Does Bank Competition Influence the Lending Channel in the Eurozone?

Zuzana Fungáčová[#]
Bank of Finland

Laura Solanko[+]
Bank of Finland

Laurent Weill[*]
EM Strasbourg Business School, University of Strasbourg

Abstract

This paper examines how bank competition influences the bank lending channel in the Eurozone countries. Using a sample of banks from 12 Eurozone countries over the period 2002-2010 we analyze the reaction of loan supply to monetary policy actions depending on the degree of bank competition. We find that enhanced competition strengthens the transmission of monetary policy through the bank lending channel. Thus our results support the view that the single monetary policy might have asymmetric effects in Eurozone countries depending on their level of bank competition. Further investigation shows that more competitive banks were more sensitive to monetary policy only before the financial crisis. Policy recommendations are the support for convergence in the levels of banking sector competition in the euro area to make monetary policy transmission more symmetric and enhancing bank competition to make the monetary policy more effective.

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[#] Bank of Finland Institute for Economies in Transition (BOFIT), Snellmaninaukio, PO Box 160, FI-00101 Helsinki, Finland. Email: zuzana.fungacova@bof.fi
[+] Bank of Finland Institute for Economies in Transition (BOFIT), Snellmaninaukio, PO Box 160, FI-00101 Helsinki, Finland. Email: laura.solanko@bof.fi
[*] Institut d'Etudes Politiques, Université de Strasbourg, 47 avenue de la Forêt Noire, 67082 Strasbourg Cedex, France. Email : laurent.weill@unistra.fr

I. Introduction

There is a wide debate on the economic role of bank competition. Whereas one might expect consensual evidence in favor of positive effects through consumer benefits and better access to credit (Beck, Demirgüc-Kunt and Maksimovic, 2004), there is burgeoning literature showing that increased competition in the banking industry might be detrimental for the economy since it tends to hamper banking stability (e.g. Berger, Klapper and Turk-Ariss, 2009; Beck, De Jonghe and Schepens, 2013).

Yet another major impact of bank competition may concern the transmission of monetary policy through the bank lending channel. Namely, we can wonder if the degree of bank competition influences the effectiveness of monetary policy by favoring or hampering the transmission of monetary policy decisions. This issue is of particular interest within the Eurozone as the degree of bank competition (Carbo et al., 2009; ECB, 2010) and the loan rates strikingly vary across countries[1], while a single monetary policy is implemented.

The bank lending channel is based on the idea that when banks face a funding shock through a monetary policy tightening, the shock will be transmitted to their supply of loans if they cannot substitute liabilities with other external sources of funding like money market funds. As a consequence, monetary policy exerts an impact on real activity also through the supply of bank loans. The real effect is particularly important if firms are dependent on bank loans. In case of imperfect substitutability between bank loans and bonds, the reduction of supply of bank loans has greater effects on real activity.

Bank competition can alter the transmission of monetary policy through the bank lending channel. If bank lending channel exists, monetary policy tightening may drive banks to decrease their loan supply. This reduction of loan supply might however differ across banks. Indeed banks which have a lower access to alternative sources of funding are expected to be more affected and should consequently reduce more their loan supply.

[1] EU Commission provides information on the interest rates charged on loans up to 1 million euros for all EU countries. The average loan rates in 2010 in Eurozone countries ranged from 2.36% in to 6.16% in Cyprus.
(source:
http://ec.europa.eu/enterprise/policies/finance/data/enterprise-finance-index/access-to-finance-indicators/loans/index_en.htm).

If bank competition is lower, banks are expected to have fewer difficulties to obtain alternatives sources of funding. Banks with a greater market power can have a better access to additional sources of funds like certificates of deposit or interbank loans. As greater market power of banks is associated with higher profitability and lower probability of failure[2], they can more easily obtain these financings.

The bank lending channel has been extensively investigated inside Europe (e.g. Altunbas, Fazylov and Molyneux, 2002; Gambacorta, 2005) and outside Europe (e.g. Kishan and Opiela, 2000). It is of particular interest for European countries, as financing of firms through bank loans is much more predominant in Europe than in the US. However the role of bank competition in influencing lending channel has been widely ignored in the literature, and has never been investigated in Europe. We are only aware of three works on this issue.

Adams and Amel (2005) analyze the role of bank competition in the bank lending channel by looking how banking sector competition influences the supply of small business lending. The study is performed on aggregate regional data in the US. Using a concentration measure, the Herfindahl index, to measure competition, they find that greater bank concentration lowers the bank lending channel.

Olivero, Li and Jeon (2011a, b) investigate if bank competition influences the bank lending channel for a sample of developing countries from Asia and Latin America. The studies differ in the adopted measure of competition, as the first one uses two concentration indices (the market share of the five largest banks, and the Herfindahl index) while the second one applies the Rosse-Panzar measure. They also differ in their findings: they provide evidence that greater concentration, i.e. lower competition, weakens the bank lending channel in the first paper, and that greater competition when measured by the Rosse-Panzar measure weakens the transmission of monetary policy in the second paper. These different results suggest the potential influence of the measure of bank competition on the conclusions.

Our aim in this research is to investigate how bank competition affects the bank lending channel in Eurozone countries. We use a panel dataset of banks from 12 "old"

[2] In line with the theoretical work from Keeley (1990), Fungacova and Weill (2013) show that greater market power reduces the occurrence of failures in the banking industry, while Turk-Ariss (2010) point out a positive relation between bank market power and financial stability.

member countries of the European Monetary Union covering the period from 2002 to 2010. We analyze the reaction of loan supply to monetary policy actions following the methodology by Kashyap and Stein (1995, 2000). According to this approach, the bank lending channel is identified if different kinds of banks (measured by e.g. bank size, capitalization or liquidity) react differently to shifts in monetary policy. As summarized in Gambacorta (2005), loan supply should be more reduced following a tightening of monetary policy for small banks, as they are more dependent on deposits, less liquid banks, as they cannot protect their loan portfolio by reducing liquid assets, and poorly capitalized banks which have a lower access to uninsured funding. In this paper we wish to analyze if bank lending channel is in fact shaped through bank market power/competition in addition than through the traditional bank characteristics (size, liquidity, capitalization). We consider the interaction between bank competition and monetary policy to study if bank competition influences the transmission of monetary policy in the Eurozone. We measure bank competition with the Lerner index, which is an individual measure of competition.

Our evidence thus advances our understanding of the effectiveness of monetary policy in the Eurozone, by providing the first contribution devoted to the impact of bank competition on the transmission of monetary policy through the bank lending channel in Eurozone countries. Nevertheless, the relevance of our results is much broader as, unlike former papers dealing with this issue, we consider the Lerner index to measure bank competition. This measure presents several major advantages in comparison with the other adopted approaches. Neither concentration indices nor the Herfindahl index do not exactly appraise competition. They infer the degree of competition from indirect proxies like market shares by assuming that greater market share is associated with higher market power or that concentration is negatively correlated with competition, which can be irrelevant. The new empirical industrial organization literature provides measures of competition which measure directly the competitive behaviour of banks. The Rosse-Panzar measure adopted in Olivero, Li and Jeon (2011b) is one of these measures. As pointed out by Shaffer (2004), this indicator only provides measure of competition useful for a diagnosis of the type of market structure (e.g. monopolistic competition or perfect

competition). However it cannot be interpreted as a continuous measure of competition with greater values meaning higher competition.

In comparison with concentration indices and the Rosse-Panzar measure which all represent aggregate measures of competition, the Lerner index has an advantage of being a bank-level measure of competition. This characteristic is of importance as banking markets can have a local nature which makes it difficult to measure competition at the country level. Moreover when using the approach à la Kashyap and Stein (1995) to investigate the bank lending channel where bank characteristics play a key role, we need to adopt a bank-level measure of competition.

We also contribute to the literature by examining a period including the financial crisis which allows us to check the existence of the impact of bank competition on the bank lending channel in normal times and troubled times. Since the beginning of the crisis, the behavior of banks might indeed have changed. However the studies examining how the bank lending channel could have been modified during the crisis remain scarce (Gambacorta and Marques-Ibanez, 2011).

The impact of bank competition on the lending channel has broad implications for policymakers in the Eurozone. First, any evidence confirming an impact of bank competition on the effectiveness of monetary policy would plead in favor of the harmonization of bank competition levels across European countries, so that the single monetary policy would not have asymmetric effects. Second, such evidence would also provide motivations to foster bank competition. As mentioned above, the detrimental effects of bank competition on financial stability have raised concerns on the support of pro-competitive policies. But the finding that greater bank competition strengthens the transmission of monetary policy could be one additional reason to implement procompetitive policies in EU banking industries.

The rest of the article is structured as follows. Section 2 presents the methodology we apply to measure bank competition and to estimate the lending channel. Section 3 discusses data and variables. Section 4 displays the results. Section 5 concludes.

II. Methodology

II.1 Lerner index

One of the main contributions of our study is the fact that we employ a measure of competition computed at the bank level that, unlike nation-wide measures, can be used to compare the market power among different banks.

In general, the empirical approaches to measuring bank competition can be divided into two groups: traditional and new industrial organization (IO) methods. The traditional approach relies on the structure conduct performance (SCP) model that was widely used until the beginning of the 1990s. The SCP hypothesis argues that banks in more concentrated banking markets behave less competitively which further leads to higher bank profitability. Thus, bank competition can be proxied by structural measures of market concentration such as the Herfindahl index or the market share of n-largest banks in the system. Empirical literature has however shown that concentration is in general a poor measure of bank competition (Bikker et al., 2012). The second approach, so called new empirical IO method, does not infer the degree of competition from indirect proxies such as market structure and market shares but rather aims to measure bank competition directly. The most widely used non-structural measures include Lerner index, Rosse-Panzar H-statistic and Boone competition indicator. Their usage might however be restricted due to a lack of detailed data necessary for their calculation.

Following the new empirical IO approach we account for bank competition by estimating the Lerner index. It measures the mark-up of price over marginal cost i.e. how much market power a bank has to set a price above its marginal cost. Higher values of the Lerner index thus imply higher market power. We consider the Lerner index the most suitable measure for our analysis as, unlike the other non-structural measures, it is calculated at the bank level for each time period. Moreover, the Lerner index has been widely used in recent studies investigating bank competition (e.g. Carbo et al., 2009; Beck, De Jonghe and Schepens, 2013) and we follow this methodology in our calculations.

The Lerner index is calculated as the ratio of the difference between price of output and its marginal cost and the price. The price of output is the average price of bank production proxied by total assets, defined as the ratio of total revenues to total assets. The marginal cost is estimated on the basis of a translog cost function with one output

(total assets) and three input prices (price of labor, price of physical capital, and price of borrowed funds). We estimate one cost function using panel data with bank fixed effects in which we include time and country[3] dummy variables. Symmetry and linear homogeneity restrictions in input prices are imposed. The cost function is specified as follows:

$$\ln TC = \alpha_0 + \alpha_1 \ln y + \frac{1}{2}\alpha_2 (\ln y)^2 + \sum_{j=1}^{3} \beta_j \ln w_j + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln w_j \ln w_k + \sum_{j=1}^{3} \gamma_j \ln y \ln w_j + \varepsilon \quad (1)$$

where TC denotes total costs, y total assets, w_1 the price of labor (ratio of personnel expenses to total assets)[4], w_2 the price of physical capital (ratio of other non-interest expenses to fixed assets), w_3 the price of borrowed funds (ratio of interest paid to customer deposits and short term funding). Total cost is the sum of personnel expenses, other non-interest expenses and interest paid. The indices for each bank have been excluded from the presentation for the sake of simplicity. The estimated coefficients of the cost function from eq. (1) are then used to derive the marginal cost (MC):

$$MC = \frac{TC}{y}\left(\alpha_1 + \alpha_2 \ln y + \sum_{j=1}^{3} \gamma_j \ln w_j\right) \quad (2)$$

Once marginal cost is estimated and price of output computed, we calculate Lerner index for each bank and thus obtain a direct measure of bank competition that is used in the main estimations.

II.2 Lending channel: literature

The current crisis has helped underline the crucial role of banks in transmission of monetary policy actions into lending for the real economy. It is widely acknowledged that monetary policy is transmitted via various channels into the real economy. The traditional interest-rate channel stresses the direct impact of interest rates on loan demand. Monetary policy tightening increases the interest rates and therefore decreases demand for credit.

[3] We do not estimate separate equations for each country because for some of the countries the number of observations is so small that this estimations would not be possible.

[4] As our dataset does not provide numbers of employees, we use this proxy variable for the price of labor, following Maudos and Fernandez de Guevara (2007).

The credit channel focuses on the importance of financial intermediaries in the transmission of monetary policy actions into lending for the real economy. In the literature the credit channel is traditionally seen as amplifying the effects of the interest rate channel. Credit channel is generally divided into the 'broad credit channel' (including the asset-price channel) that stresses the effects of monetary policy actions on borrowers' net wealth and into the 'bank lending channel' that examines the effects of monetary policy on actions by depositary financial institutions (Bernanke and Gertler, 1995).

Following Bernanke and Blinder (1988), the bank lending channel literature argues that monetary policy actions affect the balance-sheet structure of banks, causing changes in banks' loan supply in addition to causing changes in loan demand. The underlying assumption of the bank lending channel is that tightening (loosening) of monetary policy drains (replenishes) reserves and deposits from the banking system and this reduction (increase) in loanable funds causes banks to reduce (increase) their loan portfolio. If banks were able to costlessly compensate the loss in loanable funds by e.g. issuing new equity, the bank lending channel would be shut down. This is hardly a plausible assumption, and much of the existing empirical literature points that some banks may find it difficult to compensate for the loss of loanable funds and hence may contract their loan supply (Peek and Rosengren, 2010).

To sort out the changes in loan supply from changes in loan demand, the literature has focused on micro-level evidence on cross-sectional differences between banks. The intuition is that, if changes in bank lending differ across bank types, the reason has to be that different kinds of banks adjust their credit supply differently. The underlying assumption in the literature is that all banks face identical loan demand. This implies, inter alia, that loan demand does not depend on bank characteristics. For instance, if customers of small banks typically reduce their loan demand more than customers of large banks, when faced with an interest rate hike, identification of bank lending behavior becomes impossible. The assumption of homogeneous loan demand is thus crucial. As most customers have no short-term alternative to bank loan financing, this is usually taken as a fairly reasonable benchmark especially in bank-based financial systems like the ones from Eurozone countries.

During the last twenty years various studies have tested the existence of a bank lending channel by considering three bank characteristics connected to bank loan supply behavior: bank size, capitalization and liquidity. The overall conclusion seems to favor existence of the bank lending channel in the US. The channel works through small banks (Kashyap and Stein, 1995), small and illiquid banks (Kashyap and Stein, 1997), small and undercapitalized banks (Kishan and Opiela, 2000, Van den Heuvel, 2002). The evidence from the European banking system is far less conclusive. Altunbas, Fazylov and Molyneux (2002) find that the bank lending channel works through capital-constrained banks in a dataset of the largest European banking systems. Ehrmann et al. (2001) conclude that illiquid banks are most likely to change their loan supply following monetary policy changes. Matousek and Sarantis (2009) find that bank size and liquidity mostly shape the loan supply reactions in a dataset of 8 CEE countries.

The comparability of the results on European banking systems is seriously hampered both by the great variety of geographical coverage in the literature and the apparent structural breaks in the monetary policy transmission due to European monetary integration. We therefore propose to focus only on the Eurozone countries and on the period after 2000. As the great majority of the Eurozone banks are not listed, we consider it appropriate to use a dataset as wide as possible to ensure a better picture of the whole banking system in the region.

II.3 Lending channel: the empirical model

A simple theoretical framework justifying the empirical model is developed by Ehrmann et al. (2001) and Ehrmann et al. (2003). Following Bernanke and Blinder (1988), the framework assumes that in equilibrium deposit (money) demand D equals money supply M and that money demand depends on monetary policy (mp) as follows:

$$D = M = -\varphi(mp) + \gamma \qquad (1)$$

γ represents all other factors that affect deposit demand beyond monetary policy. Loan demand depends on real GDP (y), price level (p) and the loan interest rate (r):

$$Ld = \emptyset_1 y + \emptyset_2 p - \emptyset_3 r \quad (2)$$

The supply of loans depends directly on the amount of loanable funds (deposits or money) D available, the loan interest rate r and the monetary policy stance (mp):

$$Ls = \emptyset_4 D(mp) + \emptyset_5 r + \emptyset_6 mp \quad (3)$$

Monetary policy, typically approximated by a central bank's policy interest rate, enters the loan supply function both directly and indirectly. First, the direct link is the opportunity cost for a bank that uses interbank markets to finance loans. Secondly, the amount of deposits (or money) available depends negatively on the policy interest rate.

Following Kashyap and Stein (2000) and Ehrmann et al. (2001), it is assumed that banks are not equally dependent on deposit finance. The impact of deposits on loan supply depends on bank characteristics X_i , typically taken as bank size, capitalization and liquidity. We propose to add a novel bank-specific variable, Lerner index, measuring bank competition, as we wish to examine if bank competition influences monetary policy transmission via the bank lending channel.

$$\emptyset_4 = \mu_0 - \mu_1 X_i \quad (4)$$

Assuming that the loan market clears and using the equations above, loan supply can be written as

$$L = ay + bp - cc_0 MP + c_1 X_i MP + dX_i + constant \quad (5)$$

Loan supply depends on the level of economic activity (*y*), price level (*p*), monetary policy stance (*MP*), individual bank-level characteristics (X_i) and the interaction of the last two ($X_i MP$). In this framework a significant coefficient c_1 would imply the existence of a bank lending channel, i.e. that monetary policy affects bank loan supply.

Our empirical model is based on (5) with slight modifications. We introduce some dynamics and estimate the empirical model in first differences.[5] The basic regression model is thus

$$\Delta \log(L_{i,t}) = a_i + \sum_{j=1}^{l} b_j \Delta \log(L_{i,t-j}) + \sum_{j=0}^{l} c_i \Delta MP_{t-j} + \sum_{j=0}^{l} d_i \Delta \log(GDP_{t-j}) + \sum_{j=0}^{l} e_i \log(\text{Inflation})_{t-j} + f X_{i,t-1} + \sum_{j=0}^{l} g_1 X_{i,t-1} \Delta MP_{t-j} + \varepsilon_{it} \quad (6)$$

where i=1, …, N and t=1, …, T. N denotes the number of banks, T the total number of time periods (years) and j the number of lags. L_{it} are loans by bank i at time t to private non-banking sectors, MP denotes the monetary policy indicator, *GDP* the real GDP and *Inflation* the inflation rate. The bank-specific characteristics are denoted by X_i. The model further includes a bank-specific fixed effect a_i.

In the empirical model, the existence of a bank lending channel should be reflected in a significant coefficient for the interaction of the bank characteristics with the monetary policy indicator. The three measures of bank characteristics often used in the literature are bank size, capitalization and liquidity. Bank size and its capitalization and liquidity ratios are measures that may influence a bank's access to and premium on external finance. High levels of liquidity may also allow a bank to draw on own liquid funds instead of going to the market after a monetary tightening. Following Ehrmann et al. (2003), we define bank characteristics as

$$Size_{it} = logA_{it} - \frac{1}{N_t}\sum_i logA_{it}$$

$$Liquidity_{it} = \frac{L_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{L_{it}}{A_{it}}\right)$$

$$Capitalization_{it} = \frac{C}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{C_{it}}{A_{it}}\right)$$

$$Competition_{it} = Lerner_{it} \quad (7)$$

[5] The underlying idea is that banks react to a *change* in the monetary policy indicator by adjusting the *new* loans. The level of loans approximates the stock of loans, whereas the flow of new loans can be best approximated by the first difference.

Size is measured as log of total assets. Liquidity is the share of liquid assets in total assets as defined by Bankscope. Capitalization is the bank's own-capital-to-total assets ratio. All these variables are normalized with respect to their sample means. The size variable is normalized, not over the whole period, but with respect to the sample average of each period, in order to remove the constantly increasing trends in size. Normalization implies that the average interaction term is zero and the coefficients are directly interpretable as the average monetary policy effects on bank loan supply. Competition is defined as explained in the previous sub-section.

The preceding literature on European economies and emerging countries most often rely on central bank refinancing /repo rates or short-term money market interest rates as the indicator of monetary policy stance.[6] In our main specification, we use the main indicator for the ECB monetary policy: the refinancing rate.

The dynamic equation (6) is typically estimated by difference GMM method developed by Arellano and Bond (1991). In our case the results, however, indicate that the lagged value of loan growth is not significant, casting serious doubt on using GMM. As we are using annual instead of higher frequency data, the result is not entirely surprising. There certainly can be convincing reasons why lending in the previous quarter may influence current lending, but it is much harder to find economic rationale on why lending last year should influence current lending. As the lagged dependent variable is not statistically significant and we do not find strong economic rationale for including the variable in the list of regressors, GMM clearly is not the appropriate econometric methodology. We therefore estimate (6) without the lagged dependent variable in standard fixed-effect panel regression framework.

III. Data

Our analysis is based on bank-level balance sheet and income statement yearly data that come from BankScope, a financial database maintained by Bureau Van Dijk. The dataset constitutes a non-balanced panel that covers the time period between 2002 and

[6] See Ehrmann et al (2003), Gambacorta (2005), Olivero, Li and Yeon (2011b).

2010. In order to prevent double counting, we only consider unconsolidated data. The banks from the "old" Eurozone member countries are included in our sample: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. The dataset consists of over 16,800 bank-year observations for 3,032 commercial, savings and cooperative banks as we aim to include a broad representation of banking sectors in every country.

All the countries in our sample implement the same monetary policy. The monetary policy rate that we use in the estimations is either the main refinancing rate of the Eurosystem, as it is the key monetary policy indicator of ECB, or euro interbank overnight rate (EONIA)[7] for robustness checks. Both of them are calculated as an average for a given year. Figure 1 displays the development of these policy rates.

The data together with variables that describe the structure of the banking system in Eurozone countries come from the ECB Statistical Data Warehouse. The data on GDP and inflation are from the World Bank's World Development Indicators Database.

Descriptive statistics of the main variables used in the estimations are presented in Table 1. It is of interest to notice that the mean Lerner index is equal to 10.8%. This figure is of the same order of magnitude as what was observed in other studies measuring the Lerner index for EU banking industries. For instance Carbo et al. (2009) find country-level average Lerner indices ranging from 11% to 22% with a EU mean of 16% for a sample of banks from 14 EU countries for the period 1995-2001.

IV. Results

This section presents our results for the impact of bank competition on the transmission of monetary policy through the lending channel. We start with the main estimations for the entire period of study. We then compare the results before and during the crisis to analyze the potential effect of this event. Finally we provide some robustness tests.

[7] It is a measure of the effective interest rate prevailing in the euro interbank overnight market calculated as a weighted average of the interest rates on unsecured overnight lending transactions denominated in euro, as reported by a panel of contributing banks.

IV.1 Main estimations

The estimations for the full period are presented in Table 2. We test three different specifications. In the first column, we consider the standard specification to study the bank lending channel: we include capitalization, liquidity, size, and their interaction terms with monetary policy.

In the second column, we add the Lerner index and we consider only one interaction term with monetary policy, the one with the Lerner index, to analyze its sign. In the third column, we add the interaction terms between monetary policy and the three standard bank characteristics (capitalization, liquidity, and size). Both these latter specifications provide evidence concerning the impact of bank competition on the bank lending channel. Our main findings are as follows.

First, we find evidence that the effect of monetary policy on loan growth has the expected negative sign. The coefficient for monetary policy is significant and negative in all estimations. An increase (decrease) of interest rates leads to a decline (enhancement) in loan growth.

Second, the interaction terms between capitalization, liquidity, size on one side, and monetary policy on the other are not significant. This means that these bank-specific characteristics do not influence how bank lending reacts to monetary policy changes. As the bank lending channel predicts such different response of bank lending among banks, our results do not support the existence of a bank lending channel in Eurozone countries over the period of study.

These results are not completely at odds with former literature. Focusing on a similar period as our study (1999-2009), Gambacorta and Marques-Ibanez (2011) obtain similar conclusions in their study on banks from 15 countries (11 Eurozone countries, Denmark, Sweden, the UK, the US). When considering older periods, evidence seems to be mixed. For instance, Altunbas, Fazylov and Molyneux (2002) find limited support for the bank lending channel with only some evidence for the fact that undercapitalized banks react more to changes in monetary policy.

Third, the interaction term between the Lerner index and monetary policy is significantly positive. This result is observed both when we include and exclude the

interaction terms between monetary policy and the other bank-specific characteristics. Therefore, we do have robust and statistically significant evidence for the existence of bank lending channel in the eurozone through bank competition. Our results show that increased market power makes transmission of monetary policy weaker. In other words, greater bank competition contributes to strengthen the transmission of monetary policy.

This result indicates that a lower market power makes the access of banks to alternative sources of funding harder. Changes in monetary policy influence the available funds and are then more directly transmitted to bank's loan supply if competition is fierce. This conclusion indicates that greater bank competition makes monetary policy more effective.

This is of importance when considering the debates around the separation between supervision of banking activities and monetary policy management, and the possibility of conflicting objectives between both these tasks.

When analyzing the other variables in our estimations, we can point out that well-capitalized, highly-liquid and small banks have a greater loan growth. The coefficients of capitalization and liquidity are significant and positive, while it is significant and negative for size in all estimations. Furthermore, we observe that changes in economic activity measured by GDP growth and the inflation rate have both a positive relation with loan growth.

IV.2 Considering the crisis

Our period of study includes the recent financial crisis which has undoubtedly influenced the way monetary policy was implemented; the evidence being the development of non-standard monetary policy measures. This major event is also likely to influence the behavior of banks. Namely bank competition can play a less significant role during episodes of financial distress. Monetary policy might have become less effective through such periods for various reasons including the reluctance of banks to increase their lending whatever the monetary policy decisions. We thus run our estimations by distinguishing between two periods: the period before the crisis (2002 to 2006) and during the crisis (2007-2010). This allows us to check how the role of bank

competition on the bank lending channel can change over time and following the economic situation. The estimations are displayed in Table 3. We find several striking results.

First, the interaction term between the Lerner index and monetary policy is significantly positive before the crisis while it is not significant during the crisis. Thus our key finding of a positive impact of bank competition on the transmission of monetary policy through the bank lending channel is driven by the years before the crisis.

Second, the interaction terms between capitalization, liquidity, and monetary policy are significant before the crisis but not significant during the crisis. We observe that well-capitalized and highly liquid banks were more able to buffer their lending activity against shocks affecting the availability of funds before the crisis. The results for capitalization and liquidity reveal some evidence for the bank lending channel before the crisis, when considering these bank-specific characteristics as indicators for the distributional effects of monetary policy. They also show that the channel was weakened during the crisis.

The result for size is different as the estimated coefficient is significant and negative before the crisis and significant and positive during the crisis. In other words, we find some evidence that greater banks are less affected by changes in monetary policy during the crisis. This might indicate that large banks were supported by different measures during the crisis.

These findings moderate our conclusion on the absence of the bank lending channel when considering the full period, as they show some evidence on the existence of bank lending channel during normal times. Nonetheless, they also support the view that monetary policy has not been as effective during the crisis as it was before.

Thus, the main conclusion from our estimations comparing the time period before and during the crisis is the fact that the bank lending channel has been more effective before the crisis. The impact of monetary policy on loan growth was influenced by the differences across banks in market power, capitalization and liquidity only before the crisis.

This conclusion is in accordance with Bech, Gambacorta and Kharroubi (2012) who find that monetary policy is less effective in a financial crisis on a dataset of 24 developed countries with data going back to 1960. This paper does not focus on the

effectiveness of the bank lending channel and has then a different perspective than our work. However, it provides interesting findings concerning our analysis of the impact of the crisis on the effectiveness of monetary policy. Namely, the main conclusion of this work is that monetary policy during an economic downturn associated with a financial crisis is less effective than during an economic downturn without such a crisis. An expansive monetary policy contributes to a stronger recovery after a downturn without a financial crisis.

IV.3 Robustness tests

We perform alternative estimations to examine whether our findings are robust to the use of an alternative measure for monetary policy, and to the chosen measure of competition.

First, we use an alternative indicator for monetary policy: the overnight rate (EONIA). As mentioned above, several different interest rates can be used to take monetary policy into account. Thus we aim to check if our results are robust to the indicator of monetary policy. The period of our study includes the financial crisis during which changes in the overnight rate might have played a greater role than variations in the refinancing rate. Hence it is of particular interest to check if the overnight rate reveals a different picture than the refinancing rate.

Tables 4 and 5 display the results when using the overnight rate as the monetary policy indicator. We present the results for the full period in Table 4, and separate the periods into before the crisis and during the crisis in Table 5 as the overnight rate might have very different effects over time.

The results for the full period show the same findings as we got with the refinancing rate. First, monetary policy is negatively associated with loan growth, which is line with the expected influence of monetary policy. Second, we do not obtain any significant coefficient for the interaction terms between capitalization, liquidity, size, and monetary policy. Third, the interaction term between the Lerner index and monetary policy is significantly positive for all estimations. Hence we again find support for the

conclusion that greater market power hampers the transmission of monetary policy through the bank lending channel.

When examining the results before and during the crisis, we also find similar conclusions as before. The interaction term between the Lerner index and monetary policy is only significantly negative before the crisis, while it is not significant during the crisis. Therefore our finding that market power plays a role in the transmission of monetary policy is again driven by period before the financial crisis. The interaction terms between capitalization, liquidity, size, and monetary policy are significant before the crisis but not significant during the crisis, with the exception of size.

Thus, also with this alternative measure of monetary policy, we find evidence that bank competition influences the transmission of monetary policy through the bank lending channel.

Second, we use an alternative measure for bank competition in our estimations. Following the utilization of concentration indices in the literature (e.g. Adams and Amel, 2005; Olivero, Li and Jeon, 2011a), we take bank concentration indicators as a natural robustness check, even though we are aware of the limitations of such indices to measure competition. Bank concentration is measured by the Herfindahl index for assets and by the share of the five largest banks in total banking assets. Both measures are computed at the country level. Results are displayed in Table 6.

We observe significant and positive coefficients for the interaction terms between bank concentration and monetary policy in all estimations. It means that greater bank concentration hampers the transmission of monetary policy through the bank lending channel. As greater concentration is associated with lower competition, these results corroborate those obtained with the Lerner index. These results are in line with the findings of Adams and Amel (2005) and Olivero, Li and Jeon (2011a) on the effects of bank concentration on the bank lending channel respectively on the US, and on Asian and Latin American countries.

Thus, our main results are confirmed by robustness tests, leading to the support of the view that greater bank competition strengthens the transmission of monetary policy through the bank lending channel.

V. Conclusion

This paper examines the impact of bank competition on the bank lending channel for Eurozone countries. We find that greater bank competition strengthens the transmission of monetary policy through the bank lending channel. We interpret this result so that a higher degree of bank competition reduces the access to alternative sources of funding and thereby makes banks more responsive to monetary policy.

The comparison of our results for the period before and during the crisis shows that this result is driven by the years before the crisis. During the crisis we do not find any influence of bank competition on the transmission of monetary policy. Moreover, before the crisis we observe some evidence in favor of the bank lending channel for the bank-specific characteristics generally considered to take into account differences across banks. Poorly capitalized banks and less liquid banks have reduced their loan supply more following a monetary tightening before the crisis. Overall, we observe that during the crisis bank lending channel has ceased to be a significant channel of monetary policy transmission.

Our findings have two major policy implications. First, the level of bank competition matters for monetary policy transmission. As transmission is less effective via less competitive banking systems, monetary authorities have an additional reason to closely monitor the structure of their banking sector. This result is of particular importance when considering the debate on the fact that the ECB would earn supervisory powers of banks in addition to its role of monetary policy management. Our result supports the view that greater bank competition and effectiveness of monetary policy would not be conflicting objectives but would rather be complements.

Second, more integration within Eurozone countries should contribute to harmonizing bank competition levels. As long as substantial cross-country differences persist, the single monetary policy has asymmetric effects. Monetary policy changes can thus have heterogeneous real effects across Eurozone countries which may cause concern for monetary policy decision-makers.

The derived lesson is that banking integration cannot be considered separately but together with monetary integration in the Eurozone. As a consequence, efforts to enhance levels and convergence in bank competition can be considered as a fundamental step to improve the monetary policy framework in the Eurozone.

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Table 1
Descriptive statistics of the main variables

Whole sample	Obs.	Mean	Median	St.dev.	Min.	Max.
Size	16,857	6.270	6.192	1.388	2.140	13.651
Capitalization	16,857	0.076	0.065	0.045	0.010	0.874
Liquidity	16,857	0.164	0.135	0.124	0	0.884
Lerner index	16,857	0.108	0.098	0.099	-0.788	0.809
Δln(loans)	16,857	0.042	0.026	0.174	-6.882	3.546
Inflation	16,857	1.743	2	0.866	-4	5
Δln(GDP)	16,857	1.072	1	2.747	-8	7
Overnight rate	16,857	2.170	2.279	1.238	0.355	3.879
Refinancing rate	16,857	2.329	2.250	1.053	1	4

Before crisis (2002-2006)	Obs.	Mean	Median	St.dev.	Min.	Max.
Size	7,492	6.385	6.285	1.408	2.361	13.651
Capitalization	7,492	0.069	0.059	0.042	0.012	0.774
Liquidity	7,492	0.165	0.131	0.129	0	0.877
Lerner index	7,492	0.113	0.100	0.097	-0.788	0.809
Δln(loans)	7,492	0.033	0.018	0.221	-6.882	3.546
Inflation	7,492	1.822	2	0.502	0	4
Δln(GDP)	7,492	1.838	1	1.487	-1	6
Overnight rate	7,492	2.582	2.279	0.659	2.053	3.517
Refinancing rate	7,492	2.545	2.250	0.674	2	3.5

During crisis (2007-2010)	Obs.	Mean	Median	St.dev.	Min.	Max.
Size	9,365	6.178	6.118	1.366	2.140	11.666
Capitalization	9,365	0.081	0.070	0.047	0.010	0.874
Liquidity	9,365	0.164	0.138	0.119	0.000	0.884
Lerner index	9,365	0.105	0.096	0.100	-0.771	0.722
Δln(loans)	9,365	0.049	0.032	0.125	-1.518	1.940
Inflation	9,365	1.681	2	1.067	-4	5
Δln(GDP)	9,365	0.459	1	3.312	-8	7
Overnight rate	9,365	1.841	2.486	1.472	0.355	3.879
Refinancing rate	9,365	2.157	2.500	1.252	1	4

Table 2
Main estimations

Panel estimations with bank fixed effects. Dependent variable is the loan growth. Monetary policy variable is the difference of refinancing rate between the current and previous period. The explanatory variables are lagged by one period. Robust standard errors are in brackets. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Bank lending channel	Lerner index included	Bank lending channel with Lerner index and all interactions
Specification	(1)	(2)	(3)
MP (refinancing rate)	-0.009*** [0.004]	-0.014*** [0.004]	-0.014*** [0.004]
Capitalization	1.241*** [0.359]	1.270*** [0.366]	1.260*** [0.349]
Liquidity	0.337*** [0.051]	0.322*** [0.050]	0.330*** [0.050]
Size	-0.131*** [0.023]	-0.132*** [0.022]	-0.132*** [0.023]
Δln(GDP)	0.887*** [0.203]	0.950*** [0.208]	0.920*** [0.207]
Inflation	0.014*** [0.003]	0.014*** [0.003]	0.014*** [0.003]
MP × capitalization	-0.007 [0.075]		-0.049 [0.082]
MP × liquidity	0.016 [0.015]		0.014 [0.015]
MP × size	0.000 [0.001]		-0.000 [0.001]
Lerner index		-0.035 [0.061]	-0.032 [0.061]
MP × Lerner index		0.042*** [0.015]	0.052*** [0.020]
Constant	0.013 [0.009]	0.011 [0.009]	0.013 [0.009]
Observations	16,857	16,857	16,857
Number of banks	3,032	3,032	3,032
R-squared	0.080	0.081	0.081

Table 3
Main estimations for period before (2002-2006) and during (2007-2010) the crisis

Specifications from Table 2 estimated for two subperiods. Panel estimations with bank fixed effects. Dependent variable is the loan growth. Monetary policy variable is the difference of refinancing rate between the current and previous period. The explanatory variables are lagged by one period. Robust standard errors are in brackets. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Before the crisis (2002-2006)			During the crisis (2007-2010)		
Specification	(1)	(2)	(3)	(1)	(2)	(3)
MP (refinancing rate)	-0.045**	-0.063***	-0.059**	-0.010***	-0.013***	-0.014***
	[0.021]	[0.022]	[0.023]	[0.003]	[0.004]	[0.004]
Capitalization	0.130	0.256	0.318	1.533*	1.517	1.498*
	[0.641]	[0.497]	[0.508]	[0.896]	[0.972]	[0.902]
Liquidity	0.395***	0.373***	0.391***	0.402***	0.391***	0.399***
	[0.104]	[0.105]	[0.105]	[0.057]	[0.057]	[0.057]
Size	-0.264***	-0.265***	-0.270***	-0.396***	-0.398***	-0.394***
	[0.032]	[0.030]	[0.032]	[0.037]	[0.039]	[0.038]
Δln(GDP)	6.379***	5.830***	6.397***	0.931***	0.984***	0.943***
	[1.248]	[1.147]	[1.215]	[0.211]	[0.223]	[0.211]
Inflation	0.008	0.002	0.008	0.013***	0.014***	0.013***
	[0.007]	[0.007]	[0.007]	[0.004]	[0.004]	[0.003]
MP × capitalization	0.400**		0.266	-0.022		-0.044
	[0.202]		[0.231]	[0.070]		[0.079]
MP × liquidity	0.182***		0.171***	0.009		0.009
	[0.062]		[0.062]	[0.015]		[0.015]
MP × size	-0.019**		-0.019**	0.002**		0.002**
	[0.009]		[0.009]	[0.001]		[0.001]
Lerner index		-0.172	-0.160		0.054	0.060
		[0.176]	[0.174]		[0.045]	[0.044]
MP × Lerner index		0.255***	0.172**		0.014	0.026
		[0.077]	[0.083]		[0.015]	[0.020]
Constant	-0.096***	-0.076**	-0.096***	0.015	0.012	0.014
	[0.034]	[0.032]	[0.032]	[0.009]	[0.010]	[0.009]
Observations	7,492	7,492	7,492	9,365	9,365	9,365
Number of banks	2,861	2,861	2,861	2,603	2,603	2,603
R-squared	0.100	0.092	0.102	0.198	0.197	0.199

Table 4
Robustness check: alternative monetary policy measure (overnight rate)

Panel estimations with bank fixed effects. Dependent variable is the loan growth. Monetary policy variable is the difference of overnight rate between the current and previous period. The explanatory variables are lagged by one period. Robust standard errors are in brackets. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Bank lending channel	Lerner index included	Bank lending channel with Lerner index and all interactions
Specification	(1)	(2)	(3)
MP (overnight rate)	-0.016*** [0.004]	-0.020*** [0.004]	-0.020*** [0.004]
Capitalization	1.230*** [0.358]	1.255*** [0.366]	1.245*** [0.348]
Liquidity	0.338*** [0.051]	0.324*** [0.050]	0.331*** [0.050]
Size	-0.134*** [0.023]	-0.135*** [0.023]	-0.135*** [0.023]
Δln(GDP)	1.252*** [0.252]	1.305*** [0.257]	1.278*** [0.257]
Inflation	0.016*** [0.003]	0.016*** [0.003]	0.016*** [0.003]
MP × capitalization	-0.000 [0.067]		-0.036 [0.073]
MP × liquidity	0.011 [0.014]		0.010 [0.014]
MP × size	0.000 [0.001]		0.000 [0.001]
Lerner index		-0.030 [0.061]	-0.027 [0.061]
MP × Lerner index		0.037*** [0.013]	0.044** [0.018]
Constant	0.003 [0.010]	0.001 [0.010]	0.002 [0.010]
Observations	16,857	16,857	16,857
Number of banks	3,032	3,032	3,032
R-squared	0.081	0.082	0.082

Table 5
Robustness check: alternative monetary policy measure (overnight rate) before and during the crisis

Panel estimations with bank fixed effects. Dependent variable is the loan growth. Monetary policy variable is the difference of overnight rate between the current and previous period. The explanatory variables are lagged by one period. Robust standard errors are in brackets. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

	Before the crisis (2002-2006)			During the crisis (2007-2010)		
Specification	(1)	(2)	(3)	(1)	(2)	(3)
MP (overnight rate)	-0.045**	-0.062***	-0.058**	-0.009***	-0.012***	-0.012***
	[0.021]	[0.022]	[0.023]	[0.003]	[0.004]	[0.004]
Capitalization	0.131	0.257	0.319	1.524*	1.514	1.486*
	[0.641]	[0.497]	[0.509]	[0.890]	[0.972]	[0.896]
Liquidity	0.395***	0.373***	0.391***	0.403***	0.392***	0.400***
	[0.104]	[0.105]	[0.105]	[0.057]	[0.057]	[0.057]
Size	-0.264***	-0.264***	-0.269***	-0.396***	-0.398***	-0.395***
	[0.032]	[0.030]	[0.032]	[0.037]	[0.039]	[0.038]
Δln(GDP)	6.373***	5.815***	6.397***	0.925***	0.973***	0.933***
	[1.255]	[1.151]	[1.224]	[0.211]	[0.221]	[0.210]
Inflation	0.009	0.003	0.009	0.012***	0.013***	0.012***
	[0.007]	[0.007]	[0.007]	[0.003]	[0.003]	[0.003]
MP × capitalization	0.386*		0.257	-0.020		-0.039
	[0.202]		[0.231]	[0.062]		[0.069]
MP × liquidity	0.185***		0.174***	0.007		0.007
	[0.062]		[0.062]	[0.013]		[0.013]
MP × size	-0.020**		-0.020**	0.001**		0.001*
	[0.009]		[0.009]	[0.001]		[0.001]
Lerner index		-0.172	-0.160		0.053	0.059
		[0.176]	[0.174]		[0.046]	[0.044]
MP × Lerner index		0.248***	0.165**		0.011	0.021
		[0.076]	[0.082]		[0.013]	[0.017]
Constant	-0.098***	-0.077**	-0.097***	0.015*	0.013	0.015*
	[0.035]	[0.033]	[0.033]	[0.009]	[0.010]	[0.009]
Observations	7,492	7,492	7,492	9,365	9,365	9,365
Number of banks	2,861	2,861	2,861	2,603	2,603	2,603
R-squared	0.100	0.092	0.102	0.198	0.197	0.199

Table 6
Robustness check: alternative measures of competition

Panel estimations with bank fixed effects. Dependent variable is the loan growth. Monetary policy variable is the difference of refinancing rate between the current and previous period. Competition measure is either Herfindahl index or concentration ratio accounting for the share of the five largest banks in the banking system assets in each country. The explanatory variables are lagged by one period. Specifications (2) and (3) introduced in Table 2 are estimated. Robust standard errors are in brackets. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

Competition measure	Herfindahl index		Concentration ratio	
Specification	(2)	(3)	(2)	(3)
MP (refinancing rate)	-0.016*** [0.004]	-0.015*** [0.004]	-0.027*** [0.006]	-0.027*** [0.006]
Capitalization	1.217*** [0.367]	1.217*** [0.358]	1.181*** [0.369]	1.180*** [0.359]
Liquidity	0.329*** [0.051]	0.332*** [0.051]	0.324*** [0.051]	0.327*** [0.051]
Size	-0.133*** [0.022]	-0.133*** [0.023]	-0.135*** [0.023]	-0.136*** [0.023]
Competition measure	1.576*** [0.498]	1.543*** [0.526]	0.004*** [0.001]	0.004*** [0.001]
Δln(GDP)	0.997*** [0.199]	0.988*** [0.202]	1.028*** [0.190]	1.021*** [0.191]
Inflation	0.016*** [0.003]	0.016*** [0.003]	0.019*** [0.003]	0.019*** [0.003]
MP × competition	0.181*** [0.064]	0.180*** [0.062]	0.001*** [0.000]	0.001*** [0.000]
MP ×capitalization		-0.009 [0.076]		-0.017 [0.079]
MP ×liquidity		0.009 [0.015]		0.005 [0.015]
MP × size		-0.000 [0.001]		-0.001 [0.001]
Constant	-0.036* [0.019]	-0.035* [0.021]	-0.110*** [0.034]	-0.108*** [0.036]
Observations	16,857	16,857	16,857	16,857
Number of banks	3,032	3,032	3,032	3,032
R-squared	0.082	0.082	0.084	0.084

Figure 1

Development of the monetary policy rates (main refinancing rate and overnight rate) during the period 2002-2010