Banks and monetary transmission in Europe: empirical evidence *

G.J. DE BONDT

1. Introduction

Over the last two decades, the process of monetary policy transmission has been a hot topic in the literature. Especially the issue whether credit channels of monetary policy exist has shown a revival of interest (see for an overview, among many others, Gertler and Gilchrist 1993, Bernanke and Gertler 1995 and de Bondt 1998b). Credit channels in a broad sense focus on financial market imperfections as an essential factor of propagation and amplification of a monetary policy shock. The *bank lending channel* emphasizes the impact of monetary policy on bank loan supply rather than on money supply. A monetary policy tightening by reducing bank reserves potentially have additional effects that operate through the asset side of bank balance sheet. The decrease in reserves decreases reservable deposits held by banks, and this, if not offset by an increase in non-reservable deposits and assuming that bank assets are imperfect substitutes, leads to a fall in bank loan supply. The *balance sheet channel* asserts that information problems between borrowers and lenders drive a wedge between the price of uncollateralised external funds and the price of internal funds. This so-called external finance premium, in turn, is inversely related to borrowers' net worth. Of course, the balance sheet of borrowers is directly and/or indirectly affected by monetary policy.

☐ De Nederlandsche Bank NV, Econometric Research and Special Studies Department, Amsterdam (The Netherlands).

* I thank Peter van Els, Martin Fase and two anonymous referees for helpful comments, Frank Stork and Bert Vos for research assistance. The usual disclaimer applies.

A large body of empirical studies test the existence of credit channels of monetary policy by using aggregated data or disaggregated data on non-financial firms. Empirical analyses with disaggregated data on banking firms, however, are scarce and focus on the US. The advantage of using disaggregated bank data is that it provides one of the most precise ways to test the existence of credit channels from a lender's perspective. The disadvantage is that disaggregated data provide no aggregate information about the importance of credit channels. This paper uses bank-level panel data for the years 1990-95 to test the existence of a bank lending and balance sheet channel in Europe. A common empirical analysis is applied for six member states of the European Union (EU), allowing cross-country comparison. The EU countries considered are Germany, France, Italy, the United Kingdom, Belgium and the Netherlands. The first four are the most important in terms of the size of their banking industries, while Belgium and the Netherlands are two small European economies with a high degree of banking concentration.

The empirical findings provide strong support for the existence of a bank lending channel in Germany, Belgium and the Netherlands. In these countries monetary policy matters most for small banks and for banks with relatively illiquid balance sheets. The empirical results supports the existence of a balance sheet channel strongly in again Germany and to a lesser extent also in Italy. In both countries loan demand interacts with bank size and therefore with borrower size. With the assumption that large banks lend to large borrowers, large banks' effective loan demand reacts less prominently to a monetary contraction, since large firms' balance sheets remain relatively strong. The empirical results also provide support for the existence of a bank lending channel in France and Italy as the stance of monetary policy is measured by a monetary conditions index instead of the change in the short-term interest rate. For the United Kingdom no supportive evidence for the existence of both credit channels is found.

The remainder of this paper is organised as follows. Section 2 provides a background by reviewing studies which use bank data to examine credit channels of monetary policy. Section 3 postulates an empirical bank lending model and introduces two hypotheses, one regards the existence of a bank lending channel and the other the existence of a balance sheet channel. Section 4 describes the data. Section

5 assesses the empirical results, in particular with respect to both hypotheses. Section 6 provides a summary and conclusions.

2. Studies using bank data

The existence of a bank lending channel has been tested using disaggregated bank data for the US by Kashyap and Stein (1995 and 1997a) and Peek and Rosengren (1995a). The empirical evidence for the US provided by these authors shows that cross-sectional differences in lending behaviour of banks with varying characteristics exist, supporting the existence of a bank lending channel.

Kasyhap and Stein (1995) analyze cross-sectional differences in financing and lending decisions of banks of different sizes. The strongest result in their paper is that following a monetary contraction, measured by an increase in the federal funds rate, the total quantity of loans held by small banks falls while that of large banks does not. They argue that small banks have less access to the certificates of deposits (CDs) market, where large banks are able to attract external funds to protect their loan portfolio. This finding indicates that a drain of reserves forces especially a reduced supply of loans by small banks.

In another paper Kashyap and Stein (1997a) emphasize that buffer stocks held by banks will make it more difficult to find bank lending responses to shifts in monetary policy. Banks that have difficulty making up for deposit outflows should typically hold a buffer stock of securities, so that they can reduce security holdings rather than having to cut back loans following a monetary tightening. Kashyap and Stein's main finding is that changes in monetary policy, measured by three different indicators, have had a more powerful impact on those banks with lower ratios of cash and securities to assets. Moreover, the smaller banks in their sample drive their result almost entirely. Again, this bank behaviour is suggesting that the bank lending channel is a relevant transmission mechanism.

A VAR analysis for Korea by the Bank of Korea (1998) leads to the same qualitative conclusions. Loan volume and securities and cash holdings of small- and medium-sized Korean banks shrink more than

that of the six largest Korean banks following a monetary contraction, measured by a reduction in the reserve base. The VAR results of Steudler and Zurlinden (1997), however, show that in Switzerland the responses to short-term interest rate shocks of the small regional banks and the medium-sized Cantonal banks do not much differ and that the large banks reveal the largest response of both securities and loans.

Peek and Rosengren (1995a) argue that the use of bank size as a measure to generate cross-sectional differences does not correspond precisely to the underlying theoretical models, which stresses the importance of the net worth position of banks. In this context bank capital may be a better proxy. Peek and Rosengren (1995a) illustrate with a simple one-period bank portfolio model, based on Peek and Rosengren (1995b), that a contractionary monetary policy has a negative effect on loan supply for capital-unconstrained banks and a positive one for constrained banks. Their empirical results show that the net impact of a change in the federal funds target rate may be quite sensitive to the health of the banking sector and the share of banks facing binding capital constraints.

Empirical evidence about the existence of credit channels using bank data of EU countries is scarce. Angeloni *et al.* (1995), using data of Italian banks of different size classes, find that their proxy of the external finance premium rises after a monetary tightening, supporting the existence of credit channels. Moreover, large banks and banks with large loans tend to tighten credit conditions more than other banks following a monetary contraction. *Prima facie*, this last finding contradicts the credit channel hypothesis. It implies a comparatively smaller impact of monetary policy on small firms, since banks and borrowers size are positively related. Smaller banks, however, refrain from fully adjusting their lending rates because of the existence of customer relationships or their monopoly power in local markets (Conigliani, Ferri and Generale 1997; de Bondt 1998a).

3. Empirical bank lending model

The following empirical bank lending model is postulated:

$$\Delta \text{ loans}_{it} = \alpha_i + \beta_1 \Delta rs_t + \beta_2 (\Delta rs_t) \cdot size_{it} + \beta_3 (\Delta rs_t) \cdot liquidity_{it} + \beta_4 (\Delta rs_t) \cdot liquidity_{it} \cdot size_{it} + \beta_5 y_t + \beta_6 y_t \cdot size_{it} \quad (1)$$

with index i referring to bank i and t to period t and

loans = 100 · net loans/total assets;

rs = short-term interest rate in %;

liquidity = 100 · liquid assets/deposits and money market funding;

size = ln (total assets);

y = real GDP growth in %.

The change in the short-term interest rate is assumed to capture the stance of monetary policy; an increase in the interest rate will lead to a fall in bank lending ($\beta_1 < 0$). The impact of monetary policy on bank lending may differ across banks along with how easily they can attract non-deposit funding, as shown by a two-period bank portfolio model in Kashyap and Stein (1995) and Kakes (1999). Assuming that the costs of non-deposit funding are higher for small banks and for banks with illiquid balance sheets, the effects of monetary policy on bank lending are most pronounced for small and illiquid banks. Loan demand effects are assumed to be captured by the growth rate of real GDP; higher economic activity will lead to a rise in bank lending ($\beta_5 > 0$). The impact of loan demand may differ across bank size, assuming that bank and borrower size are positively related. Broadly speaking, the latter is the case since small banks tend to lend to small firms.

Our first principal hypothesis is that the existence of a *bank lending channel* is reflected in a positive β_2 or β_3, and/or negative β_4. The lending behaviour of large banks is less sensitive to a change in the stance of monetary policy than the lending behaviour of small banks ($\beta_2 > 0$), since large banks have easier access to non-deposit funding sources. Banks with a high degree of liquid assets are able to protect their loan portfolio by reducing their stock of liquid assets. In contrast, less liquid banks are likely to have to cut loans significantly, if they do not want to see their ratio of liquid assets to total assets sink to a level that is dangerously low. The sensitivity of lending volume to monetary policy is larger for banks with weaker (less liquid) balance sheets or put differently, the degree to which bank lending is liquidity constrained is intensified during periods of tight money ($\beta_3 > 0$). The effect of the degree of the liquidity of banks' balance sheets with respect to monetary policy shocks is most prominent for small

banks ($\beta_4 < 0$), since large banks have easier access to a variety of markets of external finance and face comparatively weak credit market imperfections, assuming that the degree of asymmetric information between banks and borrowers and information costs are inversely related to bank size. The latter is the case if bank and borrower size are positively correlated and if some information costs are fixed. This hypothesis, in a slightly different way, has also been tested empirically for US banks by Kashyap and Stein (1995, $\beta_2 > 0$) and Kashyap and Stein (1997a, $\beta_3 > 0$ or $\beta_4 < 0$).

Our second principal hypothesis is that the existence of a *balance sheet channel* is reflected in a negative β_6. For the US Gertler and Gilchrist (1993 and 1994) and Bernanke, Gertler and Gilchrist (1996) show that, as predicted by the credit channel theory, lending to small firms contracts substantially relative to large firms following a monetary policy tightening. Broadly speaking, small banks tend to lend to small borrowers, *in casu* small firms and households, whose deterioration in balance sheet position after a monetary contraction is relatively strong. Assuming a positive relation between bank and borrower size, this results in a disproportionately reduction in the effective credit demand by small borrowers. Put differently, the balance sheet channel predicts that the loan demand effects are relatively strong for small borrowers and therefore for small banks ($\beta_6 < 0$).

4. Data

Bank data are obtained from BankScope, a database of bank account figures on an annual basis maintained by Fitch IBCA and Bureau van Dijk, a major European rating agency and a publisher of financial databases on CD-ROM, respectively. If both unconsolidated and consolidated statement figures are available, the consolidated account data are used, since a parent company can freely shift resources among their subsidiaries as if there were no boundaries (Jayartne and Morgan 1997).

For each country considered, an unbalanced panel data set is constructed, consisting of individual bank data for the years 1990-95. The main benefit of looking at banks in a single country is that they face more or less the same accounting standards, economic conditions and stance of monetary policy. The data set is cleaned by eliminating all observations where the change of bank loans as a percentage of total assets is more than plus or minus 50%. Although the sample period consists of only six years because of data availability, it is long enough in the sense that it contains years of contractionary as well as expansionary monetary policy. In the 1990s also frequent merger and takeover activities took place in the European banking industry. For this reason unbalanced panel data sets are constructed, since banks that disappeared through mergers or takeovers are part of the sample at the start of the period and, in a sense, remain in the sample because their assets and liabilities appear on the balance sheet of the acquiring bank.[1]

Table 1 lists the sample size and the total number of banks (rows 1 and 2), the mean of the empirical model variables and between parentheses the standard deviation. The sample size varies between 224 observations on 55 banks for the Netherlands and 3044 observations on 1129 banks for Germany. The number of banks is low in the Netherlands, since it is a small economy and has a comparatively high banking concentration. On the other hand, Germany is the most important country in terms of the size of the economy and shows a relatively low degree of concentration within the banking industry (de Bondt 1998a).

The empirical analysis focuses on the change in the loan ratio defined as gross loan minus loan loss reserves as a percentage of total assets. On average, bank loans vary between 37% of total assets in Belgium and 58% in Germany. The variation in the loan ratio is relatively high in the United Kingdom and low in Italy (standard deviation of 31% *versus* 14%). On average, the change of the loan ratio over the total sample is slightly negative or positive.

The average bank size depends highly on the national currency unit. The standard deviation of bank size is relatively low in Germany, which implies that the German sample shows a low variation in bank size compared to the other countries considered. The exact definition of liquid assets differs between the countries. In most cases

[1] Other procedures, not followed here, are to exclude banks involved in mergers or takeovers or to aggregate pre-merger data of acquiring and acquired banks as if mergers and takeovers had taken place at the beginning of the sample period.

it includes assets such as cash and due from banks, balances at the central bank, loan and advances to and deposits with banks up to three months, treasury bills, etc. Deposits and money market funding consist of customer and short-term funding, or more specifically demand, savings and time deposits and other funding. In most EU countries liquid assets are 40% to 50% of deposits and money market funding. At 20% and 15%, these figures are considerably lower in France and Belgium, respectively. Presumably institutional differences or differences in accounting standards explain the extreme position of France and Belgium.

The mean of the short-term interest rate is relatively low in Germany and high in Italy, while its standard deviation is comparatively high in the United Kingdom. The change in the short-term interest rate is on average negative in all countries, suggesting that on average monetary policy eased during the sample period. The average real GDP growth varies between 1.3% in France and 2.4% in the Netherlands.

TABLE 1

SAMPLE SIZE AND MEAN AND STANDARD DEVIATION OF MODEL VARIABLES
(in %, unless stated otherwise)

	Germany	France	Italy	United Kingdom	Belgium	Netherlands
Observations[a]	3044	1569	1161	1036	304	224
Banks[a]	1129	399	287	239	96	55
loans	57.8	51.4	47.9	50.2	37.3	50.1
	(18.0)	(26.5)	(14.2)	(31.4)	(19.1)	(23.1)
Δloans	0.43	-0.27	1.36	-0.51	-0.38	0.08
	(3.59)	(7.49)	(4.43)	(6.10)	(5.77)	(7.43)
size[a]	7.80	8.95	14.83	6.90	10.6	8.08
	(1.35)	(1.92)	(1.63)	(1.94)	(2.08)	(1.65)
liquidity	44.4	20.3	51.2	45.1	14.7	42.7
	(50.6)	(41.3)	(17.9)	(37.0)	(15.6)	(23.4)
rs	6.1	8.0	10.9	8.2	6.8	6.7
	(1.7)	(1.8)	(1.8)	(3.1)	(1.9)	(2.0)
Δrs	-1.1	-0.7	-0.4	-1.1	-1.1	-0.8
	(1.0)	(1.5)	(2.1)	(1.9)	(1.0)	(1.3)
y	2.2	1.3	1.5	1.5	1.5	2.4
	(1.7)	(1.6)	(1.4)	(1.9)	(1.4)	(1.0)

[a] Absolute numbers.

5. Empirical results

5.1. *Estimation results*

Table 2 shows the estimation results of equation 1 with the preferred bank specific effects as described in the Appendix. In all countries except Belgium and the Netherlands, the coefficients estimated seem to be reasonable. Given the interaction terms, as the short-term interest rate increases by 1 percentage point, bank loans will decrease by less than 2% of total assets or as real GDP growth increases by 1 percentage point the bank loan ratio will increase by less than 2 percentage points. The estimated coefficients for Belgium and the Netherlands are relatively large. This is due to the fact that for both countries relatively few observations are available. The relatively high R^2 for both countries is caused by the additional explanatory variables of bank specific constants. In the other countries the R^2 is considerable lower, but still more or less typical of that obtained in US studies. In France and the United Kingdom, however, no model variable at all significantly explains bank lending.[2]

To test our first hypothesis regarding the existence of a bank lending channel, the significance level of a positive estimated β_2, positive β_3 and negative β_4 is examined. A bank lending channel seems to exist in Germany, Belgium and the Netherlands. No empirical evidence in favour of the existence of a bank lending channel is found for France, Italy and the United Kingdom. A significant negative estimated β_6 supports our second hypothesis regarding the existence of a balance sheet channel. The estimation results indicate the existence of a balance sheet channel in Germany and at a significance level of 10% also in Italy. For the other countries considered the empirical results do not provide evidence for the existence of a balance sheet channel.

The evidence in favour of the existence of credit channels is more or less in line with the existence of credit channels in European countries as predicted by Kashyap and Stein (1997b). Based on a review of different credit channel indicators, *i.e.* importance of small banks and firms, bank health and availability of non-bank finance, Italy emerges as the country for which the evidence most clearly sug-

[2] Throughout the paper significance refers to a significance level of 5%, unless stated otherwise.

gests potentially relatively strong credit channels. At the other end of the spectrum is the United Kingdom, where weak credit effects of monetary policy are expected. For Germany and France the picture is less clear than for Italy, while Belgium and the Netherlands appear to be on the relatively insensitive end of the spectrum close to the United Kingdom.

TABLE 2

ESTIMATION RESULTS

	Germany	France	Italy	United Kingdom	Belgium	Netherlands
Δrs	-1.948 (4.72)***	-0.310 (0.44)	-1.398 (0.55)	-0.431 (1.12)	-5.842 (2.45)**	-29.10 (4.47)***
Δrs·size	0.178 (3.51)***	0.055 (0.70)	0.068 (0.41)	0.073 (1.45)	0.487 (2.13)**	3.033 (4.25)***
Δrs·liquidity	0.022 (4.11)***	0.024 (1.75)*	0.024 (0.50)	0.004 (0.45)	0.238 (2.77)***	0.717 (4.41)***
Δrs·liquidity·size	-0.002 (3.46)***	-0.003 (1.43)	-0.001 (0.38)	-0.000 (0.02)	-0.020 (2.32)**	-0.078 (4.24)***
y	1.272 (7.10)***	0.716 (1.34)	1.873 (2.45)**	-0.170 (0.63)	-1.365 (1.51)	1.232 (0.50)
y·size	-0.088 (4.03)***	-0.052 (0.89)	-0.099 (1.94)*	-0.004 (0.13)	0.143 (1.85)*	-0.055 (0.21)
R^2	0.071	0.010	0.023	0.010	0.384	0.450
Model	Random effects	Random effects	Random effects	No bank specific effects	Fixed effects	Fixed effects
Sample size	3044	1569	1161	1036	304	224

Explanatory notes: estimations of (bank specific) constant(s) are not reported; absolute t-ratios are reported in parentheses, heteroschedasticity corrected for models with no bank specific or fixed effects; ***, ** and * indicate significance at the 1, 5 and 10% level, respectively.

5.2. *Other measures for stance of monetary policy*

The change in the short-term interest rate may not be a good indicator for the stance of monetary policy, because exchange rate crises with the accompanying unusual increases and decreases in the short-term interest rate occurred during the sample period, especially in France, Italy and the United Kingdom. A better indicator for the

stance of monetary policy could be a monetary conditions index which takes also exchange rate developments into account. The monetary conditions index is constructed as a weighted average of the short-term interest rate and the dollar exchange rate (Peeters 1998). The weights are based on alternative projections with the macroeconometric structural model for EU countries of De Nederlandsche Bank (de Bondt, van Els and Stokman 1997).

Table 3 shows the estimation results of equation 1 with a monetary conditions index as a measure for the stance of monetary policy rather than the change in the short-term interest rate.[3] In particular in Italy the explanatory power of the model increases in comparison with the results of Table 2. The empirical results still provide evidence for the existence of a bank lending channel in Germany, Belgium and the Netherlands and for the existence of a balance sheet channel in Germany. The results for France and Italy, however, change as the stance of monetary policy is measured by a monetary conditions index. The empirical results for France and Italy now support the existence of a bank lending channel. In contrast, for the United Kingdom there is still no empirical evidence in favour of the existence of credit channels of monetary policy.

5.3. *Sub-sample estimates*

This section analyzes the robustness of our estimation results by examining two sub-samples. One sub-sample distinguishes between banks of different size, the other between foreign and domestic owned banks. This distinction could be relevant because banks' access to non-deposit funding, and therefore the existence of a bank lending channel, differs along with bank size and the degree of international orientation of the banking sector. Large banks easily attract non-deposit funding sources compared to small banks and foreign-owned banks may have better access to the international capital markets and other foreign sources of funds than much larger wholly domestic-owned banks. Monetary policy contractions may be tempered by the

[3] Estimation results rarely change as the monetary conditions index is constructed as a weighted average of the short- and long-term interest rate and the dollar exchange rate.

ability of internationally operating banks to borrow funds offshore (Pill 1997).

TABLE 3

ESTIMATION RESULTS WITH MONETARY CONDITIONS INDEX AS MEASURE OF MONETARY STANCE

	Germany	France	Italy	United Kingdom	Belgium	Netherlands
mci	-1.281 (4.61)***	-1.638 (1.83)*	-2.152 (2.33)**	-0.438 (1.07)	-6.327 (3.07)***	-10.41 (2.39)***
mci·size	0.120 (3.56)***	0.139 (1.63)	0.133 (2.19)**	0.055 (1.12)	0.549 (2.91)***	0.970 (2.05)**
mci·liquidity	0.010 (2.46)**	0.033 (3.17)***	0.037 (2.12)**	0.002 (0.31)	0.189 (3.67)***	0.298 (2.65)***
mci·liquidity·size	-0.010 (1.99)**	-0.003 (2.57)**	-0.002 (1.84)*	0.000 (0.29)	-0.016 (3.15)***	-0.030 (2.35)**
y	0.890 (4.58)***	0.809 (1.45)	1.119 (1.18)	-0.473 (0.81)	-1.990 (1.96)*	4.161 (1.96)*
y·size	-0.056 (2.43)**	-0.048 (0.80)	-0.047 (0.74)	0.063 (0.85)	0.194 (2.29)**	-0.408 (1.79)*
R^2	0.076	0.011	0.048	0.007	0.387	0.416
Model	Random effects	Random effects	Random effects	No bank specific effects	Fixed effects	Fixed effects
Sample size	3044	1569	1161	1036	304	224

Explanatory notes: estimation of (bank specific) constant(s) are note reported; absolute t-ratios are reported in parentheses, heteroschedasticity corrected for models with no bank specific or fixed effects; ***, ** and * indicate significance at the 1, 5 and 10% level, respectively.

For the *first* sub-sample bank size classes are based on the latest available balance sheet totals. Three sub-samples are analyzed, one sub-sample deletes 10% of the observations on the smallest banks, the second sub-sample 25% and the third 50% (see Table 4). In all countries except Belgium, the conclusions with respect to the existence of a bank lending and balance sheet channel remain the same. For Belgium the empirical evidence supportive to a bank lending channel seems to be driven by the quartile of the observations on the smallest banks.

TABELLA 4

ESTIMATION RESULTS WITH SUB-SAMPLE OF BANKS WITH DIFFERENT SIZE CLASSES

	Germany	France	Italy	United Kingdom	Belgium	Nether-lands
	Sample without 10% of observations on smallest banks					
Δrs	-2.515 (5.19)***	-0.148 (0.17)	-0.749 (0.26)	-0.680 (1.59)	-4.780 (1.73)*	-30.41 (4.41)***
Δrs·size	0.241 (4.18)***	0.037 (0.39)	0.025 (0.13)	0.097 (1.80)*	0.399 (1.55)	3.187 (4.20)***
Δrs·liquidity	0.030 (4.17)***	0.012 (0.47)	0.014 (0.26)	-0.001 (0.15)	0.227 (2.14)**	0.753 (4.31)***
Δrs·liquidity·size	-0.003 (3.76)***	-0.001 (0.47)	-0.001 (0.16)	0.001 (0.61)	-0.019 (1.87)*	-0.082 (4.14)***
Y	1.265 (6.65)***	0.454 (0.71)	1.523 (1.61)	0.118 (0.43)	-1.881 (1.79)*	1.988 (0.63)
y·size	-0.088 (3.84)***	-0.027 (0.04)	-0.075 (1.20)	-0.041 (1.25)	0.187 (2.15)**	-0.137 (0.41)
R^2	0.073	0.005	0.018	0.014	0.372	0.423
Model	Random effects	Random effects	Random effects	No bank specific effects	Fixed effects	Fixed effects
Sample size	2739	1410	1042	932	273	201
	Sample without 25% of observations on smallest banks					
Δrs	-2.407 (4.41)***	0.625 (0.57)	1.091 (0.33)	-0.279 (0.50)	0.236 (0.07)	-14.20 (2.52)**
Δrs·size	0.230 (3.62)***	-0.036 (0.33)	-0.089 (0.42)	0.064 (0.98)	-0.022 (0.07)	1.402 (2.33)**
Δrs·liquidity	0.028 (3.40)***	-0.005 (0.14)	-0.008 (0.13)	0.005 (0.45)	-0.030 (0.16)	0.332 (2.81)***
Δrs·liquidity·size	-0.003 (3.10)***	0.000 (0.08)	0.001 (0.19)	-0.000 (0.08)	0.002 (0.12)	-0.035 (2.64)***
Y	1.334 (6.26)***	0.238 (0.32)	2.462 (2.16)**	0.273 (0.70)	-0.928 (0.77)	4.156 (1.53)
y·size	-0.096 (3.82)***	-0.008 (0.10)	-0.127 (1.73)*	-0.065 (1.49)	-0.112 (1.18)	0.359 (1.29)
R^2	0.067	0.005	0.030	0.017	0.356	0.208
Model	Random effects	Random effects	Random effects	No bank specific effects	Fixed effects	Fixed effects
Sample size	2282	1175	868	774	227	167

TABELLA 4 (*cont.*)

ESTIMATION RESULTS WITH SUB-SAMPLE OF BANKS WITH DIFFERENT SIZE CLASSES

	Sample without 50% of observations on smallest banks					
	Germany	France	Italy	United Kingdom	Belgium	Netherlands
Δrs	−2.627 (3.69)***	−0.096 (0.08)	−1.868 (0.35)	−0.896 (1.20)	−8.608 (1.57)	−15.79 (1.87)*
Δrs·size	0.254 (3.20)***	0.025 (0.20)	0.095 (0.29)	0.124 (1.42)	0.664 (1.54)	1.600 (1.82)*
Δrs·liquidity	0.032 (3.01)***	0.012 (0.28)	0.067 (0.64)	0.000 (0.00)	0.190 (0.70)	0.416 (2.46)**
Δrs·liquidity·size	−0.003 (2.83)***	−0.001 (0.30)	−0.004 (0.60)	0.000 (0.08)	−0.016 (0.77)	−0.045 (2.44)**
y	1.283 (4.59)***	0.546 (0.59)	1.029 (0.67)	−0.346 (0.79)	1.158 (0.49)	4.080 (1.18)
y·size	−0.091 (2.92)***	−0.040 (0.46)	−0.037 (0.39)	−0.015 (0.33)	−0.053 (0.32)	−0.306 (0.89)
R^2	0.057	0.004	0.025	0.013	0.346	0.197
Model	Random effects	Random effects	Random effects	No bank specific effects	Fixed effects	Fixed effects
Sample size	1518	782	579	515	148	111

Explanatory notes: estimations of (bank specific) constant(s) are note reported; absolute t-ratios are reported in parentheses, heteroschedasticity corrected for no bank specific and fixed effects model; ***, ** and * indicate significance at the 1, 5 and 10%, respectively.

The *second* sub-sample deletes foreign banks from the total sample. Banks are identified as foreign as more than 50% of the ownership, as reported in *The Bankers' Almanac*, is in foreign hands.[4] The international orientation of the banking industry differs across the countries considered. A relatively large number of foreign banks are located in the United Kingdom, Belgium and the Netherlands. At the other side of the spectrum are Germany, France and Italy, where the banking industry is relatively domestically oriented (see final row Table 5). In all cases except the liquidity effects in Germany, the evidence for the existence of credit channels becomes, as expected, stronger as foreign banks are skipped from the sample (see Table 5).

[4] It should be noted that a few banks could be classified as domestic while they are actually foreign banks, because *The Bankers' Almanac* contains only details about major international banks.

TABLE 5

ESTIMATION RESULTS OF SUB-SAMPLE WITHOUT FOREIGN BANKS

	Germany	France	Italy	United Kingdom	Belgium	Netherlands
Δrs	−1.555 (3.03)***	−0.165 (0.23)	−2.401 (0.94)	−0.149 (0.23)	−7.962 (3.10)***	−30.56 (4.40)***
Δrs·size	0.136 (2.30)**	0.038 (0.47)	0.132 (0.80)	0.052 (0.58)	0.674 (2.76)***	3.212 (4.14)***
Δrs·liquidity	0.006 (0.56)	0.016 (1.16)	0.048 (1.00)	−0.006 (0.34)	0.273 (3.35)***	0.773 (4.20)***
Δrs·liquidity·size	−0.001 (0.61)	−0.002 (0.88)	−0.003 (0.87)	0.001 (0.59)	−0.024 (2.80)***	−0.085 (4.03)***
y	1.222 (7.11)***	0.914 (1.66)*	1.903 (2.53)**	−0.558 (1.55)	−0.959 (1.00)	1.811 (0.59)
y·size	−0.082 (3.97)***	−0.074 (1.24)	−0.102 (2.03)**	0.033 (0.71)	0.094 (1.21)	−0.067 (0.21)
R^2	0.073	0.009	0.026	0.023	0.440	0.534
Model[a]	Random effects	Random effects	Random effects	Random effects	Fixed effects	Fixed effects
Sample size	2833	1396	1141	615	217	147
In % total sample	93.1	89.0	98.3	59.4	71.4	65.6

Explanatory notes: estimations of (bank specific) constant(s) are not reported; absolute t-ratios are reported in parentheses; heteroschedasticity corrected for models with no bank specific or fixed effects; ***, ** and * indicate significance at the 1, 5 and 10% level, respectively.

[a] For the United Kingdom a LM test with a p-value of 0.004 clearly indicates that the random effects model is the appropriate specification. The results, however, remain qualitatively the same with no bank specific effects.

6. Summary and conclusions

Based on an empirical bank lending model, monetary policy in continental Europe matters most for small banks and for banks with relatively illiquid balance sheets (bank lending channel) and as loan demand interacts with bank size and therefore with borrower size (balance sheet channel). All empirical results provide evidence for the existence of a bank lending channel in Germany and the Netherlands.

For Belgium the empirical support for the existence of a bank lending channel seems to be driven by the smallest banks. In France and Italy there is only empirical evidence for the existence of a bank lending channel as the stance of monetary policy is measured by a monetary conditions index, which also takes dollar exchange rate developments into account. The empirical results provide strong evidence for the existence of a balance sheet channel in Germany and to a lesser extent also in Italy. No empirical support for the existence of credit channels in the United Kingdom is found.

The main outcome of this paper is that bank lending behaviour in continental Europe is consistent with our hypotheses regarding the existence of credit channels in a broad sense, without however showing exactly its macroeconomic relevance. This is a challenging field for future research. Given the bank-oriented financial systems, particularly in continental Europe, the cross-sectional differences in bank lending behaviour are large enough to be potentially of importance for aggregate economic dynamics. Actually, credit channels involve assumptions about financial market imperfections for both lenders and borrowers, so that more complete tests of credit channels require the joint analysis of banks and borrowers, which is yet another interesting field for future research. In addition, the implications of relationship banking to the monetary transmission process should be taken explicitly into account.

APPENDIX

Estimation results with no bank specific effects and specification test statistics

This appendix provides the classical regression results of eq. (1) with no bank specific effects and several specification test statistics, leading to the preferred specifications with respect to bank specific effects (see Table A.1). The (adjusted) R^2 vary between 0.002 and 0.127 and are not very high, but typical of that obtained by others. Kashyap and Stein (1997a) report for example even some negative adjusted R^2. The probability value (p-value) is the probability that the statistic would be equalled or exceeded by the critical level of the random distribution. The p-values with respect to the test whether the slope parameters have no influence at all, $\beta = 0$, show that the basic model variables have jointly a significant contribution in all countries, except in the United Kingdom and Belgium. The Durbin-Watson statistics show that first-order autocorrelation is not a serious problem.

The reported specification statistics provide information about the preferred bank specific effects. First, the likelihood-ratio statistic (LR test) and F statistic (F test) test between no bank specific effects and bank specific constant terms, the so-called fixed effects model. The lower the p-value with respect to both tests, the more likely that the fixed effects model is the preferred specification. Secondly, Breusch and Pagan's Lagrange multiplier statistic (LM test) tests the random effects model against the classical regression with no bank specific effects. The lower the p-value with respect to the LM test, the more likely that the random effects model is the preferred specification. Thirdly, the Hausman's chi-squared statistic tests the random effects model against the fixed effects model. A low p-value of the Hausman statistic argues in favour of the fixed or random effects model against the classical regression with no bank specific effects. A low p-value of the LM statistic in the presence of a high p-value of the Hausman statistic argues in favour of the random effects model.

Overall, the specification statistics show that in Germany, Italy and France the random effects model is the preferred specification, in the United Kingdom no bank specific effects are statistically appropriate, and in Belgium and the Netherlands a fixed effects model is the preferred model. The classical regression model with no bank specific effects is estimated by ordinary least squares (OLS), while the fixed effects model is estimated by partitioned OLS. The fixed effects model is formulated with N bank specific constants and no overall constant, the so-called least squares dummy variable estimator. The random effects model is estimated by a feasible two step generalized least squares.

TABLE A.1

ESTIMATION RESULTS WITH NO BANK SPECIFIC EFFECTS AND SPECIFICATION STATISTICS

	Germany	France	Italy	United Kingdom	Belgium	Netherlands
Δrs	-1.796 (4.01)***	-0.235 (0.34)	-1.468 (0.43)	-0.431 (1.12)	-1.473 (0.76)	-10.29 (2.07)**
Δrs·size	0.143 (2.58)***	0.052 (0.74)	0.074 (0.34)	0.073 (1.45)	0.062 (0.35)	1.021 (1.87)*
Δrs·liquidity	0.017 (1.94)*	0.025 (1.64)	0.025 (0.39)	0.004 (0.45)	0.014 (0.24)	0.317 (2.81)***
Δrs·liquidity·size	-0.002 (1.58)	-0.003 (1.63)	-0.001 (0.32)	-0.000 (0.02)	0.001 (0.21)	-0.034 (2.70)***
y	1.151 (6.88)***	0.774 (1.64)	1.848 (3.16)***	-0.170 (0.63)	0.281 (0.29)	2.227 (1.77)*
y·size	-0.068 (3.38)***	-0.058 (1.23)	-0.097 (2.49)**	-0.004 (0.13)	0.002 (0.03)	-0.186 (1.67)*
constant	-1.501 (7.37)***	-0.405 (1.45)	0.711 (2.85)	0.069 (0.22)	-1.251 (1.52)	-1.570 (0.95)
R^2	0.073	0.010	0.023	0.010	0.022	0.127
R^2 (adjusted)	0.071	0.006	0.018	0.004	0.002	0.103
P-value β = 0	0.000***	0.013**	0.000***	0.124	0.361	0.000***
Durbin-Watson	2.02	2.18	2.21	1.98	1.83	2.18
Fixed *versus* classical:						
P-value LR test	0.336	1.000	0.905	0.676	0.001***	0.000***
P-value F test	1.000	1.000	0.998	0.970	0.098	0.003***
Random *versus* classical:						
P-value LM test	0.003***	0.000***	0.003***	0.118	0.292	0.609
Fixed *versus* random: P-value						
Hausman test	0.000***	0.802	0.871	0.749	0.154	0.001***
Specification preferred	Random effects	Random effects	Random effects	No bank specific effects	Fixed effects	Fixed effects
Sample size	3044	1569	1161	1036	304	224

Explanatory notes: heteroschedasticity corrected absolute t-ratios are reported in parentheses; ***, ** and * indicate significance at the 1, 5 and 10% level, respectively.

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