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BANK LENDING AND MONETARY TRANSMISSION IN THE EURO AREA

Roberto A. De Santis and Paolo Surico

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Abstract: To what extent does the availability of credit depend on monetary policy? And, does this relationship vary with bank characteristics? Based on a common source of balance sheet data for the four largest economies of the euro area over the period 1999-2011, we uncover three main regularities. First, the effect of monetary policy on bank lending is significant and heterogeneous in Germany and Italy, which are characterised by a large number of banks; but it is very weak in Spain and more homogeneous in France, where the banking industry has a higher degree of market concentration. Second, there is some evidence that monetary policy exerts larger effects on cooperative and savings banks with lower liquidity and less capital in Germany and savings banks with smaller size in Italy. Third, heterogeneity across groups of banks belonging to the same category in any particular country is found to be less pronounced.

Keywords: credit availability, monetary policy, heterogeneous effects; commercial, cooperative, and savings banks.

JEL classification: C33, E44, E52, G21

Non-technical summary

The transmission of monetary policy in the euro area has been the focus of a comprehensive set of studies on pre-1999 samples undertaken by the Eurosystem Monetary Transmission Network, jointly by the European Central Bank (ECB) and the euro area National Central Banks (Angeloni, et al., 2003). This coordinated research effort has documented that pre-1999 an increase in interest rates tended to reduce loan growth in France, Germany, Italy and Spain. Moreover, they found that banks in these four countries with more liquid asset holdings showed weaker loan adjustments.

This paper studies a similar question using data post-1999, when the ECB was in charge of monetary policy in the euro area. Our findings suggest that heterogeneity in the transmission of monetary policy to banks' lending activities appears associated with heterogeneity across countries and across typologies of banks in the same country, while it is broadly homogenous within the bank typology group in each country. The effects of interest rate changes engineered by decisions at the European Central Bank are in Germany and Italy far stronger than in Spain and France. Interestingly, the German and Italian banking industries are populated by a relatively larger number of saving and cooperative banks. This contrasts with the French and Spanish markets, which appear dominated by fewer commercial banks. Moreover, heterogeneity across countries and across typologies of banks within each country seems far more pronounced and significant than heterogeneity across groups of banks belonging to the same category in any particular country.

Our findings also suggest that changes in the cost of funding engineered by monetary policy actions exert their maximum impact on cooperative and saving banks in Germany, especially those with lesser liquidity and lower capital, and saving banks in Italy, especially those with smaller size. Large commercial banks, on the other hand, appear more capable to isolate their lending activities from changes in monetary policy conditions. Small banks are best placed to refinance the real economy, in particular small- and medium-sized firms, which are the biggest generator of employment in the economy. The analysis suggests that the increase in the number of cooperative and savings banks that have access to the ECB standard and non-standard measures during the recent financial crisis is likely to improve the transmission mechanism of monetary policy in the euro area.

Another important policy issue is the evidence that unexpected monetary policy changes had limited implications for the bank loans in Spain over the 1999-2011 period. The limited impact of interest rates on bank lending in Spain suggests that in a monetary union country-specific excessive growth of credit should be counteracted with instruments that limit the fall in lending standards during boom times.

1. INTRODUCTION

A key requirement for an optimal currency area is that the business cycle of the joining countries be sufficiently synchronized and the structure of the economy be sufficiently similar for the transmission of monetary policy to be homogeneous within the currency union. While a number of empirical studies have provided tentative evidence that euro area countries may not be too far from such requirement along a number of important dimensions, including price changes in product markets (see De Grauwe and Mongelli, 2005 and the reference therein), empirical and anecdotal evidence suggest that the banking industry may be a significant source of heterogeneity in the transmission of monetary policy In particular, the response of bank lending to monetary conditions may vary across countries and within the banking sector, thereby making endogenously heterogeneous a common monetary policy.

A similar question was addressed out using data pre-1999 by the Eurosystem Monetary Transmission Network (MTN) in the euro area (Angeloni, et al., 2003). [2] The results from the Eurosystem MTN conducted using data pre-1999 indicated that the impact of interest rate changes was not highly heterogeneous across countries, given that an increase in interest rates tended to reduce loan growth in France, Germany, Italy and Spain, particularly of banks with less liquid asset holdings (see e.g. Ehrmann, et al., 2003). In this paper, we review the analysis using post-1999 observations.

A main challenge to investigating these issues empirically is that disentangling credit demand versus credit supply is not straightforward and it is the main identification problem of the literature pioneered by Kashyap and Stein (1995 and 2000). Following their contributions, a popular approach to study how lending activities vary with monetary conditions is to focus on micro data at bank level and project a measure of credit conditions (typically loans) on a measure of monetary policy (typically a short-term interest rate), bank-specific characteristics, business cycle indicators and their interactions. Particular emphasis is given to the so-called bank lending channel, namely the impact of the interaction between monetary policy and banks' individual characteristics on lending activities.

Most of the available evidence on the euro area, however, is typically based on individual economies, with dataset that are not readily comparable in terms of data source, level of disaggregation and sample period. More importantly, the literature is scant of comparative studies that try to quantify after the introduction of the euro the extent to which the transmission of monetary policy through bank lending is heterogeneous across euro area countries, in a way that may depend on banks' and

[2] The MTN is probably the most comprehensive exercise to date to analyse the transmission mechanism of monetary policy. It was an extensive three-year joint effort by the European Central Bank and the other Eurosystem central banks.

borrowers' characteristics, regulatory environment, financial development and institutions characteristics.

The paper aims at filling this important gap in three steps:

1. Using a common data source on banks' balance sheet data over the sample 1999-2011, we present some distinctive characteristics of bank lending across the four largest economies of the euro area. Particular emphasis is given to differences in bank-specific characteristics meant to capture supply conditions (such as capital, liquidity, size, profitability) as well as to bank typologies. A main finding, highlighted in Section 2, is that France, Germany, Italy and Spain are very different in their composition of commercial, saving, cooperative and real estate banks as well as in terms of individual characteristics within each typology of banks.
2. Then, we turn to the possible sources of such heterogeneity. A non-exhaustive list of candidates, which is discussed in Section 3, includes size, liquidity and capital. Moreover, the transmission of the monetary policy can be highly affected by a specific relationship of banks with their customers, the network if banks, the concentration of the bank industry, the characteristics of the borrowers, the structure and the development of the nonfinancial sector. We will analyse this by looking at various typologies of banks.
3. Finally, in Section 4 we present an empirical model of the bank lending channel and in Section 5 we provide formal econometric evidence in favour of the hypothesis that heterogeneity in banks' characteristics lead to heterogeneity in the monetary transmission across countries and typology of banks. Two approaches are used: (*i*) the linear ordinary least square (OLS) approach, which consists of interacting the policy instrument with the candidate source of heterogeneity (i.e. size, liquidity and capital); (*ii*) the nonlinear quantile regression approach, which splits the sample around the exogenous policy instrument and the threshold values. The first more traditional approach, which identifies heterogeneity with observed characteristics such as size, capital and liquidity, allows us to study heterogeneity of the monetary transmission mechanism across countries and across banks. The second approach is used to study heterogeneity between typologies of banks, recognising that banks are inherently different not only in observed characteristics, but also in unobserved dimensions such as business model, risk propensity, managerial ability and borrowers' characteristics.

Section 6 compares the results obtained with the post-1999 sample with the pre-1999 evidence and the final section provides some policy conclusions.

2. BANK LENDING ACROSS THE EURO AREA: SOME FACTS

The euro area banking system is the largest in the world. Total on-balance sheet assets of the euro area banks were EUR 31.1 trillion at the end of 2009, totalling almost 345% of euro area nominal GDP and about 3.75 times the size of the US banking system. The credit intermediation process in the euro area is dominated by banks which account for about three-quarters of the market (as opposed to one quarter in the United States). Furthermore, over and above the high overall level of bank dependence, there are notable differences across euro area countries and across typologies of banks.

For example, the Bank Lending Survey (BLS),[3] which is designed to provide information on supply and demand conditions in the euro area credit markets and the lending policies of euro area banks, indicate that credit access is heterogeneous across countries with the degree of dispersion increasing since the beginning of 2007, before the financial crisis actually started. (see Figure 1). This is not inconsistent with the notion that the bank lending channel is highly heterogeneous across countries and possibly across banks' typologies (see also Ciccarelli, Maddaloni and Peydro, 2013).

In this section, we present banks' balance sheet descriptive statistics grouped by country and typology of banks for the four largest economies of the euro area: France, Germany, Italy and Spain. We use proprietary data from Bankscope, which are detailed in Appendix A. The focus is on key banks' characteristics such as size, liquidity, capital and profitability to assess differences and similarities across countries. Furthermore, we use data from a common source to make sure that the differences in the data set are not responsible for differences in the empirical results available in the literature. This appears an advantage relative to earlier studies, which have typically focused on a single country (Angeloni, et al, 2003; Chatelain, et al, 2003; Ehrmann and Worms, 2004; Gambacorta, 2005 and 2008; Jimenez et al., 2012), or have used synthetic aggregate data for the euro area (Altunbas et al., 2004 and 2009), Europe and the US as a whole (Gambacorta and Marques-Ibanez, 2011).

The relevant specialization categories in the Bankscope database are: (i) commercial banks, (ii) savings banks and (iii) cooperative banks. Because of the low number of observations for each country, we exclude real estate and mortgage banks as well as medium- and long-term credit banks from the econometric analysis in section 5, but we report descriptive statistics for them in this section. The selected categories (i) to (iii) represent more than eighty percent of the euro area corporate and household credit markets. Commercial banks are defined in Bankscope as mainly active in a combination of retail banking –individuals, Small and Medium Enterprises (SMEs),

[3] The BLS addresses issues such as credit standards for approving loans as well as credit terms and conditions applied to enterprises and households. It also asks for an assessment of the conditions affecting credit demand. The survey is addressed to senior loan officers of a representative sample of euro area banks and is conducted four times a year starting from the first quarter of 2003. The sample group participating in the survey comprises around one hundred banks from all euro area countries and takes into account the characteristics of their respective national banking structures.

wholesale banking (large corporates) and private banking (not belonging to groups of saving banks, co-operative banks). Saving banks refer to banks mainly active in retail banking (individuals, SMEs) and belonging to a group of savings banks which, unlike commercial banks, are characterized by broadly decentralized distribution network, providing local and regional outreach.

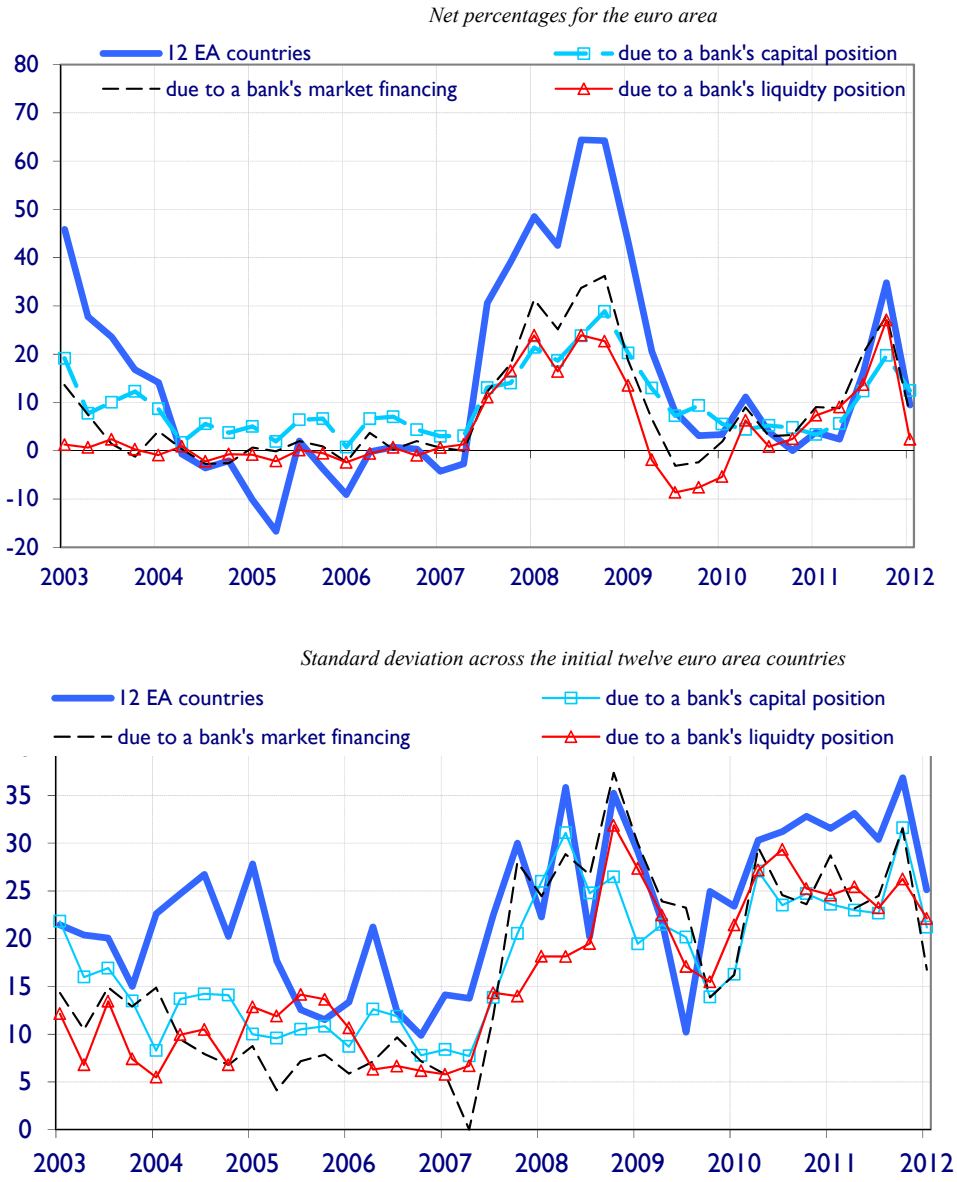

Figure 1.
Changes in credit standards on loans to corporations
(net percentages of banks reporting tightening standards and standard deviation across countries)
Source: European Central Bank.
Note: The net percentage refers to the difference between the sum of the percentages for "tightened considerably" and "tightened somewhat" and the sum of the percentages for "eased considerably" and "eased somewhat". See http://www.ecb.int/stats/money/lend/html/index.en.html for further information. Sample period: 2003Q1 – 2012Q1.

Cooperative banks have a cooperative ownership structure and are mainly active in retail banking (individuals, SMEs).[4] Real estate and mortgage banks are mainly active in mortgage financing and project development. Medium and long-term credit banks provide loans finance such as export finance, finance of projects in less developed countries, environmental programs and loans to small and medium sized firms.

To give a sense for the large extent of heterogeneity in the euro area data, Figure 2 and Tables 1 and 2 report descriptive statistics from banks' balance sheets in France, Germany, Italy and Spain, grouped by typology of banks. A few facts about banks heterogeneity are worth noting:

- commercial banks have a large market share in all countries, which is particularly sizeable in Italy; savings banks are very important in Spain and Germany; cooperative banks have a sizable market share in France and Italy; medium and long term credit bank play only a marginal role; and real estate and mortgage banks are mainly present in Germany (see Figure 2).
- cooperative banks have the smallest size in Germany and Italy; savings banks are particularly large in France and Spain (see Table 1).
- French savings banks are the most liquid; while German savings banks are the least liquid. Overall, Italian banks and the commercial banks in all four countries are relatively liquid (see Table 1).
- Italian (German) banks are the most (least) capitalised. Savings banks are the least capitalised banks in all countries except Italy (see Table 1).[5]
- French banks have the lowest loan loss provision, which is particularly low among savings banks (see Table 2).
- German, Spanish and French banks finance their activity largely by means of deposits (about 80%); Italian banks instead rely only for about 54% to deposits, one third of banks' activity is financed by other liability means, such as debt securities. This financing structure is homogenous among banks within the same country (see Table 2).
- French and Spanish banks are the most profitable, having the largest return on average assets (ROAA = net profit / average assets) and on average equity (ROAE = net profit / average shareholders' equity). Spanish banks appear the most efficient as measured by the lowest cost/income ratio (= operating expenses / operating income) (see Table 2).
- Spanish (German) banks recorded the fastest (slowest) growth rate of credit (see Table 1).

[4] Cooperative banks are owned by the depositors and often offer rates more favourable than for-profit banks. Typically, membership is restricted to employees of a particular company, residents of a defined neighbourhood, members of a certain labour union or religious organizations, and their immediate families. This specialization category includes also "Banche Popolari" in Italy, "Volksbank" in Germany, "Caja rural" in Spain or "Banque populaire" in France.

[5] Commercial banks and cooperative banks are more capitalised than savings banks most likely because they can find capital on the market, the former issuing equities, and the latter finding members, while savings banks can increase capital only through retained earnings and through the intervention of municipalities.

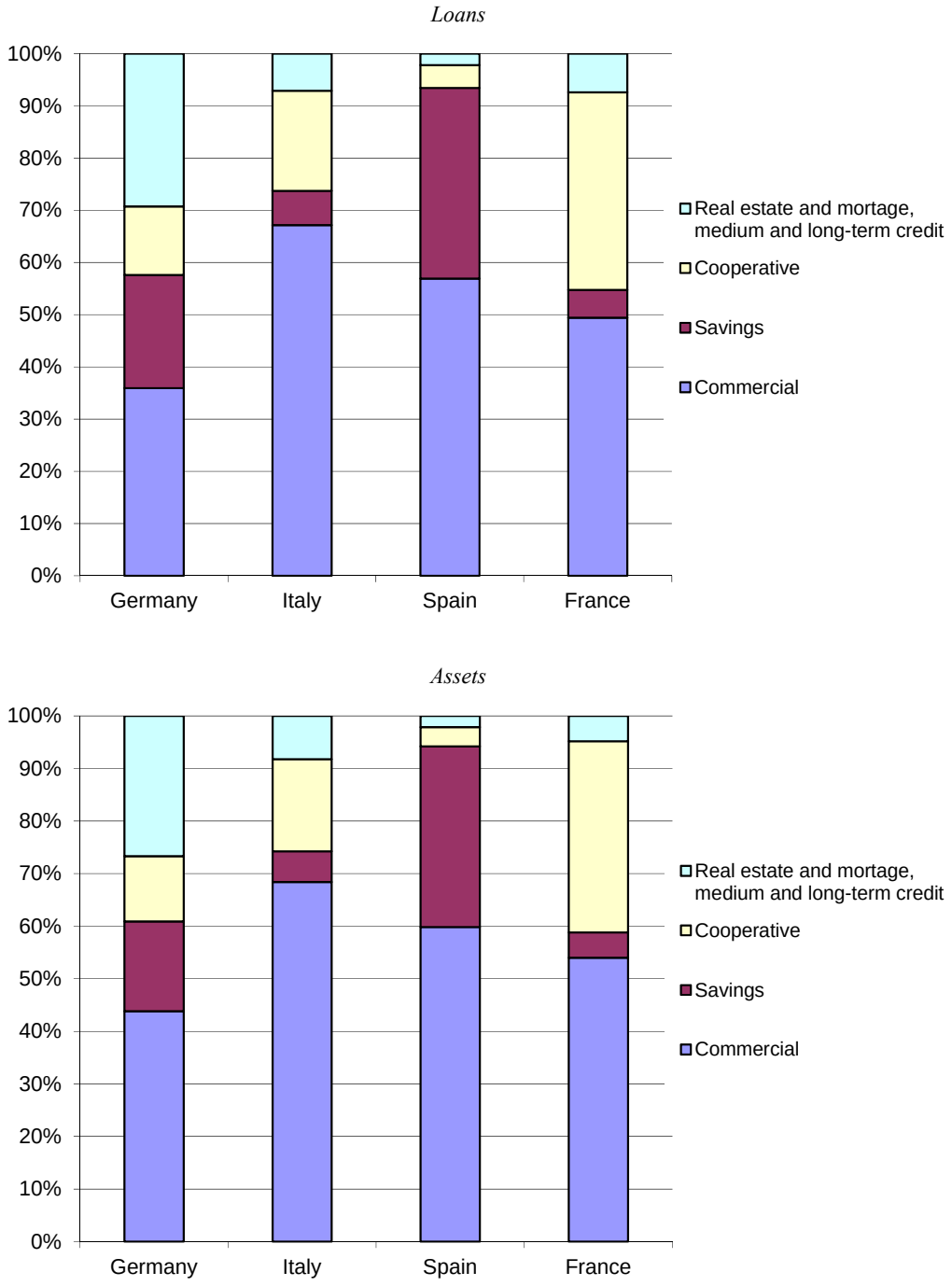

Figure 2.
Countries' Market Share for Loans and Assets by Bank Type

Source: Bankscope and authors' calculations. Sample period: 1999-2011.

Table 1.

Descriptive statistics by typologies of banks

(Median, sample period: 1999-2011)

	All	Commercial	Savings	Cooperative
		Germany		
Liquidity / Assets (%)	14.5	22.5	12.6	15.0
Capital / Assets (%)	5.5	6.5	5.0	5.8
Size (log of assets, EUR mil.)	6.3	6.9	7.1	5.8
Loan growth (%)	1.8	3.4	1.7	1.8
Number of observations	18669	1364	5848	10645
		Italy		
Liquidity / Assets (%)	20.0	20.4	19.1	20.3
Capital / Assets (%)	10.6	7.4	8.7	11.5
Size (log of assets, EUR mil.)	5.9	8.0	7.4	5.4
Loan growth (%)	9.8	10.0	8.7	10.2
Number of observations	6536	1055	592	4680
		Spain		
Liquidity / Assets (%)	14.1	19.3	13.5	11.8
Capital / Assets (%)	7.4	7.5	6.9	8.6
Size (log of assets, EUR mil.)	8.3	7.6	9.1	7.0
Loan growth (%)	12.4	12.4	14.4	3.4
Number of observations	1332	540	518	248
		France		
Liquidity / Assets (%)	19.3	24.2	46.5	12.4
Capital / Assets (%)	7.6	6.7	5.7	9.6
Size (log of assets, EUR mil.)	8.1	7.2	9.0	8.7
Loan growth (%)	7.0	6.6	7.4	8.2
Number of observations	2671	1300	260	829

Source: Bankscope and authors' calculations.

Table 2.

Banks' Balance Sheet and Financial ratios in the Largest euro area Countries

(Median, sample period: 1999-2011)

Germany

	All	Commercial	Savings	Cooperative
Assets (%)				
Liquid assets	14.5	22.5	12.6	15.0
Loans	60.9	54.6	60.8	61.1
Fixed assets	1.4	0.4	1.3	1.5
Other assets	23.3	22.5	25.3	22.4
Total assets	100.0	100.0	100.0	100.0
Liability and Equity (%)				
Deposits	86.1	84.1	87.6	85.7
Other liabilities	8.4	9.4	7.4	8.5
Equity capital	5.5	6.5	5.0	5.8
Total liabilities and equity	100.0	100.0	100.0	100.0
Profitability and efficiency (%)				
ROAA	0.2	0.3	0.2	0.3
ROAE	4.1	4.7	3.5	4.3
Net interest margin	2.6	2.1	2.5	2.7
Cost to income ratio	70.4	69.1	68.1	71.8
Loan loss provision to asset ratio (%)	0.4	0.3	0.5	0.4
Size (log of assets, EUR)	6.3	6.9	7.1	5.8

Italy

	All	Commercial	Savings	Cooperative
Assets (%)				
Liquid assets	20.0	20.4	19.1	20.3
Loans	66.5	66.0	71.2	65.4
Fixed assets	1.4	1.2	1.5	1.5
Other assets	12.2	12.3	8.2	12.8
Total assets	100.0	100.0	100.0	100.0
Liability and Equity (%)				
Deposits	53.9	58.5	55.5	53.1
Other liabilities	35.5	34.1	35.8	35.4
Equity capital	10.6	7.4	8.7	11.5
Total liabilities and equity	100.0	100.0	100.0	100.0
Profitability and efficiency (%)				
ROAA	0.7	0.6	0.7	0.7
ROAE	6.0	6.7	6.9	5.7
Net interest margin	3.1	2.7	3.3	3.2
Cost to income ratio	69.6	67.6	66.8	70.8
Loan loss provision to asset ratio (%)	0.3	0.4	0.4	0.3
Size (log of assets, EUR)	5.9	8.0	7.4	5.4

continued…

Spain

	All	Commercial	Savings	Cooperative
Assets (%)				
Liquid assets	14.1	19.3	13.5	11.8
Loans	70.9	66.9	70.7	74.7
Fixed assets	1.8	1.1	2.2	2.1
Other assets	13.3	12.8	13.7	11.4
Total assets	100.0	100.0	100.0	100.0
Liability and Equity (%)				
Deposits	77.7	80.2	73.5	81.3
Other liabilities	14.9	12.3	19.7	10.1
Equity capital	7.4	7.5	6.9	8.6
Total liabilities and equity	100.0	100.0	100.0	100.0
Profitability and efficiency (%)				
ROAA	0.7	0.7	0.8	0.5
ROAE	9.4	8.6	10.7	5.9
Net interest margin	2.3	2.3	2.5	2.2
Cost to income ratio	58.7	56.5	58.7	61.8
Loan loss provision to asset ratio (%)	0.3	0.3	0.3	0.3
Size (log of assets, EUR)	8.3	7.6	9.1	7.0

France

	All	Commercial	Savings	Cooperative
Assets (%)				
Liquid assets	19.3	24.2	46.5	12.4
Loans	66.9	59.3	39.3	75.1
Fixed assets	0.6	0.6	0.6	0.7
Other assets	13.2	15.8	13.6	11.8
Total assets	100.0	100.0	100.0	100.0
Liability and Equity (%)				
Deposits	73.0	71.9	90.1	77.6
Other liabilities	19.4	21.4	4.2	12.8
Equity capital	7.6	6.7	5.7	9.6
Total liabilities and equity	100.0	100.0	100.0	100.0
Profitability and efficiency (%)				
ROAA	0.7	0.7	0.4	0.8
ROAE	8.4	10.3	7.9	7.9
Net interest margin	2.1	2.5	1.5	2.2
Cost to income ratio	65.8	66.9	70.6	63.3
Loan loss provision to asset ratio (%)	0.2	0.2	0.1	0.3
Size (log of assets, EUR)	8.1	7.2	9.0	8.7

Source: Bankscope and authors' calculations.
Note: Net interest margin = net interest income / total earnings assets. Return on average assets (ROAA) = net profits / average assets. Return on Average Equity (ROAE) = net profits / average shareholders' equity. The cost/income ratio = operating expenses / operating income.

This set of descriptive statistics exemplifies the significant extent of heterogeneity in euro area data across countries and typology of banks. At the same time, they call for a deeper understanding of the relevant source(s) of heterogeneity and the

consequences for the conduct of monetary policy. The rest of the paper aims at addressing these issues.

3. SOURCES OF HETEROGENEITY IN BANK LENDING

The starting point of the bank lending channel is the recognition of the imperfect functioning of capital markets and the existence of incomplete contracts in a violation of the Modigliani-Miller (1958) theorem. The imperfections are brought about by the pervasiveness of asymmetric information and the associated agency problems that can result in large gaps between the lenders' expected returns and the borrowers' costs of funds.[6] In this context, banks are not able to substitute freely across different sources of finance as well as firms may not easily replace bank loans with other form of financing (e.g. market debt and trade credit). However, there are many factors that can influence credit supply, the most important being: the specific characteristics of banks, a particular relationship with customers, the networks among banks, and the degree of market competition. Moreover, bank lending is influenced by borrowers' characteristics as well as the structure and the development of the nonfinancial sector.

Bank's characteristics

Given that credit provision requires the evaluation of both projects and borrowers as well as the monitoring of the borrowers' performance before and during the loan, the theoretical literature attributes a prominent role to net worth (banks' capital) in reducing the agency costs of borrowing (Bernanke and Gertler, 1995; Holmstrom and Tirole, 1997 and 1998; Bernanke, Gertler and Gilchrist, 1999; Gertler and Kiyotaki, 2010), while the empirical literature suggests using size (banks' total assets) as a proxy for informational asymmetries. It is generally argued that following a monetary tightening, the banks less likely to contract loan supply are: (i) the larger banks as they can raise external funds more easily (Kashyap and Stein, 1995); (ii) the more capitalized banks as they have more equity securities to absorb future losses (Kishan and Opiela, 2000; Van den Heuvel, 2002) and less moral hazard problems at the bank level given that relatively more money is at stake (Bernanke, 2007); but also (iii) the more liquid banks as they can use their liquidity to satisfy the demand for loans (Kashyap and Stein, 2000, and Chatelain et al., 2003).

Relationship lending

In several euro area countries, the market for intermediated finance is characterised by relationship rather than arm's length lending. It is very common that bank customers establish long lasting relationships with banks, with a prominent example being the German system of "house banks", in which firms conduct most of their

[6] The role of credit in the economy becomes important once the assumption of perfect information is relaxed. Indeed, the essence of the credit creation process is the gathering and transmission of information, which are needed to evaluate projects and borrowers and to monitor borrowers' performance after the loan. In particular, banks have the expertise to channel savings to small business projects that are information-intensive and particularly hard to evaluate.

financial business with one bank only. With most German banks operating as universal banks, and therefore supplying their customers with the full range of financial services, this implies a much closer linkage to a single bank than in many other countries. For the creditor, this could also imply an implicit guarantee to have access to (additional) funds even if the central bank follows a restrictive monetary policy. In such a case, the reaction of bank loan supply to monetary policy should be at least muted. Italian banks seem to be characterized by a similar business model, according to which many small banks entertain close relationships with their customers (especially small firms). This is true also for France as most small firms have business relationships with one bank only. However, French small firms do not account for a large share of GDP. Typically, house bank relationships exist between relatively small banks – for which the loan business with non-banks is still a central activity – and their customers. However, also the typology of banks is very important, given the personal contact typical of credit cooperatives.

Bank networks

Banks have set up networks of various kinds. This is particularly true for two sectors: savings banks and credit cooperatives in Germany. Both sectors consist of an "upper tier" of large banks serving as head institutions and a "lower tier" of smaller banks that entertain very close relationships to the head institutions, leading to an internal liquidity management. On average, the "lower tier" banks deposit short-term funds with the "upper tier" banks, and receive long-term loans in turn. Therefore, these types of banks might be less affected by a monetary policy shock even if they have a relatively lower liquidity ratio.

Banks' concentration

Since the inception of the single currency, the banking industry in the euro area has continued to experience a gentle trend in market concentration, mostly driven by the steadily increase in the number of mergers and acquisitions. While the evolution of market concentration over time appears rather homogeneous across the four economies,[7] we note that the extent of concentration for the entire sample period stands at different levels in the various countries and, using various measures of concentration indices, it is higher in Germany and Italy. These two countries are also characterised by a banking system with many more banks per unit of GDP or working population (see Figure 3).

Therefore, the transmission mechanism can differentiate across countries due to the different degree of market competition, because the sensitivity of the lending rates to monetary policy rates may also depend upon the intensity of market competition (Klein, 1972; Monti, 1972). As the market become more competitive, the degree of pass through rises. This hypothesis has been tested favourably. Hannan and Berger (1991), for example, show that lending rates are sticky and that this thickness increases with market concentration in accordance with the prediction of the Klein-Monti model. The survey by Berger et al. (2004) on the impact of bank concentration

[7] More specifically, the ranking of the four countries in terms of market concentration has not changed over the sample period.

and competition provides additional reviews of the existing literature. Clearly, the assumption of perfect competition may not seem appropriate for the banking sector, given the large barriers to entry.

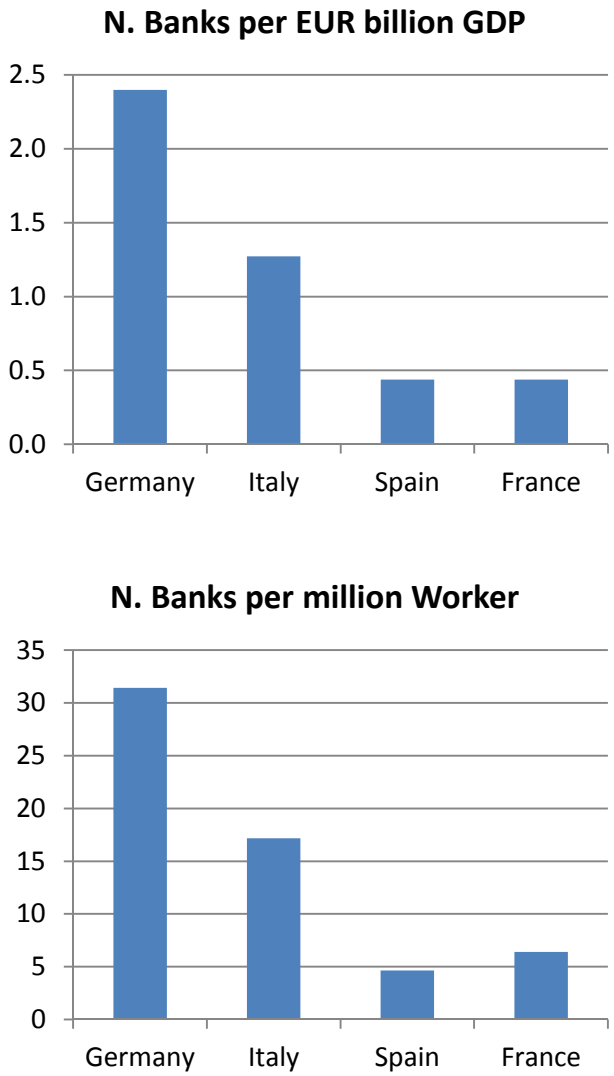

Figure 3.

Number of banks per GDP and per working population

Source: Bankscope, European Central Bank.and own calculations.

Note: based on the average 1999-2011 period.

Balance sheet channel

The transmission of monetary policy through credit markets is also affected by borrowers' net worth, cash flow and liquid assets, namely the balance sheet channel. It is widely recognised that firms' balance sheets deteriorate with a monetary contraction, through a reduction of both net worth (and thus collateral) and cash flows. As pointed out by Jiménez, et al (2011), tighter monetary conditions may

reduce supply through increased agency costs of banks; but it also may influence demand because of reductions in net worth and expected investment. They suggest controlling for borrowers' characteristics with firm-month fixed effects, which capture time-varying observed and unobserved firm heterogeneity. They use the credit register of Spain, which is collected by the Banco de España acting in its capacity as bank supervisor, to attain identification. Unfortunately, we do not have information on the borrower side, which prevents us from investigating this additional channel.

Nonfinancial sectors

Heterogeneity in bank lending across countries and typology of banks may also reflect differences in the real economy. If firms in different sectors are run using different business models, have diverse managerial practice or face different risks, for instance, then heterogeneity in lending activities may be rooted outside the banking industry. And if the euro area is not a fully optimal currency area, then perhaps such an asymmetry would not necessarily be undesirable as heterogeneity in bank lending may compensate for heterogeneity in the structure of the economy. While controlling for this effect would require access to borrowers' characteristics (something that unfortunately we do not observed in our data), the empirical specification below allows for GDP growth and its interaction with bank characteristics to influence loan growth heterogeneously. This suggests that in our model any evidence of heterogeneity in the lending response to monetary conditions would be occurring over and above the heterogeneous impact captured by GDP growth and the associated interaction terms, which are likely to capture some of the effects stemming from the nonfinancial sectors.

4. MODELLING THE EFFECTS OF MONETARY POLICY ON LENDING

This section presents an empirical specification to study the impact of monetary policy on bank lending. Our estimation strategy follows the contributions by Kashyap and Stein (1995 and 2000), Kishan and Opiela (2000), Ehrmann, et al. (2003), Altunbas, et al. (2009) and Gambacorta and Marques (2011), among many others. These studies share the emphasis that some form of heterogeneity matters for the transmission of monetary policy and this is explored by introducing an interaction term between the policy instrument and the candidate source of heterogeneity. We carry out the same exercise.

In addition, one should recognise that banks are inherently different not only in observed characteristics such as size, capital and liquidity, etc., but also in unobserved dimensions such as business model, risk propensity and managerial ability. While the main focus of this paper is on cross-country heterogeneity, monetary policy may also have diverse effects within typology of banks for each country. To investigate this possibility, we will complement the results by splitting the sample around some exogenous variables and threshold values using an estimation strategy that allows heterogeneity in the transmission of monetary policy across groups of banks within the same country and bank typology.

4.1 The empirical specification

The transmission of monetary policy through the bank lending channel requires the identification of the monetary policy shock as well as controlling for loan demand determinants. A vast empirical literature has proposed alternative identification strategies to decompose changes in the short-term interest rate into the systematic and the non-systematic component of monetary policy. Among those, one of the most popular set of restrictions assumes that the short-term interest rate responds contemporaneously to inflation, real activity and possibly a measure of credit conditions. Accordingly, we label monetary policy shocks the residuals of a Taylor-type rule in which changes in the 3-month overnight index swap are orthogonalised vis-à-vis euro area real GDP growth, inflation and the growth of loans to non-financial corporations and households.[8] Previous studies have typically used the realised short-term interest rate as monetary indicator (see for instance Kashyap and Stein, 1995 and 2000, and the literature they have pioneered).

To control for loan demand determinants, we use nominal GDP growth at time *t* and time *t-1*, the past value of loan growth and the interaction of current and past nominal GDP growth with individual bank characteristics at time *t-1*, such as banks' profitability measures (such as the return on equity), loan loss provisions, size, capital and liquidity. The aggregate variables and their interaction with bank characteristics are used to isolate loan demand effects. In addition, the bank-specific variables aim at capturing individual characteristics associated with the cyclical effects not captured by GDP growth (through returns on equity) and borrowers' risk (through loan loss provisions), as banks exposed to financially stronger borrowers are expected to make relatively smaller non-performing loans.[9]

Finally, we allow banks to respond differently to the monetary policy shock in a way that may also depend on individual characteristics. By doing so, we hope to disentangle the policy effect that is common across all banks from the policy effect that may vary according to the size, liquidity or capital position of each bank.

4.2 The Ordinary Least Squares (OLS) specification

A separate model is estimated for each country and each bank typology. The econometric specification takes the following form:

$$\begin{aligned}\Delta L_{i,t} = {} & a_0 + a_1 \Delta L_{i,t-1} + \sum_{j=0}^{1} a_{2j} MP_{t-j} + \sum_{j=0}^{1} a_{3j} \Delta NGDP_{t-j} \\ & + a_4 ROE_{i,t-1} + a_5 LLP_{i,t-1} + \sum_{j=0}^{1} a_{6j} w_{i,t-1} \Delta NGDP_{t-j} \\ & + a_7 z_{i,t-1} + \sum_{j=0}^{1} a_{8j} z_{i,t-1} MP_{t-j} + \sum_{j=0}^{1} a_{9j} z_{i,t-1} \Delta NGDP_{t-j} + u_{i,t}\end{aligned} \quad (1)$$

[8] The finding of heterogeneity is robust to compute the monetary policy shock using the first lag of inflation, output and credit aggregate as instruments for their contemporaneous values. The correlation of the policy shocks obtained with OLS and IV is 0.85.

[9] Loan loss provisions are non-cash expenses for banks to account for future losses on loan defaults. This guarantees a bank's solvency and capitalisation if and when the defaults occur. Given that the loan loss provisions increase with the riskiness of the loans, it is often used as a proxy for bank risk (see also Altunbas, et al., 2009).

where $\Delta L_{i,t}$ is the first difference of the logarithm of loans of bank *i* in period *t* to private non-banks in deviation from the average loan growth for that bank. Following Altunbas, Gambacorta and David-Marques (2009), we exclude interbank positions.[10] The variable MP_t refers to the monetary policy shock, $\Delta NGDP_t$ stands for the log difference of nominal GDP (in deviation from the average GDP growth), $ROE_{i,t}$ is the return on equity of bank *i*, $LLP_{i,t}$ describes loan loss provisions to asset ratio of bank *i*, $w_{i,t} = [ROE_{i,t}, LLP_{i,t}]$ and $z_{i,t}$ represents a vector of bank characteristics such as size, liquidity and capital. $w_{i,t}$ and $z_{i,t}$ are standardised value for each bank. The term $\varepsilon_{i,t}$ represents the source(s) of unobserved heterogeneity across banks (See Appendix A for detailed information on the construction of the variables).

Negative coefficients on the monetary policy shock (i.e. $\alpha_2 < 0$) but insignificant coefficients on its interaction with bank-specific variables would indicate that the transmission of monetary policy on lending activities is homogeneous across banks. Positive coefficients on the interaction terms between the MP variable and the bank characteristics (i.e. $\alpha_8 > 0$) would indicate that the effects of monetary policy vary with the size, liquidity and capital of individual banks.

4.3 The Quantile Regression (QR) specification

The OLS specification allows studying the extent of heterogeneity in the effects of monetary policy on lending both across countries and across typologies of banks within each country. In this section, we move one step further and ask whether there exists heterogeneity within typology of banks for each country. As it seems arbitrary to take a stand a priori on the relevant source of heterogeneity across groups of banks within the same category (intra-group heterogeneity), our empirical strategy will be based on quantile regressions (QR), which allow us to deal with unobserved heterogeneity. To provide intuition for the way quantile regressions work it is useful to draw an analogy between Ordinary Least Squares (OLS) and Least Absolute Deviations (LAD). As OLS provides an estimate of the average effect, LAD provides an estimate of the median effect. Quantile regressions generalize the idea behind LAD in a way that allows the econometrician to characterize the entire distribution of lending responses to unanticipated movements in the policy rate across financial institutions. To the extent that policy institutions, including the central bank, is concerned about risk management in the credit market, looking at the average effect is likely to be inappropriate for the purpose of identifying the characteristics that are likely to make a bank more sensitive to changes in its cost of funding and business cycle conditions.

In the heterogeneous response model, bank lending is treated as a potential latent outcome. The potential outcome $\Delta L_{i,t}$ at date *t* is latent because, given the monetary policy shock, MP, and other observable individual covariates, *x and z*, and macro

[10] See Giannone, Lenza, Pill and Reichlin (2012) for a study of the effects of the ECB monetary policy, especially the nonstandard tools, on the Euro area interbank market.

covariates, ΔNGDP, the observed outcome for each bank *i* is only one of the possible realizations in the admissible space of outcomes. The quantiles, Q_r, of the potential outcome distributions conditional on covariates are denoted by:

$$Q_r\,(\Delta L_{i,t}|MP,\ \Delta NGDP,\ w_i,\ z_i) \quad \text{with } \tau \in (0,1) \tag{2}$$

and the effect of the treatment, here the unanticipated interest rate change, on different points of the marginal distribution of the potential outcome is defined as:

$$QTE_{\tau} = \frac{\partial Q_{\tau}\left(\Delta L_i|MP,\Delta NGDP,w_i,z_i\right)}{\partial MP} \tag{3}$$

The quantile treatment model can then be written as:

$$\Delta L_{i,t} = q(MP_t,\ MP_{t-1},\ \Delta NGDP_t,\ \Delta NGDP_{t-1},\ w_{i,t-1},\ z_{i,t-1},\ u_{i,t})$$
$$\text{with } u_{i,t}|MP,\ \Delta NGDP,\ W_i,\ Z_i \sim U(0,1) \tag{4}$$

where $q(\ldots.) = Q_r\,(MP|\Delta NGDP,\ w_i,\ z_i,\ u_i)$ and $u_{i,t}$ captures unobserved heterogeneity across banks *i* with the same observed characteristics w_i, z_i and "treatment" MP. The variable $u_{i,t}$ is usually referred to as the rank variable as it determines the relative ranking of unit of observations in terms of potential outcomes. To the extent that the unanticipated component of monetary policy is independent from bank-specific characteristics, QTE_{τ} measures the causal effect of monetary policy on loan growth, holding the unobserved characteristics driving heterogeneity fixed at $u_{i,t} = \tau$.

To estimate quantile effects, we can use methods outlined by Koenker and Bassett (1978), which are based on the following conditional moment restrictions:

$$\text{Prob}[\Delta L \le q(MP,\Delta NGDP,x,)|MP,\Delta NGDP,w,z]$$
$$= \text{Prob}[u \le \tau|MP,\Delta NGDP,w,z] = \tau$$

for each $\tau \in (0,1)$. The estimated parameters, α*'s*, are the results of the following optimization problem:

$$\min_{\alpha} \sum_{i=1}^{n} \rho_{\tau}\left(y_i - x_i'\alpha\right)$$

where $\rho_{\tau}(u) = u(\tau - I(u<0))$ and the indicator function $I(\bullet)$ takes value of one for negative values of *u* and zero otherwise. The penalty function above is asymmetric and piecewise linear. The asymmetry is introduced by the tilting term $(\tau - I(u<0))$ which weights differently the absolute residuals associated with the different parts of the conditional distribution of the endogenous variable. By varying the weights in the tilting term, quantile regressions yield a set of estimates for the slope coefficient over the conditional distribution of the latent variable, which in the present context is loan growth.

The empirical specification of the conditional τ-th quantile distribution of loan growth then takes the following form:

$$
\begin{aligned}
Q_{\tau}\left(\Delta L_{i,t}\middle|\cdot\right) = {} & \alpha_0(\tau) + \alpha_1(\tau)\Delta L_{i,t-1} + \sum_{j=0}^{1}\alpha_{2j}(\tau)MP_{t-j} + \sum_{j=0}^{1}\alpha_{3j}(\tau)\Delta NGDP_{t-j} \\
& + \alpha_4(\tau)ROE_{i,t-1} + \alpha_5(\tau)LLP_{i,t-1} + \sum_{j=0}^{1}\alpha_{6j}(\tau)w_{i,t-1}\Delta NGDP_{t-j} \\
& + \alpha_7(\tau)z_{i,t-1} + \sum_{j=0}^{1}\alpha_{8j}(\tau)z_{i,t-1}MP_{t-j} + \sum_{j=0}^{1}\alpha_{9j}(\tau)z_{i,t-1}\Delta NGDP_{t-j}
\end{aligned} \tag{5}
$$

for each $\tau \in (0,1)$, where the variables have been defined in the previous section.

Specification allows –unlike earlier studies- the impact of monetary policy shocks, α_2, and its interaction with bank characteristics, α_8, to vary across endogenously determined groups of banks within each country. Furthermore, we also allow the growth rate of GDP and its interaction with all individual characteristics to have heterogeneous effects across the conditional distribution of loan growth. Given that the financial sector typically represents a small fraction of GDP in each of the four countries we consider, allowing for heterogeneity in α_3, α_6 and α_9 suggests that any evidence of heterogeneity in α_2 and α_8 is most likely to capture heterogeneity in the bank lending response to monetary conditions, over and above any possible heterogeneous influence coming from the nonfinancial sectors.

5. EMPIRICAL EVIDENCE

In this section, we present the main results of the paper, namely the effects of non-systematic changes in the short-term interest rate on lending activity. We distinguish between the direct effect of monetary policy on loans, as exemplified by the estimated coefficients α_2, and the indirect effect coming from the interaction between the short-term interest rate and bank-specific variables (i.e. the bank lending channel) such as size, liquidity and capital, as exemplified by the coefficients α_8. In each table and panel, we report the sum of the coefficients on the variable of interest at time *t* and *t-1*. Given our focus on the effects of monetary policy in the euro area, we investigate the impact of the monetary policy shock using data for the period 1999-2011. We estimate a separate specification for each country and then within each country for each typology of banks. We consider neither real estate and mortgage banks nor medium and long term credit banks separately because of the insufficient number of observations for each country.

The first column of Figure 4 reports the direct effect of the monetary policy shock on loan growth in Germany (first row), Italy (second row), Spain (third row) and France (fourth row). Non-systematic changes in the cost of short-term financing have a negative impact in all countries with the largest extent of heterogeneity in Germany and Italy. The impact is milder and statistically insignificant in Spain.

The interaction between monetary policy shocks and bank's size (liquidity) in the second (third) column reveals that this form of the bank lending channel is active in Italy, Spain and France (Germany and Italy). Finally, there is little evidence in the last column of Figure 4 that banks' capital may significantly dampen the effect of monetary policy on lending activities.

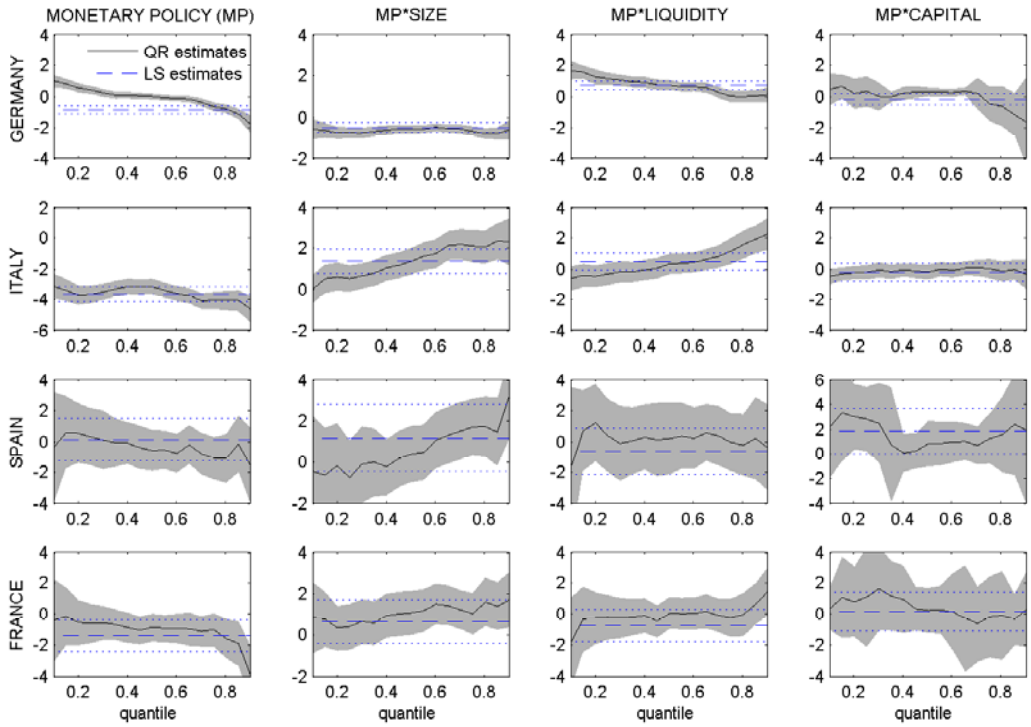

Figure 4.
Impact of monetary policy shock and its interaction with bank characteristics on loan growth
The econometric specification takes the form of equations (1) and (5). Prior to estimation the interest change is orthogonalized by taking the residuals on a regression of interest rate change on euro area real GDP growth, euro area GDP deflator inflation, euro area loan growth and lagged interest rate change. The panels report the sum of the coefficient of the variables at time t and t-1. Source: Bankscope, annual data. QR (LS) estimates in black (blue) refer to quantile (least squares) regressions. Shaded areas (dotted lines) are 95% confidence bands estimated using robust standard errors. Estimates are reported for $\tau \in [.05, .95]$ *at .05 unit intervals. Sample: see Table 1.*

Figure 5 decomposes the estimates of the effect of the monetary policy shock by banks' categories with the effects of monetary policy on lending for commercial, cooperative and saving banks reported in the first, second and third column, respectively. We find that the impact of non-systematic changes in the short-term interest rate is significant and larger for cooperative banks in Italy and France and for saving banks in Italy. A fraction of commercial banks in Germany, Italy and France also appear negatively affected by monetary policy shocks, although the coefficients seem imprecisely estimated.

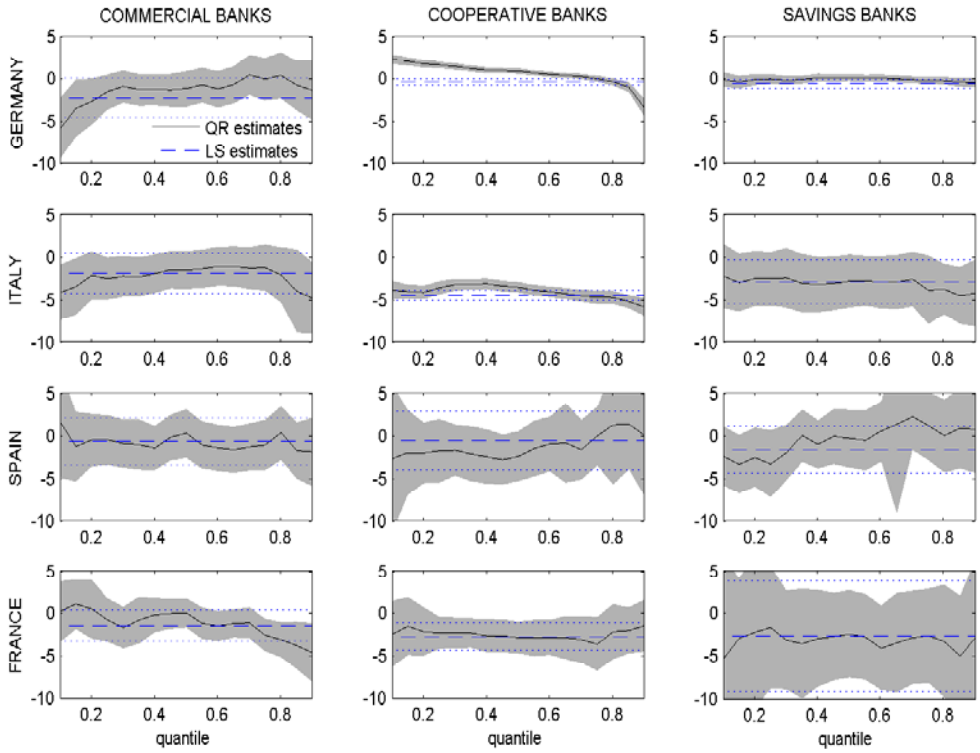

Figure 5.
Impact of monetary policy shock on loan growth across typologies of banks
The econometric specification takes the form of equations (1) and (5). Prior to estimation the interest change is orthogonalized by taking the residuals on a regression of interest rate change on euro area real GDP growth, euro area GDP deflator inflation, euro area loan growth and lagged interest rate change. The panels report the sum of the coefficient of the variables at time t and t-1. Source: Bankscope, annual data. QR (LS) estimates in black (blue) refer to quantile (least squares) regressions. Shaded areas (dotted lines) are 95% confidence bands estimated using robust standard errors. Estimates are reported for $\tau \in [.05, .95]$ *at .05 unit intervals. Sample: see Table 1.*

As the interaction between monetary policy and size does not seem to have significant effects on lending activities (with the possible exception of German cooperative banks and Italian saving banks), we move to the impact of the interaction between the policy shock and size, liquidity and capital in Figures 6, 7 and 8 respectively, focusing on the countries and typologies of banks for which there is evidence of significant effects or heterogeneous behaviour.

Figure 6 reveals that the bank lending channel working through size is significant and heterogeneous for German cooperative banks and Italian saving banks.

Figure 7 reveals that the bank lending channel working through liquidity is significant and heterogeneous for German cooperative and saving banks, Italian cooperative banks.

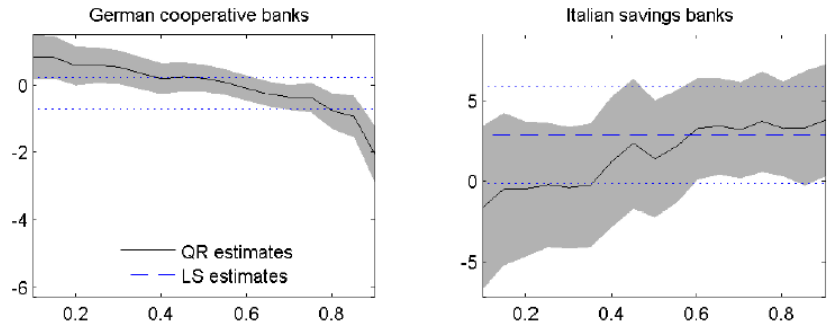

Figure 6.

Impact of monetary policy interacted with size on loan growth across typologies of banks

The econometric specification takes the form of equations (1) and (5). Prior to estimation the interest change is orthogonalized by taking the residuals on a regression of interest rate change on euro area real GDP growth, euro area GDP deflator inflation, euro area loan growth and lagged interest rate change. The channel is calculated using the interaction between the monetary policy shocks at time t and t-1 and liquidity at time t-1. The panels report the sum of the coefficient of the variables at time t and t-1. Source: Bankscope, annual data. QR (LS) estimates in black (blue) refer to quantile (least squares) regressions. Shaded areas (dotted lines) are 95% confidence bands estimated using robust standard errors. Estimates are reported for $\tau \in [.05, .95]$ *at .05 unit intervals. Sample: see Table 1.*

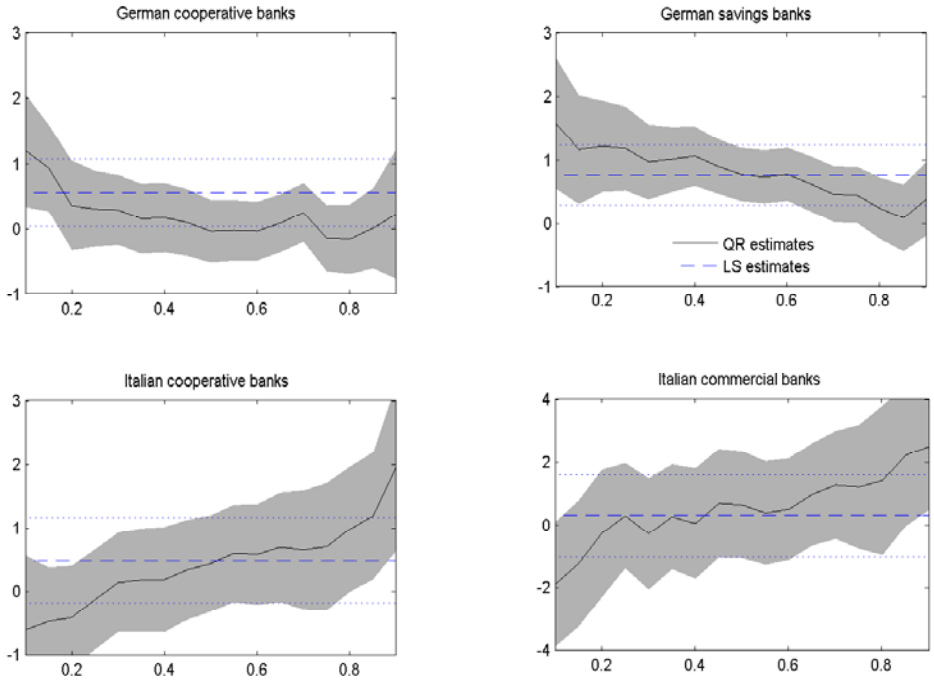

Figure 7.

Impact of monetary policy interacted with liquidity on loan growth across typologies of banks

The econometric specification takes the form of equations (1) and (5). Prior to estimation the interest change is orthogonalized by taking the residuals on a regression of interest rate change on euro area real GDP growth, euro area GDP deflator inflation, euro area loan growth and lagged interest rate change. The channel is calculated using the interaction between the monetary policy shocks at time t and t-1 and liquidity at time t-1. The panels report the sum of the coefficient of the variables at time t and t-1. Source: Bankscope, annual data. QR (LS) estimates in black (blue) refer to quantile (least squares) regressions. Shaded areas (dotted lines) are 95% confidence bands estimated using robust standard errors. Estimates are reported for $\tau \in [.05, .95]$ *at .05 unit intervals. Sample: see Table 1.*

In line with the aggregate results in Figure 4, we detect little evidence of a significant bank lending channel operating in Spain and France. Finally, as for the interaction between monetary policy and capital, Figure 8 reports significant effects only for German cooperative and saving banks.

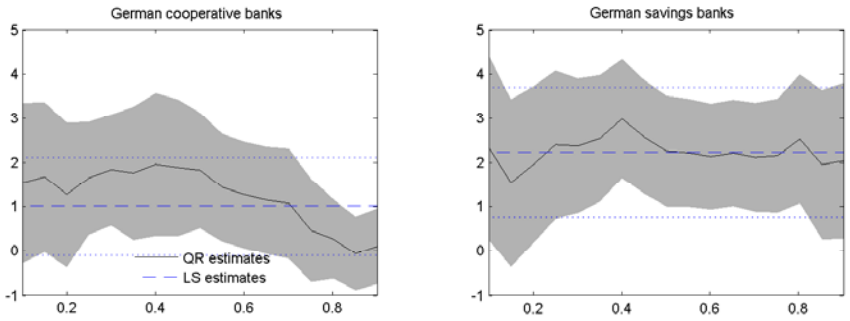

Figure 8.

Impact of monetary policy interacted with capital on loan growth across typologies of banks

The econometric specification takes the form of equations (1) and (5). Prior to estimation the interest change is orthogonalized by taking the residuals on a regression of interest rate change on euro area real GDP growth, euro area GDP deflator inflation, euro area loan growth and lagged interest rate change. The channel is calculated using the interaction between the monetary policy shocks at time t and t-1 and liquidity at time t-1. The panels report the sum of the coefficient of the variables at time t and t-1. Source: Bankscope, annual data. QR (LS) estimates in black (blue) refer to quantile (least squares) regressions. Shaded areas (dotted lines) are 95% confidence bands estimated using robust standard errors. Estimates are reported for $\tau \in [.05, .95]$ *at .05 unit intervals. Sample: see Table 1.*

Cooperative banks, which are typically present in the financial, crafts and agricultural sectors, differ from stockholder banks by their organization, their goals, their values and their governance. Cooperative banks are often created by persons belonging to the same local or professional community or sharing a common interest with the ownership, which is widely shared. The first aim of cooperative banks is not to maximise profit but to provide the best possible products and services to its members. They provide access to financial services to individuals who would otherwise be excluded from such offers. Also saving banks, unlike commercial banks, are characterized by broadly decentralized distribution network, providing local and regional outreach. Given that the core business of the credit cooperatives and savings banks is local, the heterogeneous impact of the monetary policy shocks on local income and deposits might explain the findings.

In summary, the direct effect of policy rate changes on lending activities is highly heterogeneous in Germany and Italy, but it is far more muted in Spain and France. As for the bank lending channel, we find evidence that it is mostly operating through liquidity in Germany and Italy, with the significant and heterogeneous effects mostly driven by cooperative banks. There is some evidence that the effects of monetary

policy on bank lending may change with the size of banks in Italy, Spain and France but these findings do not seem to correlate with the classification in commercial, cooperative and saving banks, thereby suggesting that other forms of (unobserved) heterogeneity may be at play. Next section discusses some possible interpretations for these findings.

6. COMPARISON WITH EARLIER MICRO STUDIES FOR INDIVIDUAL EURO AREA COUNTRIES

At this point, it is useful to compare our estimates with those obtained by selected studies using balance sheet data on individual banks for single euro area countries. Most of these earlier studies on single countries have typically focussed on pre-1999 samples. The comparison is meant to highlight any possible time variation in the interest rate and bank lending channel in the euro area.

We already mentioned that the impact of interest rate changes were not so heterogeneous across countries as an increase in interest rates tended to reduce loan growth in France, Germany, Italy and Spain, particularly of banks with less liquid asset holdings (see e.g. Ehrmann, et al., 2003). Conversely, in reviewing the analysis using post-1999 observations, we find clear evidence that the impact of monetary policy shocks is heterogeneous across countries and across typologies of banks. Moreover, we find that bank lending supply amplifies the effect of monetary policy changes of savings and cooperative banks in Germany and savings banks in Italy, which mainly serve individuals and small firms.

This summary study by Ehrmann, et al. (2003) was then followed by country specific studies that are here highlighted.

Using quarterly data for Germany over a pre-1999 sample, Worms (2003) argues that a bank's share of short-term interbank deposits relative to total assets (as opposed to its size) is paramount to explain the bank lending reaction to monetary policy. This is because of the existence of long-term lending relationships between the majority of German banks and their loan customers ("house-bank relationships"). Our results corroborate this view that the bank lending channel in Germany works through liquidity and not the size of the bank.

The estimates we obtain for Italy resemble those reported by Gambacorta (2003) using quarterly data over a pre-1999 sample with regard to the role of liquidity. In addition, we document a significant interaction between size and changes in the short-term interest rate since 1999.

Based on annual data over the period 1991-1998, Hernando and Martiniz-Pages (2003) find evidence for a bank lending channel working through liquidity in Spain. On the other hand, using monthly data on loan applications, Jiménez et al. (2011) conclude that the effects of monetary policy are stronger for banks of smaller size.

Our results suggest that on average over the 1999-2011 period policy interest rates have not affected credit growth in Spain and the bank lending channel was impaired.

As for France, Loupias, et al. (2003) employ annual data over the period 1993-2000 and find that, following a change in the interest rate, the reduction of loan growth in French banks with lesser liquid assets (relative to total assets) tends to be larger than the reduction in more liquid banks. We instead cannot find a bank lending channel for France.

7. POLICY CONCLUSIONS

The transmission of monetary policy in the euro area has been the focus of a comprehensive set of studies on pre-1999 samples undertaken by the Eurosystem Monetary Transmission Network, jointly by the European Central Bank (ECB) and the euro area National Central Banks (Angeloni, et al., 2003). This coordinated research effort has documented that pre-1999 an increase in interest rates tended to reduce loan growth in France, Germany, Italy and Spain. Moreover, they found that banks in these four countries with more liquid asset holdings showed weaker loan adjustments.

This paper studies a similar question using data post-1999, when the ECB was in charge of monetary policy in the euro area. Our findings suggest that heterogeneity in the transmission of monetary policy to banks' lending activities appears associated with heterogeneity across countries and across typologies of banks in the same country, while it is broadly homogenous within the bank typology group in each country.

Our findings also suggest that changes in the cost of funding engineered by monetary policy actions exert their maximum impact on cooperative and saving banks in Germany, especially those with lesser liquidity and lower capital, and saving banks in Italy, especially those with smaller size. Large commercial banks, on the other hand, appear more capable to isolate their lending activities from changes in monetary policy conditions. Small banks are best placed to refinance the real economy, in particular small- and medium-sized firms, which are the biggest generator of employment in the economy. The analysis suggests that the increase in the number of cooperative and savings banks that have access to the ECB standard and non-standard measures during the recent financial crisis is likely to improve the transmission mechanism of monetary policy in the euro area.

Another important policy issue is the evidence that monetary policy shocks had limited implications for the bank loans in Spain over the 1999-2011 period. The limited impact of interest rates on bank lending in Spain suggests that in a monetary union country-specific excessive growth of credit should be counteracted with instruments that limit the fall in lending standards during boom times.

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APPENDIX A: THE DATA

The data we use are commercially distributed through Bankscope, a comprehensive database provided by the rating agency Fitch Ibca containing detailed annual information on about 8,000 European banks, 14,000 North American banks and more than 6,000 banks from other areas around the world. The data cover the universe of banks in the four euro area economies we focus on. The global disclosure format provides consistent financial criteria standardised across countries and accounting standards. Each bank report contains detailed unconsolidated and/or consolidated balance sheets and income statements. Our results below are robust to using unconsolidated or consolidated data, so we only report estimates based on consolidated balance sheets. Our data are annual. Other databases, such as the SNL Financials or Thomson Reuters, provide quarterly data on banks' balance sheet, but only for the largest banks and they are very weak on historical information and coverage for non-listed banks. These alternative databases, therefore, are not really suitable to study the bank lending channel.

The specialization categories in the Bankscope database of relevance for our analysis are: (i) commercial banks, (ii) savings banks and (iii) cooperative banks. Thereby, we excluded (also because of the low number of observations for each country) real estate and mortgage banks, medium- and long-term credit banks, investment banks and securities houses, islamic banks, non-banking credit institutions, specialised government credit institutions, bank holdings and holding companies, central banks, and multilateral government banks.

Bankscope contains data from 1989 onwards. However, the coverage during the first half of 1990s is very limited. Furthermore, given our focus on the effects of monetary policy in the euro area, it makes sense to select a sample characterized by a homogeneous policy regime, as represented, for instance, by the transfer of responsibility for setting the area wide short-term interest rate from national monetary authorities to the European Central Bank. With this goal in mind, our sample begins in 1999 and ends in 2011, with the last observation reflecting data availability at time of writing.

More specifically, we employ four releases of data in electronic format so as to keep track of the balance sheets of merged and failed banks which are no longer reported in the new releases. By doing so we reduce the errors related to survivorship bias and to a spurious burst of credit growth that only reflect take-overs between banks.

To quantify the bank lending channel, we consider (i) size measured by the logarithm of banks' assets, (ii) liquidity measured by cash, interbank lending, reserves at central banks plus government securities divided by total assets and (iii) capital measured by banks equity capital and retained earnings divided by total assets. To ensure that the size of the coefficients is comparable across variables, we standardise individual characteristics across banks in each year. This implies that the parameters a_{2j} in equation (1) and α_{2j} in equation (5) below can be interpreted as a direct measure of

the overall monetary policy effect on loans, given that the average of the interaction terms is zero. Also, bank-specific variables are normalised relative to the cross-sectional average in each year, in an effort to remove low-frequency components. Loan loss provisions divided by total assets as well as return on equity, defined as net profits over a fiscal year divided by shareholders' equity, are also standardised.