces the problem of having too many variables loading on one factor or a variable showing significant loading on more than one factor. An analysis of the 'eigenvalues' of the factors and several significance tests help to decide on how many factors to retain. Consequently, three factors have been retained in the analysis, together accounting for 95% of the common variance in the data. The resulting pattern of factor loadings is presented in Table 1. Substantial factor loadings, conveniently set equal to or higher than 0.13, are printed in bold letters for easier interpretation.

TABLE 1 – FACTOR PATTERN

Factor number *Factor label*	Factor 1 *Retail banks*	Factor 2 *Foreign banks*	Factor 3 *Wholesale banks*
Size	− 0.009	− 0.027	0.004
Capital/assets	− 0.027	− 0.021	− 0.006
Cash/assets	**0.291**	0.074	0.067
Interbank deposits/assets	− 0.080	0.081	− 0.023
Securities/assets	− 0.006	− 0.033	0.000
Loans to firms/assets	− **0.157**	− 0.009	**0.992**
Loans to households/assets	**0.532**	0.015	0.128
Secured loans/assets	0.059	− 0.017	0.015
Deposits of households/assets	**0.149**	− 0.043	0.038
Deposits of firms/assets	0.110	**0.503**	0.004
Deposits of foreigners/assets	0.054	**0.435**	− 0.006
Cumulative proportion of common variance	0.527	0.765	0.950

Number of banks = 99; Number of observations = 2519.

Loans to households show the highest positive loading on the first factor, while loans to firms have a negative loading. The large positive loading of cash holdings indicates that these types of banks carry a lot of cash for daily operations. Households' deposits also carry a significant loading in this factor. Since these characteristics point towards banks being heavily involved in the retail market, the first factor is labelled 'Retail banks.' Deposits of firms and foreigners dominate the second factor – i.e. the depositors are mostly foreign firms. Thus, the

second factor is labelled 'Foreign banks.' The third factor is dominated by loans to firms and is labelled 'Wholesale banks.'

The conclusion from this factor analysis is that three types of banks can be distinguished: retail, foreign and wholesale banks. In section 4.2 this distinction will be taken up when assessing monetary policy responses in different segments of the banking market.

The question may arise whether it would not be more straightforward to measure market orientation by the original observable variables, on which the unobservable common factors have been based (e.g. loans to firms/assets, loans to households/assets). The answer is that it may be more straightforward but not more appropriate. First, it should be noted that the fact that the factor loading for loans to firms in factor 3 is 0.99 (Table 1) does not mean that this variable is the only contributing variable to that factor. Remember that the factor pattern has been simplified optically by rotation in order to facilitate economic interpretation, but this does not mean that the coefficients in the factor pattern matrix can be interpreted simply as the weights of a linear relationship. Second, and more fundamental, the reason for using the factors is that they take account of the interrelationships between the different variables. For example, factor 1 shows that retail banks do not only lend mainly to households but also hold relatively large cash balances and attract relatively more households' deposits. A one-dimensional classification variable such as loans to households would imply throwing this information away. Third, a general advantage of factor analysis is that it defines categories of banks that exclude each other. In other words, a bank with a high value for factor 1 will not also have a high value for the other factors. This is an advantage which the use of several one-dimensional classification variables (such as liquidity and capitalisation) normally do not have, although in the case of loans to households *versus* loans to firms this characteristic would also be present.

4 ESTIMATION AND RESULTS

In this section the results of the estimation of equation (7) are presented. Section 4.2 presents the results using the bank characteristic variables size, liquidity and capitalisation as defined in section 2. In section 4.3 the model is re-estimated with the alternative three bank characteristic variables derived from the factor analysis in section 3.2. But first, section 4.1 discusses some econometric issues.

4.1 *Econometrics*

Due to the inclusion of a lagged dependent variable in equation (7), ordinary least squares (OLS) estimation cannot be applied. Therefore, the generalised method of moments (GMM) estimator suggested by Arellano and Bond (1991) is used. This estimator yields more robust estimates, provided that the models are not subject to serial correlation of order two and provided that the set of instru-

ment variables that are used are valid, which is tested for with the Sargan test. The Arellano-Bond estimator first-differences the equation in order to remove the individual bank effects and produces an equation that is estimable by instrumental variables. Lagged levels of the dependent and predetermined variables and differences of the strictly exogenous variables are used.

The instruments that are used, apart from the usual lags of the model variables, concern lagged values of the seasonal differences of the logs of the house price, the average selling period for houses on sale, real consumption, and real investment expenditure. This controls for the strong relationship between the house and credit market developments during the 1990s in the Netherlands, which resulted in a boom in house prices and a rapid growth of mortgage credit to households.[9] The Sargan statistics indicate whether the instruments are valid. The chosen maximum lag length L is four for the dependent variable and three for all the other variables; more lags generated, on average, lower significance of the variables.

All tables with estimates set out in the subsections 4.2 and 4.3 present long-term coefficients, calculated from the sum of the coefficients of the three lags of the explanatory variables divided by one minus the sum of the coefficients of the four lags of the dependent variable. Corresponding p-values are given denoting their levels of significance. Separate coefficients for all the lags of the variables are not reported for reasons of space. In general, the first lags carry much weight. Hence, the estimated time lags between the interest rate changes and the bank lending responses are relatively short. This may partly be due to the fact that the sample period is relatively short because of data restrictions and is, moreover, characterised by some specific circumstances. During most of the period monetary policy was loose, i.e. the short-term interest rate went down. In general it is easier for banks to expand lending when interest rates are low than to cut lending when monetary conditions are tight. Therefore, the presented evidence of a significant response of lending to interest rate changes may entail some small sample bias, as the interest rate changes during the sample period were mainly downward.[10] The number of observations and banks in the respective samples are also given. These numbers are lower than the total number of banks in the original sample, which was 99 (see section 3.1). The reason is that the panel data set is unbalanced, since some banks have longer time series than others. Due to the inclusion of lags and taking fourth-lag differences in the estimation, some banks completely drop out of the sample. Moreover, the number of banks is even lower when the model is estimated for subcategories of loans (for instance long-term

9 For more information on the link between the house and credit markets in the Netherlands, see Nederlandsche Bank (1999, 2000a, 2000b), den Butter et al. (1977), Rouwendal and Alessie (2002).
10 Recent macroeconomic studies for the Netherlands point towards an asymmetric reaction of bank lending to monetary contraction and expansion; see e.g. van Ees et al. (1999) and Kakes (2000, chapter 7).

loans, short-term loans). This is due to the fact that some banks do not have these types of loans on their balance sheet and drop out of the sample.

The instruments are also in fourth-lag differences, where appropriate. The number of lags for the instruments were chosen on empirical grounds and set not too high in order to preserve as many observations. The Sargan statistics indicate that the instruments are valid, although there might be some 'overfitting' which, however, is not a serious problem. The AR1 and AR2 tests indicate that first-order autocorrelation in the residuals is present, but that second-order autocorrelation is not. The presence of first order autocorrelation does not imply that the estimates are inconsistent. The presence of second order autocorrelation would imply inconsistency, though. Further checks on higher order autocorrelation, not reported here, were also negative. The tables below report estimates obtained using the two-step GMM estimator proposed by Arellano and Bond (1991). It is known that the two-step standard errors tend to be biased downward in small samples. For this reason, the one-step results are generally recommended for inference on the coefficients, although the two-step Sargan test is recommended for inference on model specification. However, many coefficients tend to become insignificant when using the one-step estimator, and for that reason the two-step estimation results are reported.[11]

4.2 *Evidence of the Lending Channel by Size, Liquidity and Capitalisation of Banks*

The results of the estimation of equation (7) are presented in Table 2. The columns denoted by 'Size,' 'Liquidity,' and 'Capitalisation' give the results of the estimation of the equation including the three different bank-characteristic variables bank size, liquidity, and capitalisation, respectively. For comparison's sake, the first column also presents the results of the estimation without interacting with any of the bank-characteristic variables.

The top panel of the table gives the long-term coefficients for total loans to the private non-financial sector, which include 47% of total assets of all banks in the sample. The coefficient of the interest rate is negative in all four cases, though not significantly (at the 5% level) in the equation with liquidity and capitalisation. The coefficient for the interest rate is -4.8 in the loan equation with size, which means that an increase in the interest rate by one percentage point in the long run leads to a decrease in the amount of loans by 4.8%. In the equation without a bank characteristic variable the coefficient is smaller (-2.0) and in the equation with liquidity and capitalisation it is insignificant, as already mentioned. Turning to the coefficients of the interaction terms in the total loan equation, the expected positive sign is found to be significant for capitalisation only. Hence,

11 The signs and relative magnitudes of the coefficients generally do not change much, so that the two-step evidence presented here can be considered indicative.

TABLE 2 – LOANS TO THE PRIVATE SECTOR: TOTAL, WITH AND WITHOUT GUARANTEE

			Bank characteristics:									
			Size			Liquidity			Capitalisation			
	Coeff.		*p*-value	Coeff.		*p*-value	Coeff.		*p*-value	Coeff.		*p*-value
Total loans (*47% of total assets*)												
Interest rate	− 2.011	***	0.000	− 4.849	***	0.000	− 1.798	*	0.091	− 0.969		0.141
Bank characteristic × Interest rate				− 0.462		0.504	5.645		0.365	94.71	***	0.000
Real GDP	− 1.560	***	0.001	1.353		0.278	− 2.027	**	0.050	− 2.569	*	0.051
Bank characteristic × GDP				3.922	***	0.000	− 35.39	***	0.000	− 171.87	***	0.000
Prices	1.995	***	0.004	3.724	**	0.019	1.896		0.420	− 2.220	*	0.084
Bank characteristic × Prices				− 0.219		0.707	− 28.74	***	0.000	− 58.86	***	0.000
Bank characteristic				− 0.592	***	0.000	2.653	***	0.000	9.481	***	0.000
AR1, AR2, Sargan (*p*-values)	0.001	0.874	1.000	0.001	0.869	1.000	0.000	0.949	1.000	0.001	0.857	1.000
Number of banks, observations	98		1563	98		1563	98		1563	98		1563
Loans with guarantee (*10% of total assets*)												
Interest rate	13.83	***	0.000	20.15	***	0.002	13.68		0.387	− 0.449		0.959
Bank characteristic × Interest rate				− 13.42	***	0.006	− 102.75	*	0.092	− 162.06		0.393
Real GDP	− 25.93	***	0.000	− 23.25	**	0.043	− 33.58	**	0.012	− 21.39		0.189
Bank characteristic × GDP				18.14	***	0.005	53.76		0.295	− 74.229		0.626
Prices	− 14.35	***	0.000	− 8.637		0.284	− 17.43		0.487	− 19.81	*	0.083
Bank characteristic × Prices				− 1.814		0.503	80.41	**	0.035	3.110		0.982
Bank characteristic				− 0.884	***	0.001	− 3.215	*	0.072	5.197		0.439
AR1, AR2, Sargan (*p*-values)	0.059	0.690	1.000	0.127	0.626	1.000	0.079	0.949	1.000	0.075	0.814	1.000
Number of banks, observations	54		725	54		725	54		725	54		725

TABLE 2 – CONTINUED

				Bank characteristics:								
				Size			Liquidity			Capitalisation		
	Coeff.		*p*-value	Coeff.		*p*-value	Coeff.		*p*-value	Coeff.		*p*-value
Loans without guarantee (*37% of total assets*)												
Interest rate	− 10.39	***	0.000	− 10.91	***	0.000	− 7.395	***	0.000	− 2.411		0.173
Bank characteristic × Interest rate				1.852	**	0.021	24.29	***	0.001	202.67	***	0.000
Real GDP	17.13	***	0.000	18.20	***	0.000	13.91	***	0.000	6.338	***	0.005
Bank characteristic × GDP				− 2.621	*	0.074	− 49.12	***	0.000	− 336.42	***	0.000
Prices	5.661	***	0.000	4.658	*	0.065	1.044		0.717	4.700		0.285
Bank characteristic × Prices				1.441		0.192	− 72.29	***	0.000	80.594	**	0.038
Bank characteristic				− 0.410	***	0.000	4.037	***	0.000	8.942	***	0.000
AR1, AR2, Sargan (*p*-values)	0.002	0.609	1.000	0.002	0.684	1.000	0.001	0.735	1.000	0.002	0.909	1.000
Number of banks, observations	95		1478	95		1478	95		1478	95		1478

*, **, and *** denote significance at the 10%, 5%, and 1% level.
The number of banks in the respective samples differ as some banks do not have all types of loans on their balance sheets and consequently drop out of the sample.

there is no equation for total loans where both the coefficient of the interest rate and the coefficient of the interaction term are significant and have the signs that are to be expected from the lending channel theory.

Further investigation reveals that in the case of the Netherlands it is important to make a distinction between bank loans with and without government guarantees when examining the lending channel of monetary policy. The government gives guarantees on specific bank loans, among which mortgage loans to low-income households are an important category. The government also acts as guarantor for loans to semi-state owned companies, such as hospitals. The second and third panels in Table 2 present estimates for loans with and without government guarantees, or in other words secured and unsecured bank debt. Secured debt accounts for 10% of total assets of the banks in the sample, unsecured debt for 37%. There are some striking outcomes. First, a significantly negative interest rate effect on lending is totally absent in the case of secured lending, while it is present in all cases for unsecured lending except in the equation with capitalisation as the interaction variable. Hence, monetary policy tightening does not appear to have any negative effect on secured bank lending. A reason could be that loans with guarantees get special treatment by banks. In fact, they earn a special interest rate, which is generally lower than the market rate. This reflects the lower credit risk on secured debt. Second, the expected positive coefficient of the interaction term is found to be significant for unsecured loans in all cases while for secured lending the interaction term has the opposite sign and is, moreover, not always significant. Third, the coefficients of the control variables ('Real GDP' and 'Prices'), when significant, are of opposite signs for secured and unsecured debt. For unsecured debt the coefficients have the intuitively expected positive sign, while for secured debt the sign is negative. Hence, secured lending moves counter to macroeconomic trends. The positive coefficients of real GDP are quite large for unsecured lending. This probably reflects the extraordinary high credit growth during the sample period, often exceeding the GDP growth rate.

All in all, these estimation results show that for the Netherlands it is highly important to look at unsecured bank credit, i.e. loans without any government guarantees, when investigating the lending channel of monetary policy. For unsecured debt the results are in accordance with expectations: there is a negative monetary policy effect on lending which is stronger for smaller, less liquid and less capitalised banks. This is in line with the lending channel theory according to which such banks are almost unable to attract non-deposit funds or use their buffer of liquid assets to shield their loan portfolios from monetary policy tightening.[12] Therefore, in what follows the focus will remain on unsecured debt.

12 The results show that small banks are more susceptible to monetary policy shocks than large banks. As several very large banks hold practically the whole market in the Netherlands, the macroeconomic impact of the lending channel may not be that great. This does not change the conclusion that the lending channel is relevant for many banks.

TABLE 3 – LOANS TO PRIVATE SECTOR WITHOUT GUARANTEE, BY MATURITY AND SECTOR

Bank characteristics:	Size			Liquidity			Capitalisation		
	Coeff.		*p*-value	Coeff.		*p*-value	Coeff.		*p*-value
By maturity:									
Short-term loans (*11% of total assets*)									
Interest rate	− 7.552	***	0.000	− 2.068		0.172	− 0.015		0.994
Bank characteristic × Interest rate	1.853		0.236	28.10		0.124	217.2	***	0.000
AR1, AR2, Sargan (*p*-values)	0.000	0.498	1.000	0.000	0.664	1.000	0.000	0.796	1.000
Number of banks, observations	95		1449	95		1449	95		1449
Long-term loans (*26% of total assets*)									
Interest rate	− 5.627		0.208	− 5.875		0.377	− 25.05	***	0.000
Bank characteristic × Interest rate	1.640		0.645	78.55	***	0.000	199.2	***	0.000
AR1, AR2, Sargan (*p*-values)	0.006	0.436	1.000	0.005	0.381	1.000	0.006	0.760	1.000
Number of banks, observations	67		1070	67		1070	67		1070
By sector:									
Loans to households (*14% of total assets*)									
Interest rate	− 5.296	*	0.063	− 0.481		0.916	− 8.196		0.581
Bank characteristic × Interest rate	1.082		0.599	31.29		0.223	− 269.6		0.441
AR1, AR2, Sargan (*p*-values)	0.001	0.177	1.000	0.001	0.198	1.000	0.001	0.119	1.000
Number of banks, observations	62		962	62		962	62		962
Loans to non-financial firms (*23% of total assets*)									
Interest rate	− 8.529	***	0.000	− 7.377	***	0.000	− 2.331		0.268
Bank characteristic × Interest rate	0.016		0.985	35.22	**	0.012	249.3	***	0.000
AR1, AR2, Sargan (*p*-values)	0.001	0.833	1.000	0.001	0.827	1.000	0.001	0.891	1.000
Number of banks, observations	95		1468	95		1468	95		1468

*, **, and *** denote significance at the 10%, 5%, and 1% level.

The number of banks in the respective samples differ as some banks do not have all types of loans on their balance sheets and consequently drop out of the sample.

Table 3 goes into more detail by presenting the monetary policy effects on unsecured bank lending by maturity and by sector. The control variables are not reported here for reasons of space; their coefficients are qualitatively similar to those given for unsecured loans in Table 2. The top panel shows the effects on lending long-term and short-term[13] and the bottom panel for lending to households and firms. Overall, going into this detail seems to lead to some loss of statistical significance for a number of the monetary policy variables. However, where the coefficients are statistically significant they still have the theoretically expected signs, i.e. negative for the interest rate and positive for the interaction term. Combinations of a significant and negative coefficient for these two variables are only found in two cases though (in the equation for unsecured long-term loans with capitalisation and the equation for unsecured loans to non-financial firms with liquidity).

4.3 *The Influence of Market Orientation*

In section 3.2 the factor analysis showed that the banks in the sample could be split into three categories: retail banks, wholesale banks, and foreign banks. This result will be used in this subsection to assess whether the bank lending responses to monetary shocks depend on which market segment banks are operating in. The factors derived from the factor analysis lend themselves to be used as bank characteristic variables, to interact with the monetary policy variable.[14] The values of these factors measure the extent to which a particular bank can be characterised exclusively as a retail bank, a foreign bank, or a wholesale bank.

It should be noted that the research question in this subsection is different compared to the one of section 4.2. It is unlikely that the signs of the coefficients of the three factors (that are the new interaction variables in the equation) can be predicted *a priori* on the basis of the lending channel theory. For example, the theory does not predict whether banks dealing with households cut down their loan supply differently after monetary tightening than banks dealing with firms. The research question posed here is just whether there is evidence that banks in different market segments respond differently to monetary policy. This is an interesting question because it gives insight into the distributional effects of monetary policy over the different groups of bank borrowers (households and firms). The control variables in the model should account for most of the differential loan demand effects, so that this experiment may shed some light on the question whether, for instance, monetary policy affects bank dependent households differently than it affects firms.

13 Short-term is defined as maturity up to two years, long-term two years and more.

14 The means of common factors over all observations are already zero by definition, so that normalisation is not necessary.

TABLE 4 – LOANS TO PRIVATE SECTOR WITHOUT GUARANTEE, BY MATURITY AND SECTOR

Bank characteristics:	Factor 1 Retail bank			Factor 2 Foreign bank			Factor 3 Wholesale bank		
	Coeff.		*p*-value	Coeff.		*p*-value	Coeff.		*p*-value
Total loans (*37% of total assets*)									
Interest rate	− 9.532	***	0.000	− 13.55	***	0.000	− 9.269	***	0.000
Bank characteristic × Interest rate	− 3.621		0.435	1.013		0.720	− 0.049		0.976
Real GDP	19.54	***	0.000	19.00	***	0.000	15.30	***	0.000
Bank characteristic × GDP	− 1.498		0.780	− 14.64	***	0.000	1.881		0.160
Prices	2.667		0.163	13.72	***	0.000	3.485		0.218
Bank characteristic × Prices	− 4.418	**	0.039	− 12.86	***	0.000	15.19	***	0.000
Bank characteristic	0.125		0.451	0.445	***	0.000	− 0.584	***	0.000
AR1, AR2, Sargan (*p*-values)	0.001	0.675	1.000	0.001	0.447	1.000	0.000	0.780	1.000
Number of banks, observations	95		1478	95		1478	95		1478
By maturity:									
Short-term loans (*11% of total assets*)									
Interest rate	− 7.158	***	0.001	− 3.172		0.123	− 4.476	**	0.011
Bank characteristic × Interest rate	4.620		0.316	1.938		0.646	8.129	**	0.051
AR1, AR2, Sargan (*p*-values)	0.000	0.467	1.000	0.000	0.329	1.000	0.000	0.872	1.000
Number of banks, observations	95		1449	95		1449	95		1449
Long-term loans (*26% of total assets*)									
Interest rate	− 5.855	*	0.100	− 8.048	*	0.060	− 14.20	***	0.006
Bank characteristic × Interest rate	− 1.025		0.922	1.926		0.562	− 27.18	***	0.000
AR1, AR2, Sargan (*p*-values)	0.007	0.478	1.000	0.004	0.525	1.000	0.004	0.170	1.000
Number of banks, observations	67		1070	67		1070	67		1070

TABLE 4 – CONTINUED

Bank characteristics:	Factor 1 Retail bank			Factor 2 Foreign bank			Factor 3 Wholesale bank		
	Coeff.		*p*-value	Coeff.		*p*-value	Coeff.		*p*-value
By sector:									
Loans to households (*14% of total assets*)									
Interest rate	− 0.294		0.952	− 6.132	**	0.034	− 5.215	**	0.063
Bank characteristic × Interest rate	− 3.671		0.561	3.099		0.551	− 3.104		0.539
AR1, AR2, Sargan (*p*-values)	0.001	0.179	1.000	0.001	0.164	1.000	0.001	0.200	1.000
Number of banks, observations	62		962	62		962	62		962
Loans to non-financial firms (*23% of total assets*)									
Interest rate	− 8.701	***	0.000	− 7.688	***	0.000	− 7.325	***	0.000
Bank characteristic × Interest rate	− 1.036		0.531	1.021		0.631	0.826		0.715
AR1, AR2, Sargan (*p*-values)	0.000	0.714	1.000	0.000	0.699	1.000	0.000	0.852	1.000
Number of banks, observations	95		1468	95		1468	95		1468

*, **, and *** denote significance at the 10%, 5%, and 1% level.

The number of banks in the respective samples differ as some banks do not have all types of loans on their balance sheets and consequently drop out of the sample

Table 4 presents the estimation results. The three columns represent the equations with the three respective factors as the bank characteristic variables. The top panel presents the long-term coefficients for total unsecured loans, with splits into long-term and short-term loans in the second panel and into households and firms in the bottom panel. Looking at the coefficients of the interest rate, it appears that in general bank lending is affected negatively by monetary tightening. However, the significance of the negative interest rate coefficient is consistently higher for lending to firms than it is for lending to households. This indicates that bank dependent households are affected less by monetary tightness than bank dependent firms. However, the finding could partly reflect the special circumstances in which the market for mortgage credit found itself during the nineties. There were special factors causing an extraordinary strong surge in mortgage lending at the time, which possibly make it difficult to filter out any interest effects on lending to households. The values of the estimated coefficients for the interaction terms in the equation for total loans are insignificant. They are only significant for short-term and long-term loans when the interaction variable is factor 3, which stands for the extent to which a bank is a wholesale bank. The interaction term is positive for short-term loans and negative for long-term loans. This suggests that banks specialising in lending to firms cut their long-term lending by more and cut their short-term lending by less when monetary conditions are tight.

5 CONCLUSION

This study presents empirical evidence on the lending channel in the Netherlands, using individual quarterly bank data. The analysis focuses on the differential response of the loan supply to monetary policy changes across several bank categories. Two categorisation devices are used in this study: first, banks' financial health (measured by size, liquidity, and capitalisation) and, second, banks' market orientation (retail banking, wholesale banking, and foreign banking).

The estimates suggest that a lending channel is operative in the Netherlands. However, it appears to be important to make a distinction between bank loans with and without government guarantees. Particularly, there is strong evidence that the lending channel is only operative for unsecured bank debt. The estimation results show that monetary tightening does not have any negative effect on secured bank lending. A reason could be that loans with guarantees get special treatment by banks. For unsecured debt the results are in accordance with expectations: there is a negative monetary policy effect on lending which is stronger for smaller, less liquid, and less capitalised banks. This is in line with the lending channel theory according to which such banks are unable to attract non-deposit funds or use their buffer of liquid assets to shield their loan portfolios from monetary policy tightening.

A contribution of this study is that it gives evidence that the monetary policy impact on bank lending also depends on the market segment in which a bank is active. The evidence suggests that the lending channel is not affecting lending to households as much as it is affecting lending to firms. This could partly reflect the special circumstances in which the Dutch market for mortgage credit found itself during the nineties.

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