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The bank lending channel of monetary policy in EU countries during the global financial crisis ☆

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ABSTRACT

The study examines the existence of the bank lending channel of monetary policy in European Union (EU) countries. The paper advances current research on the monetary transmission mechanism in the following ways: Firstly, we analyze the differences between 'old' Economic Monetary Union (EMU) and 'new' EU countries. Secondly, we examine the key bank characteristics and monetary policy indicators that may have an impact on the bank lending channel. We assume that short-term market interest rates and monetary aggregate M2 affect banks' activities. We apply the generalized method of moments (GMM) with pooled data from 1999 to 2012. We show that in the pre-crisis period the effect of changing the short-term market interest rates on the bank lending channel of monetary policy is more pronounced among 'old' EMU countries, whereas the effect of M2 is significant during the period of the global financial crisis (GFC) among 'old' EMU countries. Last but not least the important finding is that banks in 'new' EU countries react differently to monetary shocks.

1. Introduction

The recent global financial crisis (GFC) has changed banks' behavior and affected the monetary policies of central banks in Europe, the USA and also in other regions. As a reaction to the GFC, the central banks have adopted unconventional monetary policy measures such as supplying an unlimited amount of capital to the market to support the liquidity of commercial banks and foreign exchange interventions through competitive devaluations of other currencies against the euro. These systemic changes have undoubtedly had an impact on banking systems and have affected bank lending channels of monetary transmission in 'old' Economic Monetary Union (EMU) and 'new' European Union (EU) countries.

In the existing literature on monetary transmission mechanisms, three major bank characteristics are found to affect the responses of bank loans to shifts in monetary policy—asset size, bank capitalization and bank liquidity—as discussed in seminal papers by Kashyap and Stein (1995, 2000), Kishan and Opiela (2000) and further tested in different markets, see for example, Keks and Sturm (2002), Wróbel and Pawlowska (2002), Ehrmann et al. (2003), Gambacorta (2005), Matousek and Sarantis (2009), Fungáčová et al. (2014), and Heryán et al. (2015) among others.

This paper attempts to contribute to the extensive research on monetary transmission mechanisms in general, and lending channels in particular. We extend the previous studies on the lending channel in the following ways: first, we use short-term interest rates as well as the monetary aggregate M2 to examine which variable most affected the lending channels. Second, the paper uses two periods within the entire period of 1999 to 2012, that is, the pre-crisis period and entire period including the crisis period from 2007 to 2012, to show the differences in how banks' behavior changed. Finally, we compare the results for old EMU countries with the results for new EU countries that joined after 2004 (the UK, Sweden and Denmark are therefore excluded from the analysis). Only a handful of studies have focused on comparing the development of short-term interest rates and changes in monetary aggregates and their impacts on lending channels in the context of the distributional effects of monetary policies during the financial crisis period (see Heryán et al., 2015). However, there is no evidence of differences between old European economies that accept the euro as the common currency

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and new European Union (EU) economies in this field.

Reported findings indicate that there are the differences between the old EMU lending channel, in which the transmission mechanism was more obvious in terms of short-term interest rates before the financial crisis, whereas during the crisis period, there were changes in the monetary aggregate M2 that affected the channel more. In contrast, in the new EU lending channel, it was found that the transmission mechanism worked more effectively with the M2 before the crisis, whereas during the crisis period, it was the changing interest rates that affected the channel more.

Throughout the paper, we show the following: first, smaller banks react more to changes in the M2 than in interest rates within the crisis, but only in old EMU countries; this is consistent with the recent monetary behavior of the ECB. However, the old EMU lending channel is affected more by smaller banks in pre-crisis period, but by larger banks due to the GFC, in contrast to the existing literature. Even among new EU countries, no evidence supports the idea that bank size affects the lending channel. Second, bank liquidity mattered among both the old EMU and new EU countries during the crisis, but only the old EMU lending channel was affected throughout the entire crisis period. Third, strongly capitalized banks reacted more to monetary policy changes in the old EMU countries, which is consistent with the existing literature. In the case of the new EU countries, only the strongly capitalized banks reacted for the entire period, but the reactions of the undercapitalized banks were much more evident in pre-crisis period. Finally, last year's development of loans granted was significant in all generalized method of moments (GMM) models. This result contrasts with the findings published by Fungáčová et al. (2014).

Kishan and Opiela (2006) argue according to the lending channel, monetary policy must be able to shift the loan supply of some banks and some of the borrowers of these banks must be bank dependent. Contractionary monetary policy can decrease loan supply due to credit market imperfections faced by some banks. Expansionary policy (i.e. decreasing of interest rates or increasing money supply) increases loan supply due to a lack of constraints on the lending of some banks due to them. Lower interest rates on loans should also increase loan demand, then investments support an employment and aggregate demand, which finally results into the increasing of inflation.[1]

The interbank market for funds is an integral part of the short end of the term structure of interest rates. Since the functioning of the money market plays a role for the monetary transmission mechanism, the formation of prices in the interbank market of the euro area has been subject of thorough investigation (Marzo and Zagaglia, 2014). During the crisis money market rates up to 12 months still respond to revisions in the expected path of future rates, even though to a lesser extent than before August 2007. Abbassi and Linzert (2012) attribute part of the loss in monetary policy effectiveness to money market rates being driven by higher liquidity premia and increased uncertainty about future interest rates. Two paragraphs above motivate current research.

According to Bernanke and Blinder (1988) there are two necessary conditions that must hold for there to be a distinct lending channel of monetary policy transmission in the US market: (i) some firms must be dependent on bank loans-i.e., some firms must be unable to substitute between bank loans and other forms of finance; (ii) the Fed must be able, simply by conducting open-market operations, to shift banks' loan supply schedules. We assume the same conditions for monetary policy transmission of the ECB.

On the other hand, according to our results which have compared the pre-crisis period with the period affected by the GFC, there is the evidence of changes in the monetary transmission mechanism. Therefore expansionary policy is necessary even if the standard monetary policy measures taken by the ECB have already failed. However, inflation targeting monetary strategy has been pointed as a potential source of the crisis, as its main objective of inflation stabilization might have diverted central banks from financial stability (Drakos and Kouretas, 2015). From above we can finally complete those two conditions of a distinct lending channel of monetary policy transmission, made by Bernanke and Blinder (1988) with the third: (iii) Commercial banks must offer loans and do not have to hold more than enough liquidity due to potential risks of their insolvency.

In addition, the study contributes to ongoing research by providing evidence for both, pre-crisis and the crisis periods using pooled data from 1999 to 2012 that were published by BankScope and using GMM panel regression. From the methodological point of view, there are four major studies within the area of monetary policy on the bank lending channel among European countries, all of which use methodologies similar to the GMM with pooled data: Gambacorta (2005) estimated relationships within the Italian credit market; Matousek and Sarantis (2009) investigated the lending channels of each country in the Visegrad group and compared them with the channels in the Baltic states; Akinci et al. (2013) estimated the credit market in Turkey; and Heryán et al. (2015) investigated differences between the EMU and EU countries with their own currencies.

This study is structured as follows: In the next Section we summarize studies on bank lending channels, Section 3 describes the estimation methodology used in the papers from the previous paragraph and the data, Section 4 discusses the empirical results, and the last section summarizes the main conclusions.

2. Literature review

The importance of the bank lending channel (BLC) and its interaction with monetary policy was first investigated in the USA mainly in the 1990s. Initially, the lending view was interpreted by Bernanke and Blinder (1988), who interpreted it as a specific, special case of multi-asset models. Therefore, in particular, in the lending view, there were exactly three assets: money, bonds, and bank loans. The main idea was to check a basic premise of the theory, namely, that a tightening in monetary policy does in fact lead to a contraction in the deposits available to both large and small banks. This relation holds for the aggregate banking sector, which has already been established by Bernanke and Blinder (1992).

Kashyap and Stein (1995) found that the growth of bank loans for the sub-segment of small commercial banks was the most responsive to monetary policy. More specifically, they argue that if the lending view is correct, one should expect the loan and security portfolios of large and small banks to respond differentially to a contraction in monetary policy. Kishan and Opiela (2000) consider the size of banks as one of the bank characteristics, as well. They assumed that small banks are more prone to the problem of information asymmetry than large banks. This also implies a higher sensitivity of small banks to monetary policy shocks. Keks and Sturm (2002) find that lending in small German banks declines more than in large banks after a monetary contraction. Akinci et al. (2013) argue in general, the lending behavior of banks with weak balance sheets should be more sensitive to monetary shocks than that of banks with strong balance sheets (i.e. size of bank assets). According to Ehrmann et al. (2003), smaller banks have been found to be more affected by monetary policy tightenings in the euro area than large banks, and as such have been forced to restrict their lending more strongly.

Kashyap and Stein (1995) argue that the central bank must be able, simply by conducting open-market operations, to shift banks' loan supply schedules. According to these researchers, the difference between large and small bank equity emphasizes the fact that their use of bank size as a proxy for external market access is an imperfect one. The researchers find that small banks react more

[1] During GFC times the EU markets faced the risk of deflation. During the deflation consumers do not consume due to possible lower prices in the future, which is connected with lower aggregate demand and a slow-down in economic growth. Therefore the ECB has tried its expansionary policy to stimulate the inflation rate.

sensitively than large banks to changes in the stance of monetary policy for every one of their specifications. Moreover, one may expect that better capitalized banks would have an easier time raising external funds. For example, a better capitalized bank has less of a problem posed by asymmetric information when it attempts to raise funds using uninsured debt liabilities such as large CDs or subordinated debt. As we noted in Section 1, and as we will discuss in more detail momentarily, monetary policy in the EU has changed due to changes caused by the GFC. Therefore, we focus on testing whether unconventional monetary policy measures have a larger impact on banks' behavior in crisis times.

After the first two bank characteristics (bank size and its capital), the third characteristic investigated by Kashyap and Stein (2000) was bank liquidity. These researchers are interested in how US commercial banks react when the Fed drains reserves from the system. The researchers argue that changes in monetary policy matter more for the lending of those banks with the least liquid balance sheets. The studies above show that the bank lending channel in the USA appears to be strengthened when small banks are either relatively illiquid or undercapitalized. The evidence provided by Kashyap and Stein (2000) and Ehrmann et al. (2003) shows that liquid banks can insulate their loan portfolios by reducing their liquid assets, whereas less liquid banks are unable to do so.

As it is also argued in Fungáčová et al. (2014), monetary tightening may force certain banks to reduce their loan supply. However, these reductions would differentiate across banks. Banks with less access to alternative funding sources will probably be hit harder and thus cut their lending more than other banks. The access to alternative funding sources may depend not only on individual bank characteristics such as bank size, capitalization and liquidity but also on the structure of the banking sector and the market power of individual financial institutions (refer also to Kashyap and Stein, 1995, 2000; Ehrmann et al., 2003; Gambacorta, 2005; Matousek and Sarantis, 2009; Akinci et al., 2013).

There are several empirical literature sources regarding the monetary policy in the Eurozone as well. Arghyrou (2009) stated that, following the launch of the European Economic and Monetary Union (EMU) in 1999, focus on the empirical literature on monetary policy in Europe has gradually been shifting from modeling national monetary policies toward that of the European Central Bank (e.g., Gerlach and Schnabel, 2000; Mihov, 2001; Domenech et al., 2002; Surico, 2003, 2007; Clausen and Hayo, 2005; Hayo and Hofmann, 2006; or Siklos et al., 2011). Certain authors compare monetary policy before and after a country joining the EMU. Arghyrou (2009) examined, e.g., the monetary policy in the 1990s in Greece. He focused on monetary policy before and after the acceptance of the euro as the single European currency. Bleich and Fendel (2012) analyzed monetary policy conditions in Spain before and after the change to the euro. These researchers found that the policy contributed to stabilizing the Spanish economy. The researchers also found that the monetary policy stance was that of the ECB since 1999, which was appropriate because the entire euro area was excessively expansionary for Spain's economy.

Akinci et al. (2013) argue that a new strand of research has recently emerged. According to these researchers, a number of empirical studies impose a new set of research questions that attempt to answer how the bank lending channel may be affected by bank consolidation and risk factors (refer to Gambacorta and Marques-Ibanez, 2011; Olivero et al., 2011; Brei et al., 2013; Shaw et al., 2013). We have studied a few papers connected to that issue as well. Altunbas et al. (2010) find initial evidence of a bank lending channel operating in the euro area via bank risk. The researchers show that bank risk conditions, as perceived by financial market investors, need to be considered, together with the other indicators (i.e., size, liquidity and capitalization), that are traditionally used in the bank lending channel literature to assess banks' ability and willingness to supply new loans. Using a large sample of European banks, the researchers find that banks characterized by a lower expected default frequency are able to offer a larger amount of credit and to better insulate their loan supply from monetary policy changes. These researchers argue the 2007–2008 credit crisis has shown very clearly that the market's perception of risk is crucial in determining how banks can access capital or issue new bonds. In their next study, the same authors, Altunbas et al. (2012), analyze whether bank characteristics affect the impact of monetary policy on bank risk. The researchers find that the insulation effects produced by capital and liquidity were lower for banks operating in countries with particularly low interest rates in Europe. Kishan and Opiela (2012) concluded that bank capital, liquidity, and other balance sheet variables that are used to price risk are endogenous to monetary policy shocks. This endogeneity has implications for financial stability.

Financial stability in the EU is currently discussed according to the unconventional monetary policy of the ECB. The policy has affected the monetary base and could affect the financial stability in all Europe. An impact of the development of short-term interest rates as well as monetary aggregate M2 on the EU lending channel is investigated by Heryán et al. (2015). However, in contrast to their paper, our focus will be on cross-sectional differences in these responses across banks of different samples. These researchers differentiate between EU banks according to the Eurozone and non-euro countries among whole EU. We believe that these two groups of countries are excessively heterogeneous. The sovereign debt crises in the EMU show us there could be differences in economies among countries that accepted the euro before 2004 and those that accepted it later. Moreover, the researchers create the second panel from non-euro countries although there are huge differences among those economies (e.g., economy of the UK, Sweden or Denmark against the Czech Republic, Hungary and Poland). A more homogeneous sample can be formed from similar data according to the date when the countries accepted euro currency. However, we also focus on the most direct test of the theory, whether the lending volume of smaller banks is more sensitive to monetary policy (to conventional as well as unconventional) than to the lending volume of large banks.

The GFC has changed banks' behavior as well as monetary policy regimes. Reichlin (2014) argues, the key non-standard monetary policy measures taken by the ECB were liquidity operations.[2] While in the two episodes of recession and financial stress the ECB acted aggressively providing liquidity to banks, the second recession, unlike the first, has been characterized by an abnormal decline of loans with respect to both real economic activity and the monetary aggregates (Reichlin, 2014). Apergis and Christou (2015) argue that the ECB, as other central banks, attempted low (almost zero) interest rates to stimulate the economy. When these attempts failed, they also attempted unconventional measures mentioned and tested in the empirical analysis section. When these also failed (mainly due to inadequate volume levels) to maintain low interest rates and to substantially stimulate the economy, then they turned to negative interest rates policy, which turned to be a success story only with respect to discouraging banks from keeping cash with the central bank.

[2] I.e. repo loans against collateral at a fixed rate for up to one year since 2009, and up to three year since 2011 (the so-called Long Term Refinancing Operations – LTROs). In its efforts to support the liquidity situation of the euro area banks, the ECB conducted two LTROs in December 2011 and February 2012 with a maturity of 36 months, as fixed rate tender procedures (fixed interest rate) with full allotment (unlimited provision). On 21 December 2011, the ECB allotted EUR 489 billion in three-year loans to 523 banks. Then, on 29 February 2012, the ECB allotted EUR 530 billion in similar loans to 800 lenders (Darracq-Paries and De Santis, 2015).

The study contributes to the investigation of the BLC and the effects of monetary policy in the EU because we attempt to determine the changes due to the GFC. In times affected by the GFC, many banks in the EU had not been classified as insolvent. Otherwise, these banks had been classified as illiquid to arrange their opportunity for possible lending from the ECB. Certain related studies are motivated by similar occasions. Although the previous literature investigates whether a tightening in monetary policy does in fact lead to the BLC, we investigate the effects of its easing in the EU during crises times. We propose several research hypotheses in line with literature gaps identified above:

H1. Within old EMU countries and new EU countries there are no differences due to the changes of short-term interest rates and monetary aggregate M2, and their impact on the lending channels.

The European Union has accepted thirteen new members since the start of the third millennium. It was formed by only fifteen old countries before that. Monetary policy varies across the whole of the EU not only due to differences between the Economic and Monetary Union (EMU), but also European countries which have their own currency. Particular differences can rise just from differences between more and less developed economies. What should be highlighted, is that many of the new EU countries were affected by communism for almost half of the 20th century. Therefore impacts of monetary policy changes on the bank lending channel could vary in the old EMU and the new EU countries. We focus on finding differences in impacts of monetary policy on the bank lending channel in old EMU and new EU countries before and during the crisis period.

H2. It is evident that changes of monetary policy of the ECB to the unconventional policy due to the global financial crisis have some impact.

The problem of suspicion arose in the interbank money market among whole EU. Money market used to bridging liquidity shortage was totally illiquid. The first aid from the ECB was supply the liquidity to the illiquid banks as well as the market. Whereas the ECB limited money market before, its behavior changed totally opposite to supply unlimited amount of money to banks through the short-term loans, which was not secured by high quality securities and its maturity was extended from three or six months to one year. Nonetheless, the question is whether the unconventional monetary policy of the ECB has impacts on the lending channel of monetary policy transmission in the EU or not?

Beaupain and Durré (2013) argue that the crucial role played by the money market as regards the continuation of payment flows (and ultimately lending to the economy) became obvious with the 2007–2012 financial crisis. As the recent experience has demonstrated, financial distress in the money market may lead to a breakdown of interbank transactions while prolonged illiquidity can rapidly damage banks' solvency. The euro system's operational framework therefore creates strong incentives to encourage credit institutions to manage their reserves directly through the interbank market with a view to ending the maintenance period in a balanced position.

H3. Smaller commercial banks have affected the EU lending channel more than larger commercial banks.

Peek and Rosengren (1995) and Kishan and Opiela (2000, 2006) argue that poorly capitalized smaller banks reduce their loan supply more than well capitalized banks after a monetary contraction, due to their limited ability to tap into uninsured sources of funds. Whatever the size, liquidity and capitalization of banks are all expected to be positively correlated with bank loans. Similar results have been reached in Kashyap and Stein (1995, 2000). We regard the smaller banks as more likely to react on monetary policy interventions than the larger banks in general. There is much evidence of the reactions of small banks on monetary changes (e.g. Kashyap and Stein, 1995; Kishan and Opiela, 2000, 2006, 2012; Keks and Sturm, 2002; Ehrmann et al., 2003; Akinci et al., 2013). Therefore, it is logical that when the small banks react to those changes more than the large, they should affect the lending channel more.

3. Data and methodology

The data on banks were obtained from BankScope, the main worldwide statistical database of bank data. The sample includes 25 countries from the European Union (except the UK, Sweden and Denmark). The annual data of all commercial banks from these EU countries that are listed in BankScope are included in our empirical investigation. The total number was 933 banks with its annual frequency data from the 1997 to 2012 period. Selected macroeconomic data were obtained from the World Bank statistical database. We use the nominal GDP in current prices, inflation, and monetary aggregate as percentages from GDP for all European countries. Three month short-term interest rates were obtained from Eurostat for each country. As the Eurostat describes, the 3-month interest rate is a representative short-term interest rate series for the domestic money market. From January 1999, the euro area rate is the 3-month “EURo InterBank Offered Rate” (EURIBOR). EURIBOR is the benchmark rate of the large euro money market that has emerged since 1999; it is the rate at which euro inter-bank term deposits are offered by one prime bank to another prime bank. The contributors to EURIBOR are the banks with the highest volume of business in the euro area money markets. The panel of banks consists of banks from EU countries that participate in the euro from the outset, banks from EU countries that do not participate in the euro from the outset, and large international banks from non-EU countries but with important euro area operations. Finally, although EMU countries do not have their monetary aggregates because they do not have their own currencies, we can run the tests with M2 of each country according to data published by the World Bank. Whether the use of short-term interest rates is usual in previous studies, the use of M2 could expose certain strong attributes or weaknesses of using the euro due to particular relations in the credit market.

Two approaches have been employed in the empirical literature for testing the bank lending channel. One is to divide banks by size, capitalization and liquidity (e.g., Kashyap and Stein, 1995, 2000; Kishan and Opiela, 2000, 2006; Altunbas et al., 2002). This approach requires a large number of banks, which is not a problem for the USA. The alternative approach is to use a panel data model that allows the reaction of bank loans to monetary policy to become dependent on the bank characteristics, as in Ehrmann et al. (2003). This approach avoids the above problem associated with the number of banks, and this is therefore used in our paper. The authors have developed a model of the loans market that draws upon Bernanke and Blinder (1988). The solution of their model yields an equation for bank loans that relates the response of bank loans to monetary policy both directly (via the money channel) and to bank characteristics (through the bank lending channel).

Although we observed data from 1997, due to missing data and using previous year, the entire estimated period begins in 1999. Tests by Arellano and Bond show that the first order statistic is significant, whereas the second order it is not. This is what we would expect if the model error terms were serial uncorrelated in levels. Therefore, we reject the presence of significant serial correlation, thus implying that GMM estimators are consistent. For bank characteristics, we estimated the model with each

Table 1
Description of the GMM instruments.

Instrument of panel GMM model	Description of the instrument from Eq. (1)
L_{it}	Total amount of gross loans in mil. EUR of bank i at time t. Data on all banks from these countries that are listed in BankScope are included in our empirical investigation.
S_{it}	Bank size of bank i at time t, explored from BankScope data in according to Eq. (2).
Liq_{it}	Bank liquidity of bank i at time t, explored from BankScope data in according to Eq. (3).
Cap_{it}	Bank capital of bank i at time t, explored from BankScope data in according to Eq. (4).
GDP_t	Nominal GDP in current prices from the World Bank statistical database for each country. Gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current international dollars.*
CPI_t	Inflation rate in % measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that is fixed for each country.*
$C_t(Rates_t)$	One of two variables C_t which are never included together in according Eq. (1). Firstly, the 3-month interest rates obtained from Eurostat and databases of selected central banks (i.e. EURIBOR, PRIBOR). Those short-term interest rates at which inter-bank term deposits are offered by one prime bank to another prime bank.
$C_t(M2_t)$	One of two variables C_t which are never included together in according Eq. (1). Secondly, monetary aggregate M2 as % from GDP from World Bank database. Money and quasi money comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition of money supply is frequently called M2.*

Source: Authors' illustration including citations from the World Bank online database (*).

characteristic separately, then with all possible pairs of characteristics, and finally with all three characteristics together (refer to Matousek and Sarantis, 2009). Below in Table 1 we see short description of each instrument used within the basic GMM model.

The empirical specification, in accordance with Kashyap and Stein (1995, 2000), is also applied in Gambacorta (2005), Matousek and Sarantis (2009), Akinci et al. (2013), and Heryán et al. (2015, 2016). It is designed to test whether banks react differently to monetary policy shocks. This study contributes by using two types of variables among models to compare relations between development of credit market and both the short-term interest rates and monetary aggregate M2. Two-step GMM model is given by the following Eq. (1), which includes interaction terms that are the product of the monetary policy indicator and a bank-specific characteristic:

$$\begin{aligned}\Delta \log(L_{it}) = \alpha_{it} &+ \sum_{j=0}^{1} \beta\Delta \ \log\left(L_{i(t-1)}\right) + \sum_{j=0}^{1} \vartheta\Delta C_{t-j} \sum_{j=0}^{1} \delta\Delta \ \log\left(GDP_{t-j}\right) \\ &+ \sum_{j=0}^{1} \gamma\Delta CPI_{t-j} + \sum_{k=1}^{3} \varphi Z_{kit-1} + \sum_{k=1}^{3} \sum_{j=0}^{1} \omega Z_{kit-1}\Delta C_{t-j} \\ &+ \sum_{k=1}^{2} \sum_{h=k+1}^{3} \sum_{j=0}^{1} \xi \ Z_{kit-1}Z_{hit-1}\Delta C_{t-j} + \varepsilon_{it},\end{aligned} \tag{1}$$

where L_{it} is the gross loans of $i = \{1, \ldots, N\}$ number of EU banks at time $t = \{1, \ldots, T\}$. The exogenous variable ΔC_{t-j} is either a growth of short-term interest rates in the first case or a growth of monetary aggregate M2. The next regressors are GDP_{t-j} and CPI_{t-j}, which means GDP and inflation in selected EU countries. The last three exogenous variables represent a combination of Z_k, which denotes $k = 1,2,3$ bank specific characteristic variables (refer to below) and ΔC_{t-j}. Constants and residuals are variables α_{it} and ε_{it}, respectively. We estimate two types of models, for Old EMU as well as for New EU countries.

In accordance with Kashyap and Stein (1995, 2000), the following bank characteristics, size S_{it}, liquidity Liq_{it} and capitalization Cap_{it}, are applied to test the presence of the distributional effects of monetary policy among banks:

$$S_{it} = \log(A_{it}) - \frac{\sum \log(A_{it})}{N_t}, \tag{2}$$

$$Liq_{it} = \frac{LA_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{LA_{it}}{A_{it}}\right), \tag{3}$$

$$Cap_{it} = \frac{EQ_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{EQ_{it}}{A_{it}}\right), \tag{4}$$

where A_{it} means assets of all estimated banks, N_t is all banks at time t, LA_{it} means only its liquid assets (i.e., cash, interbank lending and securities), and EQ_{it} is bank capital and reserves (total equity).

Loan growth is regressed on changes of the interest rate controlled by the monetary authority and on its interaction with three bank-specific characteristics (size, liquidity and capitalization). The regression (1) also includes inflation and GDP growth to control for demand effects. The introduction of these two variables allows us to capture cyclical movements and serves to isolate the monetary policy component of interest rate changes. Gambacorta (2005) argues, this will allow us to gain further insight into the interbank lending channel by reporting the effects of changes in the interest rates on these other items of banks' balance sheets. Moreover, we employ the growth of monetary aggregate M2 to compare what will have a greater impact on the development of credit market, short-term interest rates or M2.

Akinci et al. (2013) argue that applying a pseudo general-to-specific model reduction method in the application of the GMM estimator avoids multicollinearity problems. The pseudo general model includes the current and first lagged value of variables C_{t-j}, GDP_{t-j}, CPI_{t-j} as well as the first lag of each bank characteristic, $S_{i(t-1)}$, $Liq_{i(t-1)}$ and $Cap_{i(t-1)}$. These researchers also argue that the two-step coefficient estimator is asymptotically efficient and robust to whatever heteroscedasticity, autocorrelation and cross-correlation is modeled by the new variance–covariance matrix. The rule of thumb is to maintain the number of instruments below the number of cross-sections to ensure valid inference. We also tried to use the dependent variable lagged two periods and deeper as “collapsed” GMM-style instruments to maintain a low number and avoid over fitting the endogenous variable. However, collapsing instruments in this manner did cause an efficiency loss. Therefore, we also restrict instruments to be the same for each model; these are the current values and the first lag of each of our instruments.

The results of the models presented in Tables 3–10 within the Appendix A were produced using EViews 9.0. The model does not allow for random effects. Nevertheless, all the major studies which used GMM allowed for period effects in their estimations. We

Table 2
Descriptive statistics for the main variables.

	Mean	Median	Max.	Min.	Std. dev.	Obs.
Old EMU countries:						
$\log(L_{it})$	12.8151	12.7332	20.8672	1.0424	2.4926	6102
$\log(GDP_t)$	27.2834	27.8432	28.9197	23.6418	1.4132	10,608
CPI_t	1.8360	1.7090	7.1542	-3.8272	1.4334	10,608
$Rates_t$	2.8437	2.9635	6.8758	0.5732	1.3877	10,420
$\log(M2_t)$	27.8088	27.9620	29.5504	24.8392	1.1618	9500
S_{it}	0.0789	0.7909	6.8699	-5.2939	2.8687	10,608
Liq_{it}	-0.1468	-0.2724	0.6662	-0.3338	0.2559	10,608
Cap_{it}	-0.0585	-0.0957	0.8721	-0.4331	0.1367	10,608
New EU countries:						
$\log(L_{it})$	12.9258	12.8834	17.4402	5.3899	1.9977	2148
$\log(GDP_t)$	24.5732	24.5517	26.9951	22.0135	1.1656	3780
CPI_t	13.5356	4.1482	47.7692	-3.5514	14.4452	3780
$Rates_t$	8.7371	4.6342	82.6500	0.8110	12.7730	3601
$\log(M2_t)$	23.9174	23.9138	26.3481	20.8576	1.1977	3754
S_{it}	-0.0098	0.5857	5.3475	-5.2939	2.7507	3780
Liq_{it}	-0.1582	-0.2335	0.6548	-0.3847	0.2075	3780
Cap_{it}	-0.0565	-0.0699	0.8587	-4.5882	0.1324	3780

Source: Authors' calculation in EViews 9.

must always retain GMM weights to test the Arellano-Bond Serial Correlation and to conduct Sargan/Hansen[3] tests. The Sargan (1958) and Hansen (1982) tests of over-identifying restrictions validity can be sensitive to a number of restrictions being tested. Insignificant value of the test shows us that there is no significant problem with that. The lags of the bank characteristics were excluded from the IV-style instrument set to maintain the number of instruments below the number of cross-sectional units (refer to also Akinci et al., 2013).

In Table 2 we see that number of observations differentiates between variables in Old EMU as well as New EU countries. This is the main reason why we use GMM with the pooled data. It is really possible to reach negative values of bank size S_{it}, bank liquidity Liq_{it} and bank capital Cap_{it}, as well. It does not mean that bank size or its liquidity or even the value of bank capital is negative. This means the values are lower than the averages in mean of the instruments examined due to Eqs. (2), (3) and (4). We see two extreme maximum values in the case of NEW EU countries. It is caused by higher inflation in Romania in 1999, which was 47.77% (and decreased in following few years). The second enormous maximum variable is in the case of short-term interest $Rates_t$. In post-communist countries there were higher short-term interest rates in the start of time series within our estimated period (e.g. Romania 82.65%, Hungary 15.21%, Slovakia 14.71%, Poland 14.68%, or Lithuania at 11.72%). In general, post-communist countries are more unstable due to those economic facts and remain so to this day. This is the main reason why we differentiate between Old EMU and New EU countries in our study.

4. Empirical results

This section provides a discussion of our findings. The main focus of our discussion is on the impact of short-term interest rates and monetary aggregate M2 on BLC. We also investigate specific banks' behavior during the GFC and the sovereign debt crisis in the EMU. The dependent variable within Tables 3–10 (see Appendix A) is always the logarithm of bank loans granted $\log(L_{it})$, our exogenous in lines are the logarithm of loans granted lagged by one year Loans(1), short-term market interest rates or the logarithm of monetary aggregate M2 as well as its value lagged by one year, the logarithm of GDP and its value lagged by one, and also inflation rate CPI and its value lagged by one. In columns we see then the results when we deploy our exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), also together with their combinations with the monetary policy indicator. We use the two-step GMM model with differences and period effects, the White period instrument weighing matrix, the White period standard errors & covariance (d.f. corrected).

4.1. Old EMU countries

From Tables 3 and 4, it is obvious that the change of loans granted from the previous year has a larger impact in the case of interest rates when we include the bank size into the estimation. When we include the bank liquidity, it is very similar in both cases. Conversely, where we include bank capitalization, there is a larger impact in the case of monetary aggregate M2. We observe that the change of M2 has a much larger impact on the change of loans granted than the change of interest rates. Nonetheless, we observe that our lagged endogenous is statistically significant within independent regressors at a 1% level in all panel GMM estimations (refer to all Tables 3–10). Fungáčová et al. (2014) argue, in their case, the results indicate that the lagged value of loan growth is not significant. According to them the researchers have serious doubts regarding the benefits of using the difference or system GMM due to that. However, we find the lagged value of loans' growth as significant in all estimations. It could be caused by a cyclicality of the development of loans granted. This is supported also with a significant positive impact of GDP development on the lending channel, which is often significant in the estimations. Moreover, GMM models with annual data were deployed not only in this study but also in Ehrmann et al. (2003), Matousek and Sarantis (2009), Heryán et al. (2015).

We focus only on significant results in the text, naturally. Positive impacts of the lagged inflation's development on the lending channel are found only among Old EMU countries. From the output of GMM models in Table 3, it is significant that smaller banks on average affect the lending channel more during the pre-crisis period (positive Size(1)). In Old EMU economies, their lending channel is affected by smaller banks, which are simultaneously less liquid (negative Liq(1)) and strongly capitalized (positive Capital(1)) in Table 3 with short-term interest rates. In Table 4, with monetary aggregate M2, the lending channel is affected by those banks that are conversely more liquid and less capitalized. Significant coefficients are larger in the case of a change of monetary aggregate M2 among Old EMU countries.

To assess the distributional effects of monetary policy, we examine the coefficients of the interaction terms between the bank characteristics and the monetary policy indicator (refer to Matousek and Sarantis, 2009). In Table 3, with interest rates, large banks react more to their change in average among Old EMU (positive Size*Rate). The reactions with and without one year's lag of the interest rate change have also been investigated. It is obvious that larger banks react with no lag among Old EMU countries (positive Size(1)*Rate(1)).

We observe substantial differences among the Old EMU lending channel in the period affected by the financial crises in Tables 5 and 6. We argue that the transmission mechanism of monetary policy works more in cases with short-term interest rates over the pre-crisis period, because we observe that CPI(1) is significant in Table 3. However, the result is the opposite in the

[3] Sargan/Hansen test is also used in Windmeijer (2005). He corrected standard errors within two-step GMM estimation to avoid large finite sample bias in a given application. The problem of selected bias within the estimation using unbalanced panels is pointed out also in Verbeek and Nijman (1992). Therefore this model should be used in future research studies when it is required to have a more advanced statistical package. EViews 9 does not allow a correction of standard errors following Windmeijer (2005).

crisis period, when the mechanism is evident in the cases with monetary aggregate M2 in Table 6. Therefore, finally, we focus only on the output in which the transmission mechanism is evident within the crisis. In Table 6, we observe differences among the coefficients of the interaction terms between the bank characteristics and the monetary policy indicators. The lending channel is more affected by larger banks on average (positive Size(1)), but smaller banks react to the change of monetary aggregate M2 with no lags during the crisis (negative Size(1)*M2(1)). The lending channel is more affected by less liquid banks, which react to the change with no lags (negative Liq(1)*M2(1)). We argue in crisis times, those more strongly capitalized banks react earlier to the M2 changes because significant coefficients Capital(1)*M2(1) are positive. Conversely, undercapitalized banks in average react to the M2 change with the one year's lag because significant coefficients Capital(1)*M2 are negative in Table 6.

4.2. New EU countries

Among New EU lending channels, we prove the negative impact of changes in short-term interest rates in Table 7. However, we find a stronger positive impact of changes in monetary aggregate M2 in Table 8. From the output of GMM models with pooled data for New EU countries, it is also significant that smaller banks, on average, affect the lending channel more in the pre-crisis period in Table 7 (negative Size(1)). In New EU countries, their lending channels are affected by those smaller banks that are simultaneously more liquid on average (positive Liq(1)). Once more, we naturally focus only on significant results in the text.

Conversely, in New EU countries, their lending channels are affected by smaller banks (negative Size(1)), as well as by those with a higher level of liquidity (positive Liq(1)), only in the case of short-term interest rates in Table 7. The argument that smaller banks affect the lending channel supports the results of Matousek and Sarantis (2009), who found the same result among banking sectors in Hungary and Poland. These researchers argue that it is surprising to note that there is no significant responsiveness in the growth of bank loans to the monetary policy stance that is measured by the short-term interest rate (excluding Slovenia, in their case). However, the picture changes in our study when we consider the monetary aggregate M2 in Table 8. Then, we cannot argue the same result due to the insignificance of the coefficients.

Nevertheless, in the first case of interest rates in Table 7, larger banks react more to its change on average, although the coefficient is very close to zero. We observe the statistically significant lagged reaction of larger banks only (positive Size(1)*Rate). Matousek and Sarantis (2009) concluded that small banks that have started their activities almost from scratch have a higher dynamic of lending activities compared to large, established banks. Otherwise, among New EU countries, the result is not the same in our study.

Following Gambacorta (2005) and Matousek and Sarantis (2009), we also define capitalization as the amount of capital that banks hold in excess of the minimum required to meet the prudential regulation standards in their respective countries and then re-estimate all countries' equations using this alternative measure of capitalization. The overall pattern of results for New EU countries in terms of the sign and significance of the coefficients on the interaction of interest rate changes with capitalization remain similar to the reported results. Strongly capitalized as well as undercapitalized banks in Table 7 react to the change in the interest rate. However, undercapitalized banks react with one year's lag (Capital(1)*Rate). Hence, the capitalization result appears to be related to the measure of capitalization that we employ.

In the second case, with monetary aggregate M2 in Table 8, banks that are strongly capitalized as well as banks with a lower level of capital, on average, react to its changes. Conversely, those undercapitalized banks react with no lag in this case (negative Capital(1)*M2(1)). We observe the interaction with one year's lag among banks with a higher level of capital in Table 8 (positive Capital(1)*M2). However, Gambacorta (2005) argues that the widely used capital to asset ratio may be a poor approximation for the capital constraint that banks confront under the Basle standards. We cannot conclude whether or not the lending channel is affected by more or less liquid banks (insignificant Liq(1)).

In the entire period affected by the financial crisis, we observe large differences among New EU lending channels, as well. We argue over the pre-crisis period that these mechanisms work more in the cases with M2 in Table 8. However, in the crisis period, it is more obvious in Table 9 with short-term interest rates. Therefore, we observe that the lending channel reacts to the change of CPI with no lag. This major change does not definitely cause minor changes. In New EU countries, their lending channel is more affected by smaller banks during the crisis (negative Size(1)).

Nonetheless, those more liquid banks react to the change in monetary policy with no lags in both cases in Tables 9 and 10 (positive Liq(1)*Rate(1) as well as Liq(1)*M2(1)). The change of interest rates affects capitalized banks with no lags more strongly in Table 9 (positive Capital(1)*Rate(1)). Conversely, in the case of M2, undercapitalized banks react with no lags in Table 10. Those strongly capitalized banks react with one year's lag (positive Capital(1)*M2).

4.3. Comparison

Finally, to compare the results of the pre-crisis period and the entire period including GFC, we argue that the pre-crisis period differentiates from the whole by the presence of a distinct transmission mechanism in our estimated relations. From the perspective of the lending channels: (i) In the case of Old EMU countries, their lending channel is affected by smaller banks in the case of interest rates, whereas the size does not matter in the case of M2 in the pre-crisis period. During the entire period, including the crisis, smaller banks affect their lending channel in the case of interest rates, but those larger affect it in the case of monetary aggregate M2. Within NEW EU countries, the lending channel is affected by smaller banks in the case of interest rates during the pre-crisis period as well as over the entire period. (ii) In Old EMU economies, the lending channel is affected by more liquid banks in the case of M2, than with interest rates by less liquid banks. In New EU economies, the lending channel is affected by more liquid banks in both the pre-crisis and the entire period in the case of interest rates. For M2, those more liquid react only during the time of the crisis. (iii) The Old EMU lending channel is affected by strongly capitalized banks in the case of interest rates. However, undercapitalized banks affected the channel more within the change of M2 only in the whole period. The New EU lending channel is affected in both periods by those banks that are undercapitalized on average.

The last paragraph describes the minor changes connected with the transmission mechanism. From the view of the transmission mechanism of monetary policy, the pre-crisis period varies from the entire period in these relations: (iv) In the case of Old EMU countries, larger banks react more to the change of short-term interest rates over the pre-crisis period, whereas smaller banks react more to the change of monetary aggregate M2 within the entire period including the crisis. In the case of New EU countries, we observe that larger banks react more over the pre-crisis period. (v) In Old EMU economies, more liquid banks react to the change in interest rates, whereas less liquid banks react more to the change of M2 within both periods. In New EU countries, more liquid as well as less liquid banks react to the change in interest rates, whereas over the crisis period, only those more liquid react to monetary changes in both cases. (vi) Among Old EMU countries, those strongly capitalized as well as less capitalized banks react to the change of M2 over the entire period with the crisis. Among New EU countries, strongly capitalized banks react

more to the change in interest rate as well as M2 over the whole period. Conversely, only those banks that are undercapitalized react more to changes of interest rates in the pre-crisis period.

5. Conclusion

This paper provides new evidence of the bank lending channels in the EU member states during the GFC. Our study confirms that the lending channels are affected by changes in short-term interest rates as well as in the monetary aggregate M2. We base the analysis on three research hypotheses that address important research gaps in the recent literature.

We reject the first hypothesis that there are no differences within old EMU countries and new EU countries due to the changes of short-term interest rates and monetary aggregate M2, and their impact on the lending channels. The results indicate that commercial banks react to monetary policy shocks differently in crisis periods. In fact, the bank lending channels in old EMU countries have become more sensitive to changes in M2 than in short-term interest rates during the GFC. In contrast, our results show that the bank lending channels in new EU countries are more sensitive to short-term market interest rates.

As a result, we accept Hypothesis 2, which states that changes of monetary policy of the ECB to the unconventional policy due to the GFC have some impact. We conclude that the monetary transmission mechanisms in the old EMU countries could have changed due to the unprecedented liquidity injection by the ECB (refer to also Drehmann and Nikolaou, 2013; Beaupain and Durré, 2013). Reichlin (2014) also argues that the key non-standard monetary policy measures taken by the ECB were liquidity operations. Moreover, as Akinci et al. (2013) state, new empirical studies on the bank lending channels during the GFC indicate that banks' behavior has also changed. Banks that encounter financial distress endure restructuring processes and operate in unstable economic environments. Mutual distrust between commercial banks[4] in the EU has resulted in the aforementioned problem with market liquidity. Otherwise, due to changes in monetary policy, higher levels of liquidity are inevitable among EMU countries. Therefore, banks do react to the added liquidity in the crisis period.

The transmission mechanisms among new EU countries are evident within the pre-crisis period of our analysis in the cases of M2. These findings could be caused by the fact that some of our selected new EU economies are not members of the EMU. Therefore, those countries' central banks still control the monetary base, which affects the entire lending channel. The ECB indirectly controls the monetary base. However, the ECB's interventions have affected the entire EMU. Regardless of whether or not there is an argument for these interventions in the entire market, the ECB leaves it to the interbank market and its demand and supply. Nonetheless, because of the GFC, banks in new EU countries are less liquid than banks in old EMU countries. The central banks out with the EMU do not add liquidity to the markets in the same way as the ECB. Therefore, the lending channels in new EU economies appear to be more sensitive to changes in interest rates during the crisis period, so the monetary transmission mechanisms are more effective.

In line with the third hypothesis we verify that smaller commercial banks have affected the EU lending channel more than larger commercial banks. Furthermore, we analyzed the interaction terms between all three bank characteristics and both monetary policy indicators. We agree that bank size is an important factor that has affected the new EU lending channel. However, in contrast to the previous studies (Kashyap and Stein, 1995, 2000; Kishan and Opiela, 2000; Keks and Sturm, 2002; Gambacorta, 2005; Matousek and Sarantis, 2009), the same effect was not confirmed within the group of old EMU countries due to the crisis. So, we accept the hypothesis within new EU countries in both periods but within old EMU countries only during the pre-crisis period. We reject the third hypothesis within old EMU countries for entire period, including the crisis. As recent empirical studies, e.g., Matousek and Sarantis (2009), Fungáčová et al. (2014), and Heryán et al. (2015), among others conclude, we find that liquidity plays the prominent role in the EU lending channels as well (originally proved in Kashyap and Stein (2000)). From the lending channel point of view, during the pre-crisis period in old EMU countries, it is affected by smaller banks that are less liquid and strongly capitalized, whereas in new EU countries, the channel is affected by smaller banks with a higher level of liquidity and lower bank capital. Nevertheless, lending channels have changed due to the crisis: in old EMU countries, it is affected by larger and more liquid banks, whereas in new EU countries, it is still affected by those smaller banks.

According to our results, the lending channel of monetary policy transmission is evident in the case of short-term interest rates among old EMU countries during the pre-crisis period, whereas during the crisis period it is evident in the case of monetary aggregate M2. On the other hand, distinct transmission mechanisms are found in the case of monetary aggregate M2 among new EU countries during the pre-crisis period, whereas they are evident in the case of short-term interest rates during the crisis period. From the view of monetary policy, during the pre-crisis period in the old EMU countries, the large banks reacted more to its changes in the case of short-term interest rates, whereas in new EU countries, in the case of monetary aggregate M2, more liquid and undercapitalized banks reacted more to monetary changes. Although, in the pre-crisis period, new EU undercapitalized banks reacted more to monetary shocks in the case of M2 (similar finding to Altunbas et al., 2002; Gambacorta, 2005), more strongly capitalized banks in new EU countries reacted in the case of short-term interest rates (which is in contrast to Peek and Rosengren, 1995; Kishan and Opiela, 2000, 2006; Wróbel and Pawlowska, 2002; Ehrmann et al., 2003; Pruteanu, 2004; Horváth et al., 2006). Nevertheless, distributional effects of monetary policy have changed due to the crisis as well. In the old EMU countries, those smaller, less liquid and strongly capitalized banks reacted more to the changes in the case of monetary aggregate M2, whereas in new EU countries, in the case of short-term interest rates, those more liquid and strongly capitalized banks react more to changes of monetary policy.

This study could be useful in several ways. We argue, although the unconventional monetary policy of the ECB obviously works within the lending channel, it must be well monitored. If central banks in other EU countries were also to ease their monetary policy, it would make the situation on the market unfathomable. The ECB should slowly return to conventional monetary policy to allow the lending channel to be affected in the more mature markets' manner. Future research should focus more on changes in deposits of banks' clients as well as whether or not the deposits have changed banks' behavior due to the GFC and the unconventional monetary policy of the ECB.

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[4] Before the crisis many European banks invested to Asset Back Securities (ABS). The securities were created by U.S. banks from unsecure and risky loans, otherwise they were considered safe investments. However, the problem was that no banks in the EU knew whether or not other banks were affected by this serious problem, and which banks had only a problem with their short-term liquidity.

Appendix A

Table 3
Impact of the change of interest rates on loans granted (Old EMU, pre-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.5694 [a]	0.6240 [a]	0.3168 [a]	0.6081 [a]	0.5445 [a]	0.7049 [a]	0.6656 [a]
Rate	0.0407	0.0330	0.0690 [b]	−0.0423	0.0254	0.0238	−0.0141
Rate(1)	−0.1336	−0.0358	−0.0656 [c]	−0.0284	−0.0836	−0.0274	−0.0290
GDP	0.9866	0.4963	0.8090 [b]	0.1340	1.0246	0.2505	0.1964
GDP(1)	−2.2433 [a]	0.3997	0.0453	−1.5102 [b]	−2.0787 [b]	0.8655	−1.5700 [b]
CPI	−0.0119	0.0157	0.0009	0.0004	−0.0114	0.0197 [c]	0.0009
CPI(1)	0.0252 [a]	0.0190 [a]	0.0152 [a]	0.0263 [a]	0.0243 [a]	0.0195 [a]	0.0278 [a]
Size(1)	−0.8795 [a]			−1.1232 [a]	−0.7493 [a]		−1.0673 [a]
Size(1) * Rate	−0.0013			0.0171 [a]	−0.0105		0.0102
Size(1) * Rate(1)	0.0189 [a]			0.0124 [c]	0.0155 [b]		0.0083
Liq(1)		−2.6625 [a]		−3.0791 [a]		−3.3072 [a]	−3.2803 [a]
Liq(1) * Rate		0.0978 [a]		0.0535		0.1200 [a]	0.1198 [a]
Liq(1) * Rate(1)		0.0191		0.1022 [b]		0.0480	0.0485 [c]
Capital(1)			1.6004 [a]		0.7865 [b]	3.0620 [a]	1.1537 [a]
Capital(1) * Rate			−0.1041		0.0497	−0.1013	−0.0696
Capital(1) * Rate(1)			−0.1158 [c]		−0.1260	−0.1109	−0.0701
Size(1) * Liq(1) * Rate				0.0399 [c]			
Size(1) * Liq(1) * Rate(1)				−0.0335			
Size(1) * Capital(1) * Rate					−0.1492 [a]		
Size(1) * Capital(1) * Rate(1)					0.0954 [b]		
Liq(1) * Capital(1) * Rate						−0.0364	
Liq(1) * Capital(1) * Rate(1)						0.1761	
No. of observations	4628	4628	4628	4628	4628	4628	4628
Sargan test (*p*-values)	0.1539	0.2956	0.0814	0.1043	0.1455	0.3819	0.1139
Arellano Bond (p-AR1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Arellano Bond (p-AR2)	0.0786	0.1854	0.2437	0.1436	0.0924	0.1366	0.1176

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, short-term market interest rates, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

Table 4
Impact of the change of M2 on loans granted (OLD EMU, pre-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.4357 [a]	0.6348 [a]	0.5954 [a]	0.3218 [a]	0.5112 [a]	0.7616 [a]	0.6930 [a]
M2	−0.5943 [b]	−0.1555	−0.2196	−0.5463 [b]	−0.5914 [b]	−0.1010	−0.6632 [a]
M2(1)	0.7721 [a]	0.0908	0.3680 [c]	0.6743 [a]	0.6782 [b]	0.0792	0.5200 [c]
GDP	1.0024	−0.3395	0.9482	0.0130	1.3365	−0.9073	0.3671
GDP(1)	−1.4299	1.7947 [b]	0.2001	0.5386	−1.7686 [c]	2.2266 [b]	−1.2780
CPI	−0.0036	0.0178 [c]	0.0039	0.0090	−0.0117	0.0177	−0.0079
CPI(1)	0.0225 [a]	0.0105 [c]	0.0081	0.0210 [a]	0.0192 [a]	0.0100	0.0250 [a]
Size(1)	0.2515			0.5520	−0.5707		−1.4205 [b]
Size(1) * M2	0.0627			0.1046	0.0605		0.0847
Size(1) * M2(1)	−0.0986			−0.1440 [b]	−0.0659		−0.0733
Liq(1)		5.7052 [b]		4.1057		7.7597 [b]	9.3008 [a]
Liq(1) * M2		0.4784		1.6806 [a]		0.6968 [c]	0.1291
Liq(1) * M2(1)		−0.7662 [c]		−1.9040 [a]		−1.0854 [a]	−0.5655
Capital(1)			−10.8927 [c]		−12.2582 [b]	−4.8236	−11.2294 [b]
Capital(1) * M2			−0.9633		−0.6014	−1.8205 [b]	−1.7293 [c]
Capital(1) * M2(1)			1.4165		1.0631	2.0844 [b]	2.1650 [b]
Size(1) * Liq(1) * M2				−0.7094 [a]			
Size(1) * Liq(1) * M2(1)				0.7169 [a]			
Size(1) * Capital(1) * M2					0.0349		
Size(1) * Capital(1) * M2(1)					−0.0438		
Liq(1) * Capital(1) * M2						3.0613	
Liq(1) * Capital(1) * M2(1)						−3.0021	
No. of observations	4251	4251	4251	4251	4251	4251	4251
Sargan test (*p*-values)	**0.0242**	0.1608	0.1648	**0.0024**	0.0508	0.2501	**0.0166**
Arellano Bond (p-AR1)	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000
Arellano Bond (p-AR2)	0.0585	0.1281	0.0628	0.3950	0.0861	0.0744	0.0888

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, the log of monetary aggregate M2, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

Table 5
Impact of the change of interest rates on loans granted (Old EMU, with-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.4998 [a]	0.5081 [a]	0.2355 [a]	0.5438 [a]	0.5027 [a]	0.6006 [a]	0.5746 [a]
Rate	−0.0336	−0.0518	−0.0005	−0.3455	−0.0065	−0.2042	−0.2909
Rate(1)	0.3578	0.1980	−0.1043	0.7544 [b]	0.3496	0.3846	0.6896 [b]
GDP	0.6711	1.5306 [c]	1.0602	0.9068	0.8413	0.9258	0.9402
GDP(1)	−0.2258	0.0197	0.1107	0.3534	−0.3207	0.1533	0.3498
CPI	−0.0052	0.0103	0.0003	0.0100	−0.0093	0.0174	0.0094
CPI(1)	0.0169 [b]	0.0100	0.0149 [c]	0.0129	0.0129	0.0147 [c]	0.0116
Size(1)	−1.0994 [a]			−1.4923 [a]	−1.1845 [a]		−1.5240 [a]
Size(1) * Rate	0.0162 [b]			0.0362 [a]	−0.0107		0.0223 [b]
Size(1) * Rate(1)	0.0105			0.0117	0.0321 [a]		0.0095
Liq(1)		−2.1040 [a]		−3.0445 [a]		−2.8777 [a]	−3.1951 [a]
Liq(1) * Rate		0.1475 [a]		0.1579 [b]		0.1828 [a]	0.2252 [a]
Liq(1) * Rate(1)		0.0159		0.0580		0.0482	0.0767 [b]
Capital(1)			1.9593 [a]		0.2940	3.0593 [a]	0.4188
Capital(1) * Rate			−0.2150 [a]		−0.2084 [b]	−0.1782 [b]	−0.2047 [b]
Capital(1) * Rate(1)			−0.0901		0.0435	−0.0721	−0.0242
Size(1) * Liq(1) * Rate				0.0436			
Size(1) * Liq(1) * Rate(1)				0.0131			
Size(1) * Capital(1) * Rate					−0.1509		
Size(1) * Capital(1) * Rate(1)					0.2127 [b]		
Liq(1) * Capital(1) * Rate						0.1844	
Liq(1) * Capital(1) * Rate(1)						0.0037	
No. of observations	2761	2761	2761	2761	2761	2761	2761
Sargan test (*p*-values)	0.1554	0.3345	0.3694	0.0970	0.1452	0.3408	0.0841
Arellano Bond (p-AR1)	0.0000	0.0000	0.0002	0.0018	0.0000	0.0001	0.0009
Arellano Bond (p-AR2)	0.2036	0.2386	0.5243	0.1551	0.1327	0.1355	0.1157

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, short-term market interest rates, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

Table 6
Impact of the change of M2 on loans granted (Old EMU, with-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.2091 [a]	0.5454 [a]	0.5449 [a]	0.5663 [a]	0.4080 [a]	0.7214 [a]	0.6640 [a]
M2	−0.6586 [b]	−0.4744	−0.5428 [c]	−1.0666 [a]	−0.5122 [c]	−0.6043 [c]	−0.8603 [a]
M2(1)	1.0837 [a]	0.4482 [c]	0.6568 [b]	1.4279 [a]	0.8513 [a]	0.5720 [b]	1.2148 [a]
GDP	2.2289 [b]	2.0446 [c]	2.3148 [b]	3.2095 [a]	2.4245 [b]	2.0114 [c]	2.8399 [b]
GDP(1)	−1.2597	−0.3602	−1.9002	−2.5230 [c]	−1.5248	−1.0683	−1.6930
CPI	−0.0083	−0.0002	−0.0097	−0.0261 [c]	−0.0142	−0.0057	−0.0213
CPI(1)	0.0206 [b]	0.0095	0.0153 [c]	0.0169 [c]	0.0147	0.0136	0.0126
Size(1)	5.5433 [a]			3.7120 [b]	3.2773 [b]		3.0886 [c]
Size(1) * M2	0.0923			0.2325 [b]	−0.0240		0.1129
Size(1) * M2(1)	−0.3056 [a]			−0.4138 [a]	−0.1185		−0.2796 [b]
Liq(1)		11.6562 [a]		7.8456 [b]		16.8670 [a]	9.8209 [a]
Liq(1) * M2		1.0151 [b]		0.6308		0.8502	0.8824 [c]
Liq(1) * M2(1)		−1.4950 [a]		−0.9886		−1.5506 [a]	−1.3319 [a]
Capital(1)			−12.9145		−2.5257	−11.7796	−2.8486
Capital(1) * M2			−2.2493 [c]		−2.4170 [b]	−2.4345 [b]	−2.8202 [b]
Capital(1) * M2(1)			2.7821 [b]		2.5159 [b]	2.9435 [b]	2.9309 [b]
Size(1) * Liq(1) * M2				−0.0930			
Size(1) * Liq(1) * M2(1)				0.0880			
Size(1) * Capital(1) * M2					−0.2603		
Size(1) * Capital(1) * M2(1)					0.2441		
Liq(1) * Capital(1) * M2						6.0665	
Liq(1) * Capital(1) * M2(1)						−5.9825	
No. of observations	2761	2761	2761	2761	2761	2761	2761
Sargan test (*p*-values)	0.1002	0.4097	0.5954	0.1013	0.2240	0.5839	0.0906
Arellano Bond (p-AR1)	0.0004	0.0000	0.0000	0.0015	0.0001	0.0001	0.0011
Arellano Bond (p-AR2)	0.6481	0.2342	0.1405	0.2506	0.2549	0.1394	0.1652

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, the log of monetary aggregate M2, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

Table 7
Impact of the change of interest rates on loans granted (New EU, pre-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.5412 [a]	0.6842 [a]	0.6680 [a]	0.5168 [a]	0.4894 [a]	0.6930 [a]	0.4489 [a]
Rate	−0.0394 [a]	−0.0053 [b]	−0.0067 [a]	−0.0376 [a]	−0.0347 [a]	0.0005	−0.0434 [a]
Rate(1)	0.0080 [c]	−0.0059 [a]	0.0011	0.0008	0.0027	−0.0107 [a]	−0.0058
GDP	0.5639 [a]	0.5190 [a]	0.4325 [a]	0.5234 [a]	0.5259 [a]	0.5032 [a]	0.6286 [a]
GDP(1)	0.2609 [a]	0.0966	0.1540 [c]	0.3416 [a]	0.3423 [a]	0.1309 [c]	0.3481 [a]
CPI	−0.0002	0.0018	0.0015	0.0004	0.0001	0.0006	−0.0010
CPI(1)	0.0002	−0.0028 [b]	−0.0019	−0.0014	−0.0007	−0.0020	−0.0002
Size(1)	−0.2349 [a]			−0.1969 [a]	−0.1893 [a]		−0.1378 [b]
Size(1) * Rate	0.0084 [a]			0.0100 [a]	0.0088 [a]		0.0124 [a]
Size(1) * Rate(1)	−0.0017			−0.0014	−0.0011		−0.0028 [c]
Liq(1)		0.6330 [a]		0.3984 [a]		0.6898 [a]	0.3525 [a]
Liq(1) * Rate		−0.1136 [a]		−0.1151 [a]		−0.0670 [a]	−0.0978 [a]
Liq(1) * Rate(1)		0.1058 [a]		0.1985 [a]		0.0627 [a]	0.0978 [a]
Capital(1)			0.3216		−0.4311 [b]	0.1482	−0.5893 [a]
Capital(1) * Rate			−0.1353 [a]		−0.1113 [b]	−0.0646 [a]	−0.0798 [a]
Capital(1) * Rate(1)			0.1089 [a]		0.1457 [a]	0.0987 [a]	0.1250 [a]
Size(1) * Liq(1) * Rate				0.0055			
Size(1) * Liq(1) * Rate(1)				−0.0380 [a]			
Size(1) * Capital(1) * Rate					−0.0080		
Size(1) * Capital(1) * Rate(1)					−0.0124		
Liq(1) * Capital(1) * Rate						−0.9199 [a]	
Liq(1) * Capital(1) * Rate(1)						0.8143 [a]	
No. of panel observations	1542	1542	1542	1542	1542	1542	1542
Sargan test (*p*-values)	0.3275	0.3775	0.3945	0.5031	0.4624	0.3220	0.4077
Arellano Bond (p-AR1)	0.0040	0.0007	0.0023	0.0021	0.0050	0.0025	0.0051
Arellano Bond (p-AR2)	0.0872	**0.0187**	0.0780	0.0801	0.1702	**0.0182**	0.1318

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, short-term market interest rates, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

Table 8
Impact of the change of M2 on loans granted (New EU, pre-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.5195 [a]	0.6163 [a]	0.5504 [a]	0.6189 [a]	0.5052 [a]	0.6037 [a]	0.5981 [a]
M2	0.3100 [a]	0.1987 [a]	0.2953 [a]	0.1136	0.2281 [b]	0.2151 [a]	0.1354
M2(1)	0.3132 [a]	0.3917 [a]	0.3084 [a]	0.4303 [a]	0.4060 [a]	0.3698 [a]	0.4054 [a]
GDP	0.4071 [a]	0.4291 [a]	0.3390 [a]	0.3667 [a]	0.3617 [a]	0.4192 [a]	0.3993 [a]
GDP(1)	−0.2612 [b]	−0.4518 [a]	−0.1955 [c]	−0.3803 [a]	−0.2067 [c]	−0.3544 [a]	−0.3393 [a]
CPI	−0.0072 [a]	−0.0115 [a]	−0.0073 [a]	−0.0101 [a]	−0.0071 [a]	−0.0113 [a]	−0.0097 [a]
CPI(1)	0.0000	−0.0001	0.0001	0.0002	0.0001	0.0001	0.0000
Size(1)	0.3668			0.1773	0.3393		0.0918
Size(1) * M2	−0.0163			0.0232	0.0188		0.0183
Size(1) * M2(1)	−0.0069			−0.0438	−0.0400		−0.0356
Liq(1)		−2.7112 [c]		−0.0424		−3.0814 [c]	−1.4731
Liq(1) * M2		0.0429		−1.7090 [a]		−0.0407	−0.0269
Liq(1) * M2(1)		0.0993		1.7822 [a]		0.1974	0.1174
Capital(1)			−7.1429 [b]		−4.1931	−6.1875 [c]	−8.5022 [b]
Capital(1) * M2			1.6306 [a]		1.2073	1.3916 [a]	1.8543 [a]
Capital(1) * M2(1)			−1.3248 [a]		−1.0188	−1.1224 [a]	−1.5007 [a]
Size(1) * Liq(1) * M2				0.8384 [a]			
Size(1) * Liq(1) * M2(1)				−0.8564 [a]			
Size(1) * Capital(1) * M2					0.1073		
Size(1) * Capital(1) * M2(1)					−0.1157		
Liq(1) * Capital(1) * M2						0.1379	
Liq(1) * Capital(1) * M2(1)						−0.0508	
No. of panel observations	1596	1596	1596	1596	1596	1596	1596
Sargan test (*p*-values)	0.0821	0.0997	0.2177	0.0961	0.1484	0.1626	0.1790
Arellano Bond (p-AR1)	0.0041	0.0027	0.0026	0.0032	0.0040	0.0032	0.0037
Arellano Bond (p-AR2)	0.0842	**0.0355**	**0.0470**	0.0551	0.0690	**0.0342**	**0.0484**

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, the log of monetary aggregate M2, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

Table 9
Impact of the change of interest rates on loans granted (New EU, with-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.5373 [a]	0.6020 [a]	0.5454 [a]	0.5876 [a]	0.5114 [a]	0.6359 [a]	0.4883 [a]
Rate	−0.0148 [a]	−0.0175 [a]	−0.0192 [a]	−0.0049	−0.0176 [a]	−0.0213 [a]	−0.0189 [a]
Rate(1)	−0.0108 [c]	−0.0109 [a]	−0.0149 [a]	0.0012	−0.0194 [a]	−0.0132 [a]	−0.0194 [a]
GDP	0.4008 [a]	0.2256 [b]	0.2909 [a]	0.2411 [c]	0.3864 [a]	0.1786	0.4064 [a]
GDP(1)	0.3756 [a]	0.3723 [a]	0.3698 [a]	0.3239 [a]	0.3999 [a]	0.4521 [a]	0.4650 [a]
CPI	0.0044 [b]	0.0037 [c]	0.0038 [b]	0.0057 [a]	0.0045 [b]	0.0046 [b]	0.0045 [b]
CPI(1)	0.0030	0.0010	0.0022	0.0025	0.0032 [c]	0.0008	0.0011
Size(1)	−0.4540 [a]			−0.5263 [a]	−0.4274 [a]		−0.4052 [a]
Size(1) * Rate	0.0002			−0.0027	−0.0001		0.0011
Size(1) * Rate(1)	−0.0015			−0.0038 [c]	0.0017		0.0014
Liq(1)		0.1864		0.3818 [a]		0.3261 [a]	0.3812 [a]
Liq(1) * Rate		−0.0215		−0.0010		−0.0396 [a]	−0.0374 [a]
Liq(1) * Rate(1)		0.0871 [a]		0.1410 [a]		0.0699 [a]	0.0507 [a]
Capital(1)			−0.0543		−0.6334 [a]	0.2956	−0.2887
Capital(1) * Rate			−0.0451		0.0201	−0.0768 [b]	−0.0572
Capital(1) * Rate(1)			0.1340 [a]		0.1359 [a]	0.1803 [a]	0.1276 [a]
Size(1) * Liq(1) * Rate				−0.0192			
Size(1) * Liq(1) * Rate(1)				−0.0414 [a]			
Size(1) * Capital(1) * Rate					−0.0388		
Size(1) * Capital(1) * Rate(1)					−0.0030		
Liq(1) * Capital(1) * Rate						0.0211	
Liq(1) * Capital(1) * Rate(1)						0.3609 [c]	
No. of observations	1007	1007	1007	1007	1007	1007	1007
Sargan test (*p*-values)	0.5921	0.3676	0.4300	0.7832	0.5955	0.6745	0.7339
Arellano Bond (p-AR1)	0.0229	0.0132	0.0205	0.0068	0.0253	0.0168	0.0206
Arellano Bond (p-AR2)	0.4578	0.1260	0.4139	0.2576	0.6566	0.2721	0.3620

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, short-term market interest rates, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

Table 10
Impact of the change of M2 on loans granted (New EU, with-crisis period).

	Size	Liq	Capital	Size Liq	Size Capital	Liq Capital	Size Liq Capital
Loans(1)	0.4402 [a]	0.5032 [a]	0.4824 [a]	0.4896 [a]	0.4385 [a]	0.5493 [a]	0.5646 [a]
M2	0.2824 [a]	0.1758	0.3638 [a]	−0.0453	0.3488 [a]	0.2218 [b]	0.1365
M2(1)	0.0300	0.2587 [a]	0.1705 [b]	0.2009	0.0049	0.2610 [a]	0.0060
GDP	0.3418 [a]	0.1180	0.1625	0.3138 [b]	0.2794 [b]	0.0489	0.1973
GDP(1)	0.5147 [a]	0.2967 [b]	0.4060 [a]	0.5194 [a]	0.5210 [a]	0.3957 [a]	0.5274 [a]
CPI	0.0039 [c]	0.0018	0.0031	0.0016	0.0043 [c]	0.0022	0.0036
CPI(1)	−0.0020	−0.0006	−0.0035 [b]	−0.0019	−0.0027 [c]	−0.0020	−0.0016
Size(1)	−0.4029			−0.8953 [a]	−0.4884 [c]		−0.9956 [a]
Size(1) * M2	−0.0316			0.0731	−0.0328		−0.0563
Size(1) * M2(1)	0.0354			−0.0545	0.0413		0.0771 [a]
Liq(1)		−0.4773		2.3642		0.6499	1.5426
Liq(1) * M2		−0.7194 [a]		−2.0006 [a]		−0.9909 [a]	−0.7452 [a]
Liq(1) * M2(1)		0.7661 [a]		1.9523 [a]		0.9921 [b]	0.7127 [a]
Capital(1)			−13.3392 [a]		−13.2238 [a]	−7.7950 [b]	−14.1613 [a]
Capital(1) * M2			1.3200 [a]		0.4524	−0.9901	0.5044
Capital(1) * M2(1)			−0.7486		0.0969	1.3670	0.1004
Size(1) * Liq(1) * M2				0.8470 [b]			
Size(1) * Liq(1) * M2(1)				−0.8597 [b]			
Size(1) * Capital(1) * M2					0.3030		
Size(1) * Capital(1) * M2(1)					−0.3033		
Liq(1) * Capital(1) * M2						−17.9364 [a]	
Liq(1) * Capital(1) * M2(1)						18.1296 [a]	
Total No. of observations	987	987	987	987	987	987	987
Sargan test (*p*-values)	0.3376	0.1137	0.1472	0.2810	0.4228	0.1757	0.7137
Arellano Bond (p-AR1)	0.0379	0.0245	0.0331	0.0268	0.0389	0.0281	0.0330
Arellano Bond (p-AR2)	0.5172	0.2103	0.5308	0.3657	0.6214	0.3572	0.3899

Source: Authors' calculation. Note: Symbols [a], [b] or [c] indicate significance at 1%, 5% or 10%.
Note: Dependent variable is the logarithm of bank loans granted, our exogenous with lagged value by one year are in lines (the log of loans granted, the log of monetary aggregate M2, the log of GDP, and inflation). When we deploy exogenous as bank size, liquidity and capital, and their combinations (A, B, C, AB, BC, AC, ABC), as well as their combinations with the monetary policy indicator, we see the results in columns.

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