The Importance of Bank Loan Supply for Real Economic Activity in the Euro Area – A Panel Data Analysis

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Abstract

In this paper two questions are addressed: (i) Do monetary shocks have an effect on bank loan supply in the euro area? (ii) Does bank loan supply affect output? To identify loan supply effects the strategy of Driscoll (2004) is employed. The empirical analysis applies a panel econometric approach. The analysis comprises of quarterly data since the introduction of the euro in January 1999. Two findings emerge from the empirical analysis: Firstly, banks alter the loan supply when confronted with monetary shocks. Secondly, output is unaffected by loan supply. This means that monetary policy, at least since the introduction of the euro, does not work primarily through the bank lending channel.

JEL Classifications: E44, E51, C23

Keywords: Monetary transmission, bank lending channel, monetary policy

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1 Introduction

This paper addresses the question whether monetary policy in the European Economic and Monetary Union (EMU) has an effect on real economic activity by affecting the supply of bank loans. Since bank loans are the most important source of external finance within EMU (Ehrmann et al., 2003), disruptions to the loan supply might cause great changes in economic activity. Therefore, information on this issue is important for the European Central Bank (ECB) to adjust, if necessary, their monetary strategy and, moreover, for an effective conduct of monetary policy.

The theory of monetary transmission that focuses on the supply of bank loans is the "Bank lending channel". The bank lending channel is an extension of the traditional interest rate channel and assumes that banks play a special role in providing external funds to the economy. In Bernanke and Blinder’s (1988) model of the bank lending channel, for example, a restrictive monetary policy leads to a decline in output through the interest rate channel. Apart from the interest rate channel, the bank lending channel takes effect; due to a reduction in bank reserves caused by the restrictive monetary policy, banks not only sell securities but also cut the loan supply as banks view loans and securities as imperfect substitutes, whereupon bank-dependent borrowers reduce their expenditure.

The major obstacle for an empirical analysis of the bank lending channel is to identify bank loan supply. To solve this problem an approach proposed by Driscoll (2004) is employed in this paper. From a theoretical model of the aggregate economy building on Bernanke and Blinder (1988) equations can be derived to test whether monetary shocks affect bank loan supply and bank loan supply affects real economic activity. A panel econometric framework is applied with quarterly data for the period since the introduction of the euro in January 1999. All EMU countries with the exception of Luxembourg and Greece are included.

The main results are: Monetary policy is able to influence the supply of bank loans but loan supply has no significant effect on real output. This means that the bank lending channel has no important role in the monetary transmission process of the

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1The bank lending channel together with the "Balance sheet channel" constitute the "Credit Channel". For an introduction to the credit channel, see, e.g., Bernanke and Gertler (1995) and Hubbard (1995).
euro area.

The remainder of this paper is organized as follows: The subsequent section gives a brief overview of related studies. In Section 3 the theoretical model and the identification scheme is introduced. Section 4 presents the empirical results and Section 5 the conclusion.

2 Review of the Literature

This paper addresses two issues: (i) The effect of monetary policy on loan supply and (ii) the effect of loan supply on aggregate output. These are the essential questions concerning the existence of the bank lending channel. Two strains of empirical work have been pursued to investigate these issues in the literature.

The first one relies on the analysis of macro data with a vector autoregressive approach and impulse-response analysis. Bernanke and Blinder (1992) show that output, aggregate bank lending and bank security holdings decrease after a restrictive monetary policy shock in the US. This is interpreted by Bernanke and Blinder (1992) as an indication of a bank lending channel’s existence. Since the bank lending channel requires that banks do not regard loans and securities as perfect substitutes, both assets will therefore be reduced in the wake of a monetary tightening. Gilchrist and Zakrajšek (1995) find that lending of small banks in the US reacts more strongly than lending of larger banks. This is also in line with the theory of the bank lending channel. Small banks are supposed to suffer more from problems arising as a result of informational asymmetries (Kashyap and Stein, 1995). Although the former studies find reactions of aggregate lending variables that are not in contradiction with the bank lending channel, they fail to separate loan supply and loan demand effects. This failure is overcome by the second strain of studies investigating the existence of the bank lending channel. These studies have two important features in common. Firstly, they analyse micro data coming from bank balance sheets. Secondly, they use theoretical models of individual bank behavior from which loan supply functions are derived. Each model includes the problem of informational asymmetry between borrower and lender and focuses on a different aspect. Kashyap and Stein (1995) turn their attention to bank

\footnote{The reported bank size effect by various studies is an indication of loan supply changes, but still the effect on aggregate output cannot be distinguished from demand side effects.}
size. Peek and Rosengren (1995) and Kishan and Opiela (2000) concentrate on the degree of capitalization. Stein (1995) and Kashyap and Stein (2000) turn to a bank’s liquidity position. The loan supply functions are then estimated with panel econometric methods. All find evidence for a significant impact of monetary policy on loan supply for the US and distributional effects across banks according to the bank lending channel. The shortcoming of these studies is that the importance of the loan supply effects for real economic activity remains unanswered. An answer to this shortcoming is given by Driscoll (2004). Identifying loan supply within a macroeconomic model for the US, Driscoll (2004) shows that, although monetary shocks have a significant effect on loan supply in the US, loan supply has no significant effect on real economic activity. This approach is used in the analysis here to investigate the importance of loan supply for real economic activity in the euro area. The theoretical aspects of this approach are presented in detail below.

Evidence for the Euro Area  No study on the bank lending channel using exclusively euro area data from the start of EMU in January 1999 is currently available. Peersman and Smets (2003), show with the help of impulse-response functions derived from a VAR with "artificial" euro area data from 1980 to 1998, that aggregate lending in the euro area decreases after a restrictive monetary policy shock. This is in line with the bank lending channel, but no further identification of loan supply is applied. Evidence from country studies analyzing the reaction of aggregate lending and bank securities as proposed by Bernanke and Blinder (1992) show mixed results. Bondt (1999a) analyses the period 1980 to 1996 and finds for Germany, France, Italy, Belgium and the Netherlands a negative impact on aggregate lending after a monetary tightening, but only in Germany, France and Italy is this decline in aggregate lending accompanied by a reduction of banks’ security holdings as the bank lending channel predicts.

Although only Ehrmann et al. (2003) and Altunbas et al. (2002) use an EMU cross-country microeconometric approach analysing bank balance sheet data, they encompass all identification criteria originally introduced in the US studies above.³ Altunbas et al. (2002) apply the model of Kishan and Opiela (2000). The study in-

³For country-by-country studies see, e.g., Kashyap and Stein (1997), Favero et al. (1999), Bondt (1999b) and Chatelain et al. (2003).
cludes bank data from all EMU countries, except for Greece, for the time span from 1991 to 1999. They find that loan supply of banks is significantly reduced after a monetary tightening. Furthermore, the reduction is stronger for banks with little capital strength, whereas distributional effects across banks according to banks’ asset size are not present. Ehrmann et al. (2003) also find a negative effect of monetary shocks on loan supply while employing two distinctively different sets of data.4 Concerning distributional effects across banks, Ehrmann et al. (2003) conclude that choosing among asset size, capitalization and liquidity, the banks’ liquidity position is the most likely candidate to influence the strength of a bank’s loan supply response to a monetary shock.

From the presented macro and micro evidence two findings of the role banks play in the monetary transmission process of the euro area can be agreed upon. Firstly, aggregate output and aggregate lending significantly decline after a monetary tightening, and secondly individual banks reduce their loan supply. One important gap remains. The link between micro-level loan supply effects resulting from monetary shocks and the reaction of aggregate output is still absent. Moreover, no evidence from data after the introduction of the euro exists. These two gaps are filled in the following sections. First, the theoretical model is presented and subsequently the econometric analysis conducted.

3 The Theoretical Framework

The basic framework is an IS/LM model. This model is extended in a seminal paper by Bernanke and Blinder (1988) in the ways monetary policy is transmitted to the real economy. In addition to the traditional interest rate channel they incorporate a bank lending channel working through the supply of bank loans.5 Building on this model, Driscoll (2004) proposes a solution not only to the problem of identifying loan supply effects, but also to answer the questions whether monetary shocks affect loan supply

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4One data set comes from BankScope with annual individual bank data from France, Germany, Italy and Spain for the years 1992-1999. The other is a Eurosystem data set with quarterly data including the same countries. The former covers around 3000 banks and 9700 observations and the latter around 3800 banks and 90000 observations.

5Early studies pointing to the relevance of banks within the monetary transmission process are, for instance, Brunner and Meltzer (1963, 1966, 1968, 1971), Tobin and Brainard (1963) and Tobin (1969).
and loan supply affects output. Originally formulated by Driscoll (2004) for the US economy, the following model is equally well suited to the euro area.

### 3.1 The Model

For each country $i$ of the euro area an aggregate demand model is formulated. The model consists of three markets: a money market, a loan market and a goods market.

On the loan market banks face the loan demand $l_{it}$ by households and firms given in equation (1). The loan demand depends on output $y_{it}$, the interest rate on loans $\rho_{it}$, the price of the alternative type of financing expenditure which is the interest rate $r_t$ on bonds as well as a demand shock $\upsilon_{it}$. It is important to note that the loan rate is allowed to vary across countries, whereas the bond rate is assumed to be the same for the whole euro area. This assumption pays tribute to the evidence of a fairly integrated bond market in the euro area and separated loan markets (e.g., Baele et al., 2004).

$$l_{it}^d = \tau r_t - \chi \rho_{it} + \omega y_{it} + \upsilon_{it}$$  \hspace{1cm} (1)

The supply of loans $l_{it}^s$ by banks stated in equation (2) depends on deposits as a way to generate loans and the bank’s portfolio selection between bonds and loans on the asset side, i.e. the interest rate on loans $\rho_{it}$ and bonds $r_t$. Both assets are assumed to be imperfect substitutes. Not only the demand side is prone to a shock but also the loan supply. This loan supply shock is denoted by $w_{it}$.

$$l_{it}^s = -\lambda r_t + \mu \rho_{it} + \beta (m_{it} - p_{it}) + w_{it}$$  \hspace{1cm} (2)

Equation (3) states the money market equilibrium for each country. Money demand, the right hand side of equation (3), is straightforward. It depends on output $y_{it}$, a country-specific shock $\epsilon_{it}$ and the difference between the bond rate $r_t$ and the rate on deposits $r_{it}^d$. The former represents the opportunity costs of holding money and the latter the effect of interest bearing deposits. Money supply $m_t$ is determined for all euro area countries by the European Central Bank.

$$m_{it} - p_{it} = \gamma y_{it} - \delta (r_t - r_{it}^d) + \epsilon_{it}$$  \hspace{1cm} (3)

As in the standard IS/LM model, aggregate demand in equation (4) is inversely related to the interest rate on bonds $r_t$ and as the model includes not only bonds but
also loans, aggregate demand is also inversely related to the loan rate \( \rho_{it} \). Furthermore, aggregate demand is subject to a country-specific shock \( z_{it} \).

\[
y_{it} = -\theta r_{it} - \alpha \rho_{it} + z_{it} \tag{4}
\]

The goal of this paper is to investigate two questions: 1. Does loan supply react to monetary shocks? 2. Does loan supply influence real output? In order to do so Driscoll (2004) solves the model in equation (5) and (6) for output and loans.

\[
y_{it} = \frac{\theta}{\chi + \omega \alpha} r_{it} - \frac{\alpha}{\chi + \omega \alpha} l_{it} - \frac{\alpha}{\chi + \omega \alpha} v_{it} + \frac{\chi}{\chi + \omega \alpha} z_{it} \tag{5}
\]

\[
l_{it} = \frac{\theta}{\chi + \omega \alpha} r_{it} + \frac{\chi \beta}{\chi + \mu} \epsilon_{it} + \frac{\chi \beta \gamma + \omega \mu}{\chi + \mu} y_{it} - \frac{\mu}{\chi + \mu} v_{it} + \frac{\chi \delta \beta}{\chi + \mu} r_{it}^{d} \tag{6}
\]

Three general difficulties arise in connection with these two questions that can be elucidated with the help of equation (5) and (6). Firstly, the specification of equation (5) is inappropriate to investigate whether lending restricts output because of the endogeneity problem, i.e. it cannot be determined whether it is bank lending that moves output or output that moves bank lending. Secondly, we have not, as yet, identified loan supply, which is closely related to the problem that we have not properly separated the interest rate channel from the bank lending channel. This means in equation (5) the bond rate \( r \) and aggregate bank lending \( l \) are correlated. Thirdly, a link between monetary shocks and loan supply has to be found. The solutions to these problems proposed by Driscoll (2004) will be presented in the next section.

### 3.2 Identification of Loan Supply

To separate the bank lending channel from the interest rate channel Driscoll (2004) demeanes each variable with its cross-sectional mean. The model can be rewritten with \( \tilde{x}_{it} \) representing the deviation of variable \( x \) from its cross-sectional mean \( (1/N) \sum_{i=1}^{N} x_{it} \) as follows:
Money Market

\[ \tilde{m}_{it} - \tilde{p}_{it} = \gamma \tilde{y}_{it} + \delta \tilde{r}_{it}^d + \epsilon_{it} \] (7)

Aggregate Demand

\[ \tilde{y}_{it} = -\alpha \tilde{\rho}_{it} + z_{it} \] (8)

Loan Supply

\[ \tilde{l}^s_{it} = \mu \tilde{\rho}_{it} + \beta (\tilde{m}_{it} - \tilde{p}_{it}) + w_{it} \] (9)

Loan Demand

\[ \tilde{l}^d_{it} = -\chi \tilde{\rho}_{it} + \omega \tilde{y}_{it} + \upsilon_{it} \] (10)

Again the model can be solved for output and loans leading to equation (11) and (12):

\[ \tilde{y}_{it} = \frac{\alpha}{\chi + \omega \alpha} \tilde{l}^s_{it} - \frac{\alpha}{\chi + \omega \alpha} \upsilon_{it} + \frac{\chi}{\chi + \omega \alpha} z_{it} \] (11)

\[ \tilde{l}^d_{it} = \frac{\chi \beta}{\chi + \mu} \epsilon_{it} + \frac{\chi \beta \gamma + \omega \mu}{\chi + \mu} \tilde{y}_{it} - \frac{\mu}{\chi + \mu} \upsilon_{it} \]

In both equations the interest rate on bonds \( r_t \) is no longer present. This is due to the fact that the European Central Bank has no means to let the bond rate differ across countries. In other words the interest rate channel is now closed. Although this is achieved, the problem in identifying loan supply effects and in finding an appropriate variable that links monetary shocks and loan supply remains. One such candidate that solves both problems is the money demand shock \( \epsilon_{it} \) that can be found within equation (12). The demeaned model shows that firstly, \( \epsilon_{it} \) is not correlated with loan demand but with loan supply. Secondly, \( \epsilon_{it} \) connects monetary shocks to loan supply. In the model above a positive money demand shock \( \epsilon_{it} \) in equation (7) can increase the loan supply in equation (9). As the bank lending channel rests on the assumption that banks play a special role in providing external funds to the private sector, the increase in loan supply is followed by a positive output effect if the bank lending channel is
active. Given that a monetary policy shock changes the banks’ deposits and so the loan supply in equation (9), we may interpret the money demand shock as a monetary shock in a broader sense.

This identification scheme of Driscoll (2004) leads to the following empirical strategy. The first issue investigated is whether loan supply reacts to monetary shocks. In order to do so the effect of the money demand shock $\epsilon_{it}$ on aggregate lending $\hat{L}_{it}$ is estimated based on a pooled panel OLS regression. The shocks $\epsilon_{it}$ are received by estimating the money demand function given in equation (7) for each euro area country. This is also the first stage of an instrumental-variable estimation with two-stage least squares (2SLS) in a pooled panel setting that is applied to find out whether loan supply affects output. In the second stage of the 2SLS estimation and the last step in the analysis, the monetary shock $\epsilon_{it}$ is used as an instrumental variable to identify loan supply and thus, used to clarify the importance of bank loan supply for real economic activity in the euro area.

4 Empirical Analysis

4.1 Data and Specification

A balanced panel data set is constructed with quarterly data for the period of 1999 to 2003, including all euro area countries except Luxembourg and Greece.\(^6\) Due to data availability the sample period ends in 2003. Real economic activity is measured by real GDP. Real money balances are M3 less currency in circulation which is the part of M3 available to banks for making loans. The interest rate is a deposit rate and aggregate lending is loans to the non-financial private sector. The price level is measured by the consumer price index (CPI). The CPI is used to deflate deposits and loans. As part of the identification method all variables are demeaned by their cross-sectional mean. With the exception of the interest rates all variables are in logs.

4.2 Results

Step 1: OLS Regression - Money Demand In order to obtain the country-specific monetary shocks that are employed at a later stage to identify loan supply, we first estimate for each country a long-run money demand function. According to

\(^6\)See the Appendix for further information on the included data.
Table 1: Statistical Properties of Long-Run Real Money Demand Residuals

<table>
<thead>
<tr>
<th></th>
<th>Normality Jarque-Bera Test</th>
<th>Heteroscedasticity White Test (with cross terms)</th>
<th>Autocorrelation LM Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value</td>
<td>p-value</td>
<td>Lag 1 p-value</td>
</tr>
<tr>
<td>AUT</td>
<td>0.77</td>
<td>0.07</td>
<td>0.80</td>
</tr>
<tr>
<td>BEL</td>
<td>0.46</td>
<td>0.33</td>
<td>0.25</td>
</tr>
<tr>
<td>D</td>
<td>0.69</td>
<td>0.51</td>
<td>0.85</td>
</tr>
<tr>
<td>ESP</td>
<td>0.82</td>
<td>0.36</td>
<td>0.17</td>
</tr>
<tr>
<td>FI</td>
<td>0.68</td>
<td>0.83</td>
<td>0.09</td>
</tr>
<tr>
<td>FR</td>
<td>0.73</td>
<td>0.26</td>
<td>0.50</td>
</tr>
<tr>
<td>IR</td>
<td>0.91</td>
<td>0.05</td>
<td>0.33</td>
</tr>
<tr>
<td>IT</td>
<td>0.78</td>
<td>0.74</td>
<td>0.84</td>
</tr>
<tr>
<td>NL</td>
<td>0.84</td>
<td>0.60</td>
<td>0.69</td>
</tr>
<tr>
<td>POR</td>
<td>0.73</td>
<td>0.73</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Table 2: Euro Area Long-Run Real Money Demand Equation

<table>
<thead>
<tr>
<th></th>
<th>(\bar{y}_{it})</th>
<th>(r^d_{it})</th>
<th>(R^2_{adj})</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMU</td>
<td>0.929**</td>
<td>0.155*</td>
<td>0.96</td>
</tr>
</tbody>
</table>


Note: **, * indicate significance at the 5% and 10% level.

The theoretical model this function is expressed in equation (13) and includes real money balances (M3 less currency in circulation) in logs, real output (GDP) in logs and a short-term interest rate (deposit rate). All variables are demeaned by the cross-sectional mean.

\[
\tilde{m}_{it} - \tilde{p}_{it} = \gamma \bar{y}_{it} + \delta \bar{r}^d_{it} + \epsilon_{it} \tag{13}
\]

Autocorrelation and heteroscedasticity of the residuals is no problem and normality of the residuals cannot be rejected on conventional levels of significance (see Table 1). The estimated values are in line with other studies, e.g. Fagan and Henry (1999).

To gain an insight into the data on a euro area wide level, a long-run money demand function for the euro area is estimated with a pooled panel regression. An income elasticity of 0.929 is found (see Table 2). This is in line with other studies, finding an income elasticity for M3 around 1 up to 1.6 with regard to the whole euro area (e.g., Ericsson, 1999; Coenen and Vega, 2001). The interest rate semi-elasticity is 0.155 as Table 2 shows. The positive sign reflects the influence coming from the interest bearing deposits that are part of our monetary aggregate. Ericsson (1999) reports a short-term interest rate semi-elasticity of 0.32. This is one of the few studies separating the opportunity cost effect and the positive effect from interest bearing components included in M3 by using short and long-term interest rates as an approximation.

**Step 2: OLS Panel Regression – Output and Loans** Before using the monetary shocks within the IV-estimation we inquire into the nature of the relationship between output and lending in the euro area. Therefore, output is regressed on aggregate lending and lagged output. The former variable is included with three lags and
the latter with one. To determine the optimal lag structure the Schwarz information criterion is employed. In addition, output and lending are in first differences as a consequence of unit root tests indicating that both variables are I(1). Table 3 shows the results of two multivariate panel unit root tests. The estimation is conducted with a pooled panel OLS regression.

\[
\Delta y_{it} = \sum \alpha_j \Delta y_{it-j} + \sum \beta_j \Delta l_{it-j} + c_{it}
\]

(14)

The regression equation given in (14) is also the basis for the further analysis. White coefficient covariance estimates are computed according to Arellano (1987) being robust to arbitrary within cross-section residual correlation.

The results presented in Table 4 show that bank lending is positively correlated with real economic activity. These findings are in line with the presented VAR evidence for the euro area in Section 2. For example, Peersman and Smets (2003) show that output and lending decline after a restrictive monetary policy shock. However, as was highlighted with the help of the macroeconomic model in Section 3, it is not possible to decide whether this correlation can be ascribed to demand or supply side effects.

**Step 3: OLS Panel Regression — Loans and Money Demand Shocks** We now turn to the issue whether monetary shocks restrict bank loan supply in the euro area. Thus, aggregate lending is regressed on lagged output and the residuals of the previously estimated money demand functions. Output appears with three lags and lending with one in our regression equation (15). All variables are included in first differences. The regression is performed with OLS and constitutes the first stage of the 2SLS regression that is applied in the subsequent step to investigate whether loan supply affects output.

\[
\Delta l_{it} = \sum \alpha_j \Delta y_{it-j} + \sum \beta_j \Delta \epsilon_{it} + a_{it}
\]

(15)

The results are summarized in Table 5. Monetary shocks to bank deposits have a significant positive effect on bank lending. This finding is in line with empirical evidence on the country-level. Using a microeconometric approach and analysing bank balance sheets with data from EMU countries (France, Germany, Italy and Spain)
Table 3: Panel Unit Root Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Specification</th>
<th>Breitung Test p-value</th>
<th>Im-Pesaran-Shin Test p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>trend, constant</td>
<td>0.818</td>
<td>0.408</td>
</tr>
<tr>
<td>ΔGDP</td>
<td>constant</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Loans</td>
<td>trend, constant</td>
<td>0.609</td>
<td>0.202</td>
</tr>
<tr>
<td>ΔLoans</td>
<td>constant</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Country $i = 1, ..10$; (AUT, BEL, D, ESP, FIN, FR, IR, IT, NL, POR)

IPS-Test: Allows for individual unit root processes.
Breitung Test: Assumption common unit root process.
For both tests $H_0$: Existence of a unit root.

Note: Lag selection with Schwarz information criterion.

Table 4: OLS Panel Regression on the Relationship Between Output and Loans

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\Delta y_{it-1}$</th>
<th>$\Delta y_{it-2}$</th>
<th>$\Delta y_{it-3}$</th>
<th>$\Delta l_{it}$</th>
<th>$\Delta l_{it-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta y_{it}$</td>
<td>-0.231**</td>
<td>0.172**</td>
<td>0.327**</td>
<td>0.067**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.099)</td>
<td>(0.041)</td>
<td>(0.088)</td>
<td>(0.031)</td>
<td></td>
</tr>
</tbody>
</table>

$R^2_{adj}$ 0.169

Note: **, * indicate significance at the 5% and 10% level.
Table 5: OLS Panel Regression on the Relationship Between Loans and Monetary Shocks

<table>
<thead>
<tr>
<th></th>
<th>$\Delta y_{it-1}$</th>
<th>$\Delta y_{it-2}$</th>
<th>$\Delta y_{it-3}$</th>
<th>$\Delta \epsilon_{it}$</th>
<th>$\Delta \epsilon_{it-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>dependent variable</td>
<td>0.188**</td>
<td>0.592**</td>
<td>0.047</td>
<td>0.148**</td>
<td>—</td>
</tr>
<tr>
<td>$\Delta l_{it}$</td>
<td>(0.056)</td>
<td>(0.109)</td>
<td>(0.129)</td>
<td>(0.062)</td>
<td>—</td>
</tr>
</tbody>
</table>

$R^2_{adj}$ = 0.153


Note: **, * indicate significance at the 5% and 10% level.

Chatelain et al. (2003) find in all countries a significant effect of monetary policy on loan supply.7

An important by-product of our results has to be mentioned. As we find a positive correlation between money demand shocks and bank lending, we may conclude that money demand shocks are a valid instrument for the supply effects of aggregate lending. It is possible, therefore, to proceed with the last step of the empirical analysis, namely, to clarify the issue whether loan supply has a statistical significant effect on real economic activity.

**Step 4: 2SLS Panel Regression — Output and Loan Supply** In order to investigate the question whether loan supply affects real economic activity the regression equation (14) from Step 2 is re-estimated. Again the variables aggregate lending and output are included. Both in first differences and the former with one lag and the latter with three lags. The set-up changed with respect to the estimation method. An IV-regression with two-stage least squares (2SLS) is applied. As an instrument variable to identify loan supply effects, the residuals of the former estimated money demand functions are used.

The results are presented in Table 6. The coefficient of the aggregate lending variable is not significant as Table 6 shows. In other words, a loan supply effect on real output is not present.

7The econometric model is a reduced form of a simple model of the loan and deposit market from Ehrmann et al. (2001).
Table 6: 2SLS Panel Regression on the Relationship Between Output and Loan Supply

<table>
<thead>
<tr>
<th></th>
<th>$\Delta y_{it-1}$</th>
<th>$\Delta y_{it-2}$</th>
<th>$\Delta y_{it-3}$</th>
<th>$\Delta l_{it}$</th>
<th>$\Delta l_{it-1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>dependent variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta y_{it}$</td>
<td>-0.225**</td>
<td>0.189*</td>
<td>0.328**</td>
<td>0.038</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.088)</td>
<td>(0.087)</td>
<td>(0.092)</td>
<td>—</td>
</tr>
<tr>
<td>$R^2_{adj}$</td>
<td>0.166</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Note: **, * indicate significance at the 5% and 10% level.

4.3 Discussion of Results

First of all, it has to be stated that the analysis in this paper relies on EMU data and this should be kept in mind while comparing the results to other euro area studies of the monetary transmission process. For example, a regime shift after the establishment of the European Central Bank or the use of "artificial" euro area data at a time with no central monetary authority, might restrict the comparability.\(^8\)

Two results emerge from the analysis in this paper. Firstly, monetary shocks have an impact on the supply of bank loans, along the lines that central bank actions leading to a decrease of bank deposits, are followed by a reduction of bank loan supply. Secondly, real economic activity is unaffected by changes in bank loan supply. These findings provide no positive evidence regarding the effectiveness of the bank lending channel of monetary transmission within EMU. This does not necessarily imply that banks play only the passive role which is assigned to them by the traditional interest rate channel. The bank lending channel is only one sub-channel besides the balance sheet channel that constitutes the credit channel. Although the balance sheet channel focuses on financial constraints of firms by their balance sheets covering all types of external finance, bank loans are still the major means of external finance in EMU. Consequently, banks might, nevertheless, play an important role in the transmission of monetary policy in the euro area. Chatelain et al. (2003) apply a microeconometric

\(^8\)So far, only Bondt (2004), to the author’s knowledge, uses euro area data exclusively to study the monetary transmission process.
approach with firm-level data from France, Germany, Italy and Spain. They find within each country a cost of capital effect on investment and a cash flow effect. This indicates that the interest rate channel and the balance sheet channel are operative. In addition, Bondt (2004) provides evidence for the existence of the balance sheet channel in EMU by analysing external finance premia on the euro area corporate bond market and their reaction to monetary policy.

Comparing the findings on the existence of the bank lending channel of monetary transmission in the euro area to the US study by Driscoll (2004), no contention appears. Driscoll (2004) finds for the US that monetary policy has an influence on loan supply, but loan supply has no significant effect on real economic activity. These two results are, as a matter of fact, the results we find for the euro area.

5 Conclusion

In this paper two questions are addressed: (i) Do monetary shocks have an effect on bank loan supply in the euro area? (ii) Does bank loan supply affect output? To identify loan supply effects the strategy of Driscoll (2004) is employed. The empirical analysis applies a panel econometric approach. The analysis comprises of quarterly data since the introduction of the euro in January 1999 and includes all EMU countries except for Greece and Luxembourg. Initially, it is shown that money demand shocks are valid instruments for loan supply effects. The shocks are then used within a 2SLS panel regression to investigate a correlation between loan supply and output.

Two findings emerge from the empirical analysis: Firstly, banks alter the loan supply when confronted with monetary shocks. Secondly, output is unaffected by loan supply. This means that monetary policy, at least since the introduction of the euro, does not work primarily through the bank lending channel. Although this finding suggests a minor role for banks within the euro area monetary transmission process, it may, however, not be the case. The bank lending channel is only one part of the credit channel of monetary transmission besides the balance sheet channel. First evidence from euro area data indicates the existence of the balance sheet channel. Generally, the results in this paper, taken together with the results of Driscoll (2004), cast doubts on the effectiveness of the bank lending channel.
A Appendix: Data

A balanced panel data set is constructed with quarterly data for the period of 1999 to 2003 including all euro area countries except for Luxembourg and Greece. Most of the data is taken from the IMF’s "International Financial Statistics". Some data on GDP and deposit rates stems from national central banks and national bureaus of statistics.

- Real economic activity is measured by real GDP.
- Real money balances are M3 less currency in circulation.
- The interest rate is a deposit rate.
- Aggregate lending is loans to the non-financial private sector.
- The price level is measured by the consumer price index (CPI) which is used to deflate deposits and loans.
References


