Trusting the Bankers: A New Look at the Credit Channel of Monetary Policy*

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Abstract

To identify the credit channel we disentangle loan supply and demand shocks by using the answers from the confidential Euro area Bank Lending Survey and the U.S. Senior Loan Officer Survey. Embedding this information within a VAR model, we find that: (1) The credit channel of monetary policy is operational through the balance-sheets of both banks and non-financial borrowers, and for business, mortgage, and consumer loans. (2) The impact of a monetary policy shock on GDP growth is higher through loan supply than through loan demand, whereas the latter affects more inflation. (3) The bank lending channel is stronger than the balance-sheet channel for firms, whereas the latter is stronger for households. (4) During the recent financial crisis, bank capital and liquidity problems had a strong negative impact on GDP growth by reducing loan supply to businesses. At the same time, the current expansionary monetary policy stance has reduced output decline in the Euro area.

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Key words: Credit channel of monetary policy, Bank lending standards, Loan supply and demand, Bank lending channel, Balance-sheet channel, Credit crunch, Crisis.

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"The financial intermediary sector, far from being passive, is instead the engine that drives the boom-bust cycle... Fluctuations in the supply of credit arise from how much slack there is in financial intermediary balance sheet capacity... Variations in the policy target determine short term interest rates, and have a direct impact on the profitability of intermediaries." Adrian and Shin (2009), Handbook of Monetary Economics

"The global financial crisis that began in mid-2007 has illustrated that the intersection of banking, finance, and macroeconomics is as important as ever." Boivin, Kiley and Mishkin (2009), Handbook of Monetary Economics

"Much of the earlier macroeconomics literature with financial frictions emphasized credit market constraints on non-financial borrowers and treated intermediaries largely as a veil (see, e.g. BGG)." Gertler and Kiyotaki (2009), Handbook of Monetary Economics

1 Introduction

The dramatic events unfolding in the global economy over the last few years suggests that the financial sector – in particular the banking sector – is an important determinant of business cycle fluctuations. Europe, the U.S., and much of the industrialized world have experienced the worst financial crisis of the post-war. The global recession that has followed also appears to be the most severe of this era. There are multiple channels through which a financial crisis may affect the economy at large, but the main mechanism relates to the ability of the private sector to access the credit needed to fund investment and consumption. The restrictions in access to bank credit reflect banks' solvency and liquidity problems that impaired their ability and incentive to provide credit. At the same time, the worsened financial position of the non-financial borrowers (firms and households) constrains their ability to borrow, while loan demand may be weak due to the grim economic outlook.

The expansionary monetary policy stance of central banks in most developed countries has not only aimed at supporting investment and consumption demand, but also at countervailing the reduction of loan supply from banks. Therefore, in this environment, shedding light on the mechanisms linking monetary policy, credit and the macroeconomy becomes particularly relevant, not only for policy makers but also, as several articles in the forthcoming Handbook of Monetary Economics point out, for academia.

We empirically address the following set of questions: Does the stance of monetary policy affect GDP growth and inflation through bank loan supply? How important is this mechanism – the credit channel – compared with the (loan) demand channel? If the credit channel is active, how effective is the (non-financial borrower) balance-sheet channel compared with the bank lending channel? How do these channels differ between households

and firms? Finally, focusing on the current crisis, do problems in the banking sector linked to lack of solvency and liquidity of banks significantly reduce aggregate output?

Bank loan supply is shaped by the frictions stemming from the agency cost of borrowing not only between banks and their non-financial borrowers (firms and households), but also between banks (i.e. financial intermediaries) and their providers of funds (retail and wholesale depositors, other debt-holders and equity-holders) – see e.g. Holmstrom & Tirole, 1997; Stein, 1998; Diamond and Rajan, 2001; and Freixas and Rochet, 2008. Business cycle fluctuations influence bank loan supply by altering the severity of these frictions, via changes in the net worth and external finance premia of non-financial (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Bernanke, Gertler, Gilchrist, 1999; Matsuyama, 2007) and financial borrowers (Bernanke and Gertler, 1987; Bernanke, 2007; Gertler and Kiyotaki, 2009). At the same time, monetary policy may also affect aggregate output and prices by influencing loan supply – the credit channel of monetary policy (Bernanke & Gertler, 1995; Bernanke and Blinder, 1988 and 1992; Diamond and Rajan, 2006 and 2009; Bernanke 2007; Gertler and Karadi, 2009; Adrian and Shin, 2009).

The identification of the credit channel of monetary policy at the macro level faces at least two main challenges. The first identification challenge arises since a restrictive monetary policy shock reduces both demand and supply of loans by increasing directly the cost of lending and indirectly the external finance premium of non-financial borrowers and banks, reducing in turn aggregate output and prices. Observable credit aggregates do not necessarily convey precise information to disentangle the impact of changes in loan demand and in loan supply. In fact, following a monetary tightening, both the classical interest rate channel (through loan demand) and the credit channel (through loan supply) predict a decline in (new) loans, reducing in turn real output and prices (see also Bernanke, Gertler, and Gilchrist, 1996; and King and Plosser, 1984). In addition, the volume of loans are also affected by previously committed loans (no *new* lending), and bank loan demand may even increase after a monetary tightening to finance working capital or because of restricted access to market financing (see e.g. Bernanke and Gertler, 1995; Friedman and Kuttner, 1993), further complicating identification challenges. Finally, average loan spreads may not significantly increase after a monetary tightening because of a flight to quality from banks (Bernanke, Gertler and Gilchrist, 1996). Hence the composition of loans' portfolio changes as well, which implies that average spreads and loan volumes are not enough to disentangle loan supply and demand effects.

A second identification problem arises since financially constrained borrowers – typically more affected by monetary policy shocks – tend to obtain external funds from banks, whose lending decisions are also affected by monetary policy (Gertler and Gilchrist, 1994). This dependence makes it difficult to separate the (firm and household) balance-sheet

channel from the bank lending channel.[1]

In this paper, we disentangle loan supply and demand shocks using the answers from the confidential Bank Lending Survey (BLS) for the Euro area and the Senior Loan Officer (SLO) Survey for the U.S., where national central banks and regional Feds request from banks quarterly information on the lending standards that banks apply to customers and on the loan demand that they receive (from firms and households). The information refers to the actual lending standards that banks apply to the pool of all borrowers (not only to accepted loans), and therefore is essential in providing a means of separating loan supply from demand. Moreover the surveys contain information on the *factors* affecting banks' decisions on lending standards – factors related to bank balance sheet constraints, bank competition pressures, borrowers' outlook and risk of collateral.[2] This information can be used to identify loan supply shocks and also to disentangle the effect of the bank lending channel from the (non-financial borrower) balance-sheet channel.

Since lending standards and loan demand may react to – but also influence – business cycle fluctuations (Bernanke and Gertler, 1995), we embed this rich information on lending standards into an otherwise standard VAR methodology to account for the linkages between the credit and the business cycle (see Christiano, Eichenbaum and Evans, 1999).

In the Euro area there is a common monetary policy and some cross-country heterogeneity of the business and credit cycles. Therefore, we use a panel VAR including lending standards and loan demand from the BLS for each of the 12 countries which comprised the Euro area in 2002, the year when the BLS was launched. For the US we estimate a one-country VAR. Data availability dictate the time span estimation in both economies: 2002:Q4–2009:Q2 for the Euro area and 1992:Q3–2009:Q1 for the US.

For the identification of monetary policy shocks, we follow Bernanke and Gertler (1995), Christiano, Eichenbaum and Evans (1999), Angeloni et al. (2003), and Lown and Morgan (2006) and use the overnight rate as the monetary policy instrument. In response to the financial crisis in October 2008 the ECB relaxed its policy stance by reducing the policy rate but also by introducing a measure of credit enhancement (its main and almost unique measure of quantitative easing). In this framework the Eurosystem lends to banks through fixed-rate full-allotment liquidity auctions. The implementation of this policy brought the overnight rate (EONIA) significantly below the policy rate (Trichet,

[1] The available empirical evidence on the bank lending channel is not conclusive, and comprises both works supporting the bank lending channel (e.g., Kashyap and Stein, 2000; Peek and Rosengren, 1995, 1997), and works finding evidence in favour of a more conventional transmission mechanism (Romer and Romer 1990; Ramey 1993). For an exaustive and recent review of the empirical evidence on the transmission mechanism see Boivin, Kiley and Mishkin (2009).

[2] The available information related to the factors affecting banks' decisions is more comprehensive in the Euro area BLS.

2009, and ECB, 2009). Based on this observation we use the EONIA rate as the measure of monetary policy in the Euro area for the whole period.[3]

We contribute to the current literature in several dimensions. First, as remarked above, we disentangle loan supply from demand in a novel and direct way by using confidential information from banks on the lending standards applied to customers (both businesses and households) and on the loan demand received.[4] This strategy allows the identification of the monetary policy impact on aggregate output and prices through bank loan supply and, therefore, contributes to the literature on the monetary policy transmission (Bernanke and Gertler, 1995; Boivin, Kiley and Mishkin, 2009; Adrian and Shin, 2009). Second, the survey includes answers relative to the reasons behind banks' decisions to change their lending standards. We exploit this information and we use it to disentangle the effect of the bank lending channel and of the (non-financial borrower, firm or household) balance-sheet channel (Bernanke and Gertler, 1995; Diamond and Rajan, 2006; Gertler and Kiyotaki, 2009). Third, following up on the recent work by Den Haan et al. (2007), we show the differential effects on different loans (business, mortgage and consumer loans) and assess the importance of bank loan portfolio composition effects. Finally, we contribute to the emerging literature on the current crisis. By building up on the methodology used to analyze the transmission channels, we study how the different shocks have impacted aggregate output during the crisis by analyzing potential credit crunches, their real implications, and the effect of monetary policy measures (Diamond and Rajan, 2009; Gertler and Kiyotaki, 2009).

Three sets of results emerge from the analysis. First, the credit channel is operational. A monetary policy shock affects loan supply and a loan supply shock affects GDP growth and inflation. Results are significant for business, mortgage, and consumer loans, but

[3] For the sake of symmetry we consider the federal funds rate as the measure of monetary policy for the U.S., though the actions by the Federal Reserve in the current crisis were directed towards several markets and implemented through several different mechanisms (Bernanke, 2009, and ECB, 2009). Hence, for the U.S. the overnight rates may not be a complete measure of monetary policy stance. However, the main results we present in the paper are robust to considering the period up to September 2008.

[4] Lown and Morgan (2006) also analyze the information content of the SLO. However, they use only the answers from one of the questions of the survey on lending standards – namely changes in credit standards applied to C&I loans – and proxy loan demand by macro variables commonly used in the literature. Since they want to analyse the predictive power of lending standards, they use the whole history of the SLO survey and don't include the answers to questions related to the loan demand, which only started in 1991. They find that the credit standards predict future output and credit growth. Our work is distinct from their analysis in the objective that we want to achieve and in the analysis that we implement. Our objective is to test the credit channel of monetary policy. To this aim, we use several answers from the bank lending survey to fully exploit the information content. The survey includes questions on the factors behind the decision to change lending standards. We exploit this information and also the answers related to the loan demand.

there are differences in the size and timing of the impact. For example, a shock to the supply of business loans affects mainly aggregate output, whereas a shock to the supply of consumer loans affects more inflation. Once we separate the effect of tighter lending standards due to weak liquidity and capital position of banks from restrictions due to worsened borrower outlook and collateral risk, we find that both the bank lending channel and (the non-financial borrower, firm or household) balance-sheet channel are operational. However, changes in loan supply related to bank funding and solvency react faster to a monetary policy shock than changes in loan supply due to borrower outlook and collateral risk.

Second, we quantify the relative importance of the channels for different types of loans by analyzing the economic significance of the different impacts through variance decomposition analyses and appropriately designed counterfactuals. We find that the impact of a monetary policy shock on GDP growth is stronger if the credit channel is activated in the model. When considering business loans, a monetary policy shock affects GDP growth more through loan supply than through loan demand. Moreover, when we consider the credit sub-channels, our results suggest that the bank lending channel amplifies the effect on GDP growth more than the firm balance-sheet channel. The latter (and the loan demand channel), at least in the Euro area, have a higher impact on inflation. When considering loans for house purchase, our results suggest that the household balance-sheet channel is more important for monetary policy transmission for GDP growth and inflation than the bank lending and loan demand channels.

Third, a shock decomposition of the GDP growth over the current crisis suggests that a contraction of loan supply to businesses due to bank liquidity and solvency problems contributed to the decline of GDP growth in the Euro area. In the U.S., restrictions to the supply of mortgage loans are among the most important shocks to explain changes in GDP growth during the crisis period. The current expansionary monetary policy, at least in the Euro area, seems to be supporting GDP growth.

The rest of the paper is structured as follows. Section 2 describes the data used in the analysis focusing on the details of the Euro area BLS and the US SLO Survey, and reviews the empirical identification and the methodology. Section 3 presents and discusses the results. Section 4 summarizes the paper, discusses the policy implications, and concludes.

2 Data, identification and methodology

The key testable hypotheses from the theory of the credit channel of monetary policy transmission are the following:

1. A contractive monetary policy shock reduces bank loan supply, reducing in turn

aggregate output and prices.

2. The reduction works through both non-financial borrower (firm and household) balance-sheet strength and through the bank balance-sheet strength (bank lending channel).

The main identification challenges, as explained above, are:

1. Disentangle loan demand and supply shocks.

2. Disentangle the non-financial borrower (firm and household) balance-sheet channel versus the bank balance-sheet channel (bank lending channel).

In this section we explain how we deal with the two main testable predictions from theory, focusing in particular on the data which helps us meet the two main identification challenges.

Our identification strategy relies on the answers reported in the Euro area Bank Lending Survey (BLS) and in the U.S. Senior Loan Officer Opinion Survey (SLO). National central banks and regional Feds (similarly) request from banks quarterly information on the lending standards banks apply (including the reasons for changing them), and on the loan demand they receive. The economic interpretation of the answers reported in the surveys in terms of supply of and demand for credit follows naturally from the questions formulated. Bank supervisors request information on lending standards and loan demand directly to the banks and then cross-check the answers using additional sources. Therefore, *we trust the bankers* in their assessment of conditions of the lending standards that banks applied to firms and households, on the reasons (banks argue) for changing the standards (due to firm/household versus bank balance-sheet strength changes), and on the loan demand that banks received.[5] Our empirical strategy consists in embedding, within an otherwise standard VAR model, the rich information on loans, i.e. the panel of confidential answers aggregated by country for 12 Euro area countries and the publicly available aggregate answers for the US.

The following sub-sections describe in detail the data used in the analysis and the empirical methodology. In particular, Section 3.1 summarizes in detail the setup of the Euro area BLS. Section 3.2 summarizes more briefly the main characteristics of the U.S. survey since it has already been used in the literature (Lown and Morgan, 2006). Section 3.3 describes the aggregate variables we use from the BLS and SLO. Section 3.4 describes the other macroeconomic series used for the analysis. Finally, in Section 3.5 we illustrate

[5] See Lown and Morgan (2006) and De Bondt et al. (2009) for the respective predictive power of the surveys for output and credit growth in U.S. and the Euro area.

our empirical methodology. The identification strategy is common for all the countries of the Euro area. However, some differences are present between Euro area and U.S. due to the availability of data (see also the Appendix).

2.1 The Euro area BLS

The national central banks of the Eurosystem request a representative sample of banks in each country to provide quarterly information on the lending standards that banks apply to customers and on the loan demand that banks receive.[6] The survey contains 18 specific questions on past and expected (bank) credit market developments.[7] Past developments refer to lending standards applied and on the loan demand received over the past three months, while expected developments focus on what it is expected in the following quarter. Two borrower sectors are the focus of the survey: firms and households. Loans to households are further disentangled in loans for house purchase and for consumer credit, consistently with the classification of loans in the official statistics of the Euro area.[8]

The questions imply only qualitative answers and no figures are required. The answers are collected by the national central banks of the Euro area countries. Typically the questionnaire is sent to senior loan officers, like for example the chairperson of the bank's credit committee. The sample of banks is representative of the banking sector in each country. Therefore it comprises banks of different size, although some preference was given to the inclusion of large banks.[9] The analysis reported in this paper is based on the aggregate answers received from a sample of around 90 banks.[10] The response rate has been 100% almost all the time.

The scope and the coverage of the Survey have changed little since its inception. Concerning the questionnaire, the regular questions have been kept fixed throughout the sample. A number of ad-hoc questions were added at times to shed light on specific issues.

[6] Berg, van Rixtel, Ferrando, de Bondt and Scopel (2005) describe in detail the setup of the survey. Sauer (2009) and Hempell, Köhler-Ulbrich and Sauer (2009) provide an update including the most recent developments and the few changes implemented (request of additional information via ad-hoc questions). The survey was first used for research purposes in Maddaloni and Peydro (2009) and Maddaloni, Peydro and Scopel (2008).

[7] The Euro Area financial system is bank dominated, as shown by Maddaloni et al. (2004).

[8] This classification is somewhat different from the classification used in the US for the Senior Loan Officer Survey where mortgage loans are further disentangled in prime and subprime loans.

[9] As we have access to information on banks' size, an interesting hypothesis stemming from the bank lending channel is that the credit channel should be stronger for small banks. We postpone this analysis to future investigation.

[10] At the start, there were 87 banks answering the survey. This figure remained almost fixed until 2007, when Slovenia entered the euro area and Slovenian banks entered in the survey. Successively, in 2008, this figure reached 112 with the inclusion of Cyprus, Malta and an enlarged sample for Italy and Germany.

Since the answers to these questions are available only for few quarters, we do not use them.

The questionnaire covers both bank supply of and demand for loans. Concerning supply of loans, which are addressed in ten different questions, attention is given to changes in lending standards, to the factors responsible for these changes and to credit conditions and terms applied to customers – i.e., how much, why and how lending standards are changed by banks. Concerning demand of loans, there are mainly two questions, one related to the actual volume of loans from each type of borrower, and the other related to the factors affecting loan demand (e.g. investment, access to other sources of finance, etc.).[11]

The first set of questions ask about changes in lending standards for each type of borrower (firms and households, for house purchase and for consumption). Lending standards are the internal guidelines or criteria for a bank's loan policy (see Loan and Morgan, 2006, and Freixas and Rochet, 2008). Two different questions, referring to firms and households, are asking if banks changed lending standards over the previous quarter (or they expect to change them in the following quarter).[12] The successive set of questions give banks the opportunity to assess how specific factors affected their credit standards. In particular, whether the changes in standards were due to changes in bank balance-sheet strength, to changes in competitive pressures, or to changes in borrowers' creditworthiness. Finally, the last set of questions concerns which type of several terms and conditions of loans banks change – i.e. the different contractual obligations agreed upon by banks and borrowers, such as the interest rate, the loan collateral, size, maturity and covenants.

The Euro area results of the survey (which are a weighted average of the results obtained for each Euro area country) are published every quarter on the website of the ECB (www.ecb.europa.eu). In very few countries the aggregate answers of the domestic samples are published by the respective national central banks. However, the overall sample including all the answers at the country and bank level is confidential.

For the purpose of this paper we concentrate only on few questions from the BLS that we describe in detail in Appendix. Since we aim at identifying credit supply and demand shocks and the bank versus the firm/household balance-sheet channels of transmission, we concentrate on the questions related to how much lending standards change, which factors modify supply conditions, and on the loan demand received by banks. Moreover, since we are interested in actual lending decisions by banks and we are also comparing the results

[11] The factors that change loan demand also contain some useful information. An interesting hypothesis to check in future is whether the economic impact of the credit channel is stronger when loan demand increases, given the lack of access to other financing sources.

[12] In cases when foreign banks are part of the sample, the credit standards refer to the loans' policy in the domestic market which may differ from guidelines established for the headquarter bank.

obtained for the Euro area and the US (see section 2.2), we analyze the answers related to actual changes in lending standards over the previous three months and we do not use answers related to expected changes.[13]

To use a balanced panel, we restrict the analysis to the 12 countries which comprised the Euro area in 2002:Q3. The answers cover the period from 2002:Q4 to 2009:Q2. Over this period we consistently have quarterly data for 12 Euro area countries (Austria, Belgium, France, Finland, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain).

2.2 The Senior Loan Officer Survey

The Federal Reserve publishes every quarter the results of a survey on bank lending standards, the Senior Loan Officer Opinion Survey on Bank Lending Practices (SLO). The Survey covers both business and household loans.

The questionnaire focuses on supply of and demand for bank loans, but the focus is on past developments and there are no regular questions on expectations. Since 1990 the officers are reporting separately on lending standards for small and large firms (as well as demand). We generally use in our benchmark analysis the answers related to large enterprises.[14]

The current sample is composed of around 60 banks, usually the largest in each of the 12 Federal Reserve Districts. The Survey is conducted by the district Federal Reserve Banks involved. The response rate is virtually 100%. More information on the setup of the survey is in Lown and Morgan (2006). The results of the survey are available at http://www.federalreserve.gov/boarddocs/SnLoanSurvey.

Similar to the questions asked in the BLS, for business (C&I) loans, the SLO not only asks about how much lending standards change, but also on the factors that have determined the decisions of changing lending standards by banks. These factors are broadly related to bank balance-sheet positions, banking competition factors, and bor-

[13] The answers related to the factors which changed the lending standards applied by banks (i.e. why banks have tightened lending standards) further strengthen the identification of loan supply restrictions. These factors can be categorized in two main groups: (1) factors linked to the ability of banks to lend in relation with their balance sheet constraints and the competitive pressures; (2) factors linked to changes in borrowers' risk. In our setting the answers related to the first group of factors identifies "pure (loan) supply" restrictions and, therefore, the bank lending transmission channel. This information is useful not only to disentangle the bank lending channel from the firm/household channel, but also to strentghten the loan supply identification (over and above loan demand volume and quality).

[14] The series on lending standards for large and small enterprises have a correlation of 96%. The series on demand for loans from large and small enterprises have a correlation of 93%. For the Euro Area the general question on firms refers to all firms, but then one of the secondary questions refer to lending standards applied to large versus SME firms.

rower risk/outlook. Notably, the SLO contains a specific question on how bank tolerance for risk has affected lending standards decision, an information that is not reported in the BLS.[15] Unfortunately, and differently from the Euro area BLS, the SLO information on factors affecting changes in lending standards is not available for mortgage and consumer loans.[16]

The survey was introduced for the first time in 1967. Since then, however, the basic structure of the Survey has changed several times. Therefore the time series that can be used for a comprehensive econometric analysis using consistent information of the survey is considerably shorter. The questions related to the demand for business and households loans, moreover, were included in the survey in 1992:Q3. Therefore, this is the starting point of the series we use.[17] For the purpose of this paper we concentrate only on few questions from the SLO that we describe in detail in the Appendix.

2.3 Aggregate statistics for the BLS and the SLO

The questions asked in the Euro area BLS and in the U.S. SLO imply five possible replies ranging from "eased considerably" to "tightened considerably" for the questions related to changes in lending standards and from "decreased considerably" to "increased considerably" for the questions related to the demand for loans.

Following for instance Lown and Morgan (2006), we quantify the different answers by using *net percentages*. For changes in (total) lending standards and also for the changes in standards due to firm versus bank balance-sheet strength changes, the net percentage is the difference between the percentage of banks reporting a tightening of lending standards and the percentage of banks reporting a softening of standards in each country (total change, change in bank balance-sheet strength, or change in firm/household balance-sheet strength). A positive value, therefore, implies that there has been a *net* tightening of standards. For changes in the demand for loans, the net percentage is the difference between the percentage of banks reporting an increase in the demand for loans and the percentage of banks reporting a decrease. In this case a positive figure indicates a *net* increase in the demand for loans.[18]

[15] This information can be interpreted as a direct measure of banks' appetite for risk in lending behaviour in the US. While the BLS for the Euro Area does not provide directly a measure for banks' risk appetite, the richness of survey information allow to extract this measure indirectly by controlling for the other factors and by analysing the terms and conditions of the loans (see Maddaloni and Peydró, 2009).

[16] In addition, some of the questions about the factors affecting changes in lending standards were added only in recent years, which further restrict the use of these answers over the entire time series for the SLO.

[17] Questions related to the demand for consumer loans were included only in 1995Q4.

[18] The use of this statistic implies that no distinction is made for the degree of tightening (easing) of lending standards in the replies (similarly on the degree of increase in the demand for loans). This issue can be addressed using diffusion indexes. A simple way of calculating these indexes consists for example in

The respondents of the survey assess at the same time supply and demand conditions in the banking market and, therefore, their answers are likely to be highly (negatively) correlated. However, a simple correlation analysis of the answers related to supply and demand of credit at the bank level show that they are not perfectly correlated and the correlation is particularly low when we chose the appropriate answers for identification. The charts in Chart 1 clarify this issue. The three graphs report the correlation between total loan demand and (i) total supply (changes in overall lending standards for firms), (ii) supply factors related to borrowers' risk (economic conditions and risk/outlook of firms) and (iii) "pure supply factors" (factors related to banks' balance-sheet strength and to competitive pressures). Both for the U.S. and for the Euro area the correlation between loan demand and supply of credit identified through the survey answers decreases dramatically when supply is identified via "pure supply" factors – i.e., stemming from the bank lending channel. In these cases the correlations are never higher than 40 percent.[19]

2.4 Macroeconomic data

In addition to the loan information from central banks, we include in the analysis three additional variables: aggregate output, prices and monetary policy rates. The output variable is the four-quarter growth rate of real GDP for each country of the Euro area and for the US. Developments in prices are proxied by the four-quarter growth rate of the GDP deflator. Finally, the monetary policy interest rate is the overnight money market rate (EONIA) for the Euro area and the federal funds rate for the US. In the US the fed funds rate has been extensively used as an indicator of the stance of monetary policy (see for example Bernanke and Blinder (1992), Bernanke and Mihov (1997), Christiano, Eichenbaum and Evans (1999) and den Haan (2007)). In the Euro area the Governing Council of the ECB determines the corridor within which the EONIA rate can fluctuate. Therefore, this rate is a measure of the stance of Euro area monetary policy.

It is important to notice that after September 2008 the ECB has not only reduced the policy rate but also introduced its main, and almost unique, credit enhancement measure which has been lending to banks through fixed-rate full-allotment liquidity auctions, which in turn has made the overnight rate (EONIA) to be significantly lower than the policy

weighting by 0.5 the percentage of banks answering that they have tightened somewhat (eased somewhat) and in weighting by 1 the percentage of banks that have tightened considerably (eased considerably). A similar weighting scheme can be applied to the answers concerning demand for loans. The results obtained using diffusion indexes do not differ qualitatively from the results obtained with net percentages and, therefore, we do not report them since they also imply a certain level of discretion when choosing the weights.

[19] For the US SLO it is not possible to do all these correlations for household loans. For the Euro Area results are similar for loans to households.

rate (ECB, 2009). We, therefore, continue considering EONIA as the measure of monetary policy in the Euro area for the whole period, even for the post September 2008 period. For the sake of symmetry we consider the federal funds rate as the measure of monetary policy for the U.S., even though the actions taken by the Fed in the current juncture have been very wide (Bernanke, 2009, and ECB, 2009), thus making the U.S. overnight rate a potentially incomplete measure of the monetary policy stance. Our main results remain robust to a sample ending in September 2008.

As a robustness check, in non-reported analysis we have also used the 3-month Euribor rate and the overnight interest swap rate on EONIA and on OIS. The 3-month Euribor is an interbank rate and therefore reflects also a component of credit risk. On the other hand, the OIS rate is a proxy of expectations of monetary policy, but it may also be affected by liquidity in the swap market. These measures carry also additional information compared with the overnight rates and, therefore, the results obtained may be more difficult to interpret.

At first instance, we have also included in the VAR the volume of loans as in Lown and Morgan (2006) or Den Haan et al. (2007). However, the use of both loan demand and supply proxys from the lending surveys with their detailed classification and richness of the information make the volume of loans redundant in the specification. In these (non-reported) estimations, shocks to what we identify as loan demand and supply for all categories have always the correct impact on the respective actual loan variables without substantially modifying the results related to other variables.

2.5 Empirical methodology

We embed the rich information on lending standards and demand within an otherwise standard vector autoregressive (VAR) model:

$$Y_t = A(L)\, Y_{t-1} + \varepsilon_t \tag{1}$$

where $t = 1, .., T$ denotes time, Y_t is an m–dimensional vector of endogenous variables, $A(L)$ is a matrix polynomial of order p in the lag operator L, and ε_t is a vector of white noise residuals. $Y_t = [Y_{1t}', r_t, Y_{2t}']'$ where Y_{1t} is a $(k_1 \times 1)$ vector with elements whose contemporaneous values are in the information set of central bank, r_t is the monetary policy rate, i.e. the federal funds rate for the US and the EONIA rate for the Euro area, and Y_{2t} is a $(k_2 \times 1)$ vector with elements whose contemporaneous values are not in the information set of the central bank.

While for the U.S. the available time series cover almost twenty years of quarterly observations (1992:3-2009:2), for the Euro area the sample is rather short (2002:4-2009:2), and any model estimated at the aggregate level may produce highly imprecise estimates.

Therefore, for the Euro area we estimate a VAR on a panel data set from the 12 countries comprising the Euro area in 2002, with a fixed-effects approach. This allows to pool diverse information from all countries, while controlling for heterogeneity in the constant term.[20]

In all specifications, the vector Y_t is composed of three sets of variables: the macroeconomic variables (GDP growth and inflation), the credit variables and the monetary policy rate. Given that the literature on the credit channel started mainly only looking at business loans and given the differences in availability of data between the US SLO and the Euro area BLS, we consider four models, which differ on the credit variables they use. In particular:

- Model 1: the credit variables include only changes in total demand and total supply of loans to non-financial corporations
- Model 2: the credit variables include total demand and total supply for all loan categories, i.e. non-financial corporations, mortgages and consumer credit
- Model 3: total demand, pure supply (bank lending channel) and borrower risks relative to non-financial corporations only (firm balance-sheet channel)
- Model 4: total demand, pure supply (bank lending channel) and borrower risks relative to all loan categories (firm and household balance-sheet channel)

The benchmark specification is used for the sake of comparability with the previous literature (see, in particular, Lown and Morgan, 2006). The remaining models help qualify the various components of the credit channel.[21] All VAR specifications include one lag for each variable.

For the identification of the monetary policy shock, we follow a standard approach (see for example Christiano, Eichenbaum and Evans, 1999). Unlike the previous literature, however, which typically orders the credit variables after the policy rates in the VAR and includes the credit variables in the Y_{2t} vector, we assume that the monetary authority responds to all contemporaneous (i.e. quarterly) information. This identification of the monetary policy shock takes into account the forward looking character of the survey. It assumes that when deciding on the policy rate central banks not only observes current

[20] Even though there is no official CEPR dating of the Euro Area business cycle after the 1990s, the Euro Area four-quarter growth rates of GDP shows the features of a complete cycle from 2002 to 2008. Heterogeneity across countries are nevertheless sufficient to ensure reliable estimates from a panel strategy, while ex-post tests do not reject our common slope assumption in the panel. Hence, there is enough heterogeneity in the Euro Area to exploit a panel but not so much that prevents pooling.

[21] Note that Model 4 is estimated only for the Euro Area, whereas for the U.S. we limit our extended analysis to Models 2 and 3 as the US SLO does not dispose of all the needed detailed information.

output and prices, but also the current responses of loan officers. Therefore, all these variables do not change at time t in response to a time t policy shock, and the policy rate is ordered after both the macro and the credit variables.[22] Nevertheless, we conduct several robustness checks using different ordering of variables in Y_t and the results we obtain are robust to the different specifications.

For the identification of the credit shocks, as already remarked at the beginning of this section, we *trust the bankers* and interpret their assessment as truthfully reflecting conditions in the bank credit market. Consequently, we interpret an innovation to credit standards as a (negative) shock to loan supply, and an innovation to the answers related to the demand factors as a (positive) shock to loan demand. Supply is ordered after demand following the assumption that restrictions to the supply of loans do not affect contemporaneous demand for loans. We interpret an innovation to change of credit standards due to banks' changes in balance-sheet strength and competition as the bank lending channel measure, and an innovation to change of credit standards due to firms' (households') changes in balance-sheet strength the firm (household) balance-sheet channel measure. All the results are quite robust and generally invariant to different ordering of these credit variables.

3 Results

We present the results in three main subsections. First, we analyze the full dynamics of the credit channel. We discuss the responses of the system to three shocks – monetary policy, loan demand and loan supply. Moreover, we perform some counterfactual experiments to validate the existence and strength of the credit channel of monetary policy transmission, and quantify the relative importance of loan demand and supply. Second, we focus on the existence and relevance of sub-channels of the credit channel: the bank-lending and the (non-financial borrower) firm and household balance-sheet channels. Also in this case we run counterfactual experiments to quantify the relative contribution of the different sub-channels. Finally, building on the methodology developed, we perform a shock decomposition during the crisis period (2007Q3-2009Q3). Based on this analysis we can assess the implications of the credit channel during the current crisis.

To address the issues outlined above, the analysis is performed using different specifications of the VAR model including different credit variables (see Section 3). The results are presented by means of impulse response functions. All the responses shown are normalized by dividing for their innovation variances. Therefore they can be compared on

[22] The choice of this ordering is especially justifiable in the Euro Area, where the monetary policy strategy is based on a two-pillar approach and explicitly takes into account information from credit aggregates.

a single scale. We show the median response along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms (see e.g. Kadiyala and Karlsson, 1997). The panel VAR for the Euro area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in section 3.

3.1 The dynamics of the credit channel

In this section we discuss the existence of a credit channel of monetary policy and its importance in the transmission of shocks. First we look at the impact of a monetary policy shock on loan supply and demand. Next, we assess the effect of a loan supply shock on the real economy and prices. Finally, we assess the impact of a monetary policy shock via the credit supply on aggregate output and prices through counterfactual analysis.

3.1.1 Loans to non-financial corporations (Model 1)

We start by considering only information from the banking surveys related to loans to non-financial corporations (NFC) and we use only total loan demand and total lending standards (supply). This is Model 1, as described in Section 3. With this specification our results can be compared with the results obtained by Lown and Morgan (2006), who have used the answers from the SLO, and most of the results of the literature on the credit channel, which has mainly focused on business loans only (see Bernanke and Gertler, 1995; and Bernanke, Gertler and Gilchrist, 1996, and the references cited therein).

Figure 1A shows the response of the demand for and of the supply of NFC loans – as proxied by the correspondent responses from the BLS and the SLO – to a one-standard deviation monetary policy shock. Demand for loans declines in response to an increase of the short-term interest rate in both economies. Loan supply is restricted when monetary policy is tightened (a higher value for loan supply means tighter credit standards).[23] In the Euro area the restriction to loan supply due to a monetary policy shock is significantly higher than the decline in loan demand, suggesting that monetary policy affects loan supply more than demand for loans. In the US, the opposite happens and loan demand is affected more than loan supply. Another important finding is that loan supply restrictions in response to a monetary policy shock are significantly stronger in the Euro area than in US, even despite that the increase in basis points of overnight rates in US is significantly higher than in the Euro area.[24]

[23] The results for the US are similar to Lown and Morgan (2006).

[24] A one-standard deviation shock corresponds to an increase of the short-term interest rate of around 60 basis points in the U.S. and of 30 basis points in the Euro area.

Figure 1B shows the responses of GDP growth and inflation to a shock to the bank credit variables (demand for and supply of business loans). A positive shock to credit supply (net tightening) implies lower GDP growth and lower inflation in Euro area. A negative shock to demand has similar effects. In the US the direction of the impacts is similar, but only a tightening of loan supply to NFC has a significant effect on GDP growth, whereas the other effects (on prices and from a loan demand shock) are not statistically significant at 90%. However, the reduction of GDP growth due to a restrictive loan supply shock is significantly stronger in the US than in the Euro area.

All in all these results suggest that a credit channel of monetary policy transmission is active in both economies. Tighter monetary policy restricts bank loan supply to NFC. In turn, lower credit supply reduces both output growth and inflation. We take a next step and quantify the relevance of the credit channel for the transmission mechanism. In particular we would like to address the following questions: (i) Do credit variables amplify the effect of a (tight) monetary policy shock on GDP growth and inflation? (ii) If yes, what is the mechanism through which the amplification works? In other words, is this amplification due to the induced changes in loan demand, in loan supply or in both?

We answer these questions with simple counterfactual experiments. In Figure 1C we compare the response of GDP growth and inflation to a monetary policy shock in a situation when both the loan demand and supply channels are activated (blue line) with the responses obtained when the channels are closed down (black line).[25]

Loan supply is important in amplifying the transmission of a monetary policy shock on output and prices in both economic areas. The impacts on the variables of interest (GDP growth and inflation) in a system where the loan supply has been closed down (the counterfactuals) are significantly different in magnitude and timing from the full responses. The impact of a shock of monetary policy on GDP growth through credit supply is high in the Euro area. These results underline the importance of bank loans for the financing of the private sector in the Euro area, as opposed to the US, where other financial intermediaries and financial markets play a more important role in this matter (see Allen et al., 2004).

The results when the loan supply channel is shut down are quantitatively in line with the previous literature analyzing the impact of monetary policy shocks on macroeconomic variables. The GDP response is significantly negative and remains negative for almost four years (the x-axes measures quarters). It displays the usual hump-shaped dynamics with a peak occurring between one and two years in both economic areas. The response of inflation shows a short-lived but not significant price puzzle, a result common to most related

[25] The blue lines are the responses in a system where all the channels are active. The black lines are computed from a system where the supply or demand channel has been closed down, i.e. where coefficients of supply or demand in all equations have been set to zero.

literature (see Christiano et al., 1999; or den Haan et al., 2007; Altavilla and Ciccarelli, 2009). Hence, the results suggest that monetary policy shocks have a significantly higher impact on aggregate output and prices, when the loan supply channel is considered. Note finally that the results are robust to the exclusion of the crisis period from the estimation sample. We have performed the same analysis over a shorter sample up until the second quarter of 2008, such to exclude the bankruptcy of Lehman Brothers and results do not point to a weaker credit channel.

3.1.2 NFC, mortgage and consumer loans (Model 2)

Business loans are only a fraction of bank loans and, as already pointed out by Bernanke et al. (1996), there are reasons to believe that the credit channel may be more relevant through mortgage and consumer loans than through business loans. In addition, Den Haan et al. (2007) point out the importance of the whole portfolio allocation of bank loans when analyzing a monetary tightening, as the volume of loans to different borrowers (business, consumer and real estate) may react differently to a short-term interest rate shock because banks strategically decide to reallocate their loan portfolio when monetary conditions change.

To take these issues into consideration, we include in the VAR specification the demand and the supply for the different types of loans (business, mortgage and consumer loans) as in the specification of Model 2 (see Section 3). In the US SLO the information on consumer loans is available only from 1996, which greatly reduces the time series available for the analysis. As a result, the estimation results obtained for the US tend to be less robust. Therefore we show the impulse responses obtained when including only business and real estate loans in the VAR specification for the US.

Figure 2A shows the responses of loan demand and supply to a monetary policy shock for all types of loans in the Euro area and in the US. The level and timing of loan supply reduction is significant and similar across different type of loans, whereas there are differences in the responses of loan demand. In the Euro area the reaction of loan demand for mortgages is stronger than for other loans, whereas in the US the response is not statistically significant. This may, at least in part, reflect different institutional characteristics of the mortgage credit markets. For instance, other (non-bank) financial intermediaries are important providers of mortgage loans in the US while this is not the case in (most) Euro area countries; the ratio of fixed to variable loan rates is different in the two economies; conditions for refinancing mortgage loans tend to be more favorable in the US compared to (most) Euro area countries.

These results suggest that the responses to a monetary policy shock of volumes of different kind of loans as reported in den Haan et al (2007) with US data may reflect

changes in loan demand more than in loan supply. In the results of den Haan et al (2007), a monetary tightening has a dampening impact only on real estate and consumer loans. Our results, instead, suggest that while the responses to a monetary policy shock across different type of borrowers differ somewhat in size and in timing, the direction of the shock is the same for all type of loans. These differences are likely to reflect the different identification strategy for loan demand and supply that we use in our study.

The next step is to analyze the impact of shocks on GDP growth and inflation to the supply of loans. Figure 2B plots the responses of these variables to a tightening of the supply of credit in the Euro area and in the US. A restriction to the supply of loans dampens GDP growth in both economies, with responses to NFC and mortgage loans being more significant than those to consumers' credit, possibly as a consequence of the relatively low importance of this segment of the credit market in most Euro area countries. It is interesting to note that the response of GDP growth is stronger to shocks to NFC loan supply (both in the US and in the Euro area), and mortgage loan demand (Euro area). On the other hand, the impact on inflation is more subdued. In the US this may be related to the high uncertainty surrounding the estimates in this specification. In the euro area a loan supply shock for mortgage and consumer loans dampens inflation almost immediately, whereas a restriction to supply of loans to NFC has a stronger but more delayed impact.

Counterfactual analysis All in all the results presented so far show that tighter monetary policy restricts bank loan supply to all type of borrowers both in the US and in the Euro area, albeit with some differences in the intensity and in the timing of the impacts. In turn, restrictions to loan supply significantly reduce output growth and inflation. This first evidence, therefore, suggests that a credit channel of monetary policy transmission is active and works through all the lending channels (loans to different borrowers).

As we have done for Model 1, we now quantify the relevance of the credit channel in a framework where all the different classes of borrowers are taken into account. In addition to the questions we have addressed using Model 1, the specification of Model 2 raises two additional issues. First, we can check which borrower category is more relevant for the transmission of monetary policy shocks. Second, as restrictions to loan supply may affect GDP growth and inflation by dampening loan demand (which in turn amplifies the impact on the economy), we can also check the relevance of this *indirect* channel.

The analysis is carried out using counterfactual experiments. We address the first question by looking at the impact on GDP growth and inflation of a monetary policy shock when the demand and the supply channels for each type of loans as closed down. The results are shown in Figure 2C, where we compare the dynamics of the responses of

output growth and inflation to a monetary policy shock (blue line) with counterfactual of responses of the same variables obtained when closing down either the loan supply or the loan demand for each type of loans (black line).[26]

The figures show that in the Euro area a monetary policy shock has a high impact on GDP growth through mortgage loan demand and supply, and through NFC loan supply, whereas in the US supply (of both business and mortgage loans) seems to matter more than demand. For inflation, both channels (demand and supply) seem to be important across all loan categories. Consumer loans, which do not matter for the transmission of a monetary policy shock to GDP growth, are somewhat relevant for the transmission of the shock to inflation.

Finally, in Figure 2D we check the *indirect* channel of monetary transmission. The figures show the results of counterfactual experiments where the full-system impact of a credit tightening (shock to supply) on output growth and inflation is compared with the responses of the same variables when closing down the demand channel. The evidence indicates that the tightening of bank loan supply has a significant direct impact on GDP growth, while the indirect effect working through the decline of loan demand is small, especially in the Euro area. At the same time, the effect of the credit channel on inflation depends strongly on the effect that loan supply restrictions have on loan demand especially in the US.

3.2 Firm and household balance-sheet versus bank-lending channel

In this subsection we disentangle the two main sub-channels of the credit channel of the transmission of monetary policy. In particular, we assess the relative importance of the mechanisms of transmission of monetary policy shocks through the balance sheets of banks and borrowers (the bank lending channel and the non-financial borrower balance sheet channel).

To identify these channels we use the rich information provided by the surveys, in particular the answers related to the *factors* (reasons) inducing banks to change their credit standards to firms and households. We categorize these factors in two broad sets. The *pure supply* factors are related to the capital and liquidity positions of the banks, their ability to access market financing and to the competitive pressures in the banking sector. These factors affect the *ability* and *incentives* of banks to grant loans for a certain quality of the borrowers. Therefore, these factors provide a measure of the importance of the bank lending channel. The current financial crises has emphasized the need to understand deeply these mechanisms in light also of the policies put in place to support

[26] As before, the black lines are computed from a system where the supply or demand channel has been closed down, i.e. where coefficients of supply or demand in all equations have been set to zero.

the banking sector (see e.g. the forthcoming chapters in the Handbook of Monetary Policy, in particular Adrian and Shin, 2009; Boivin et al., 2009; and Gertler and Kiyotaki, 2009).

The factors related to the *borrowers' quality* are instead linked to the outlook for firms and households and to the quality of their collateral. Therefore, they are more related to the *willingness* of banks to lend to borrowers with different risk profiles, hence reflecting different agency problems (see Bernanke, Gertler and Gilchrist 1996 and 1999). We use these factors as indicators of the relevance of the (non-financial borrower) balance sheet channels.

Note that in this context there is an important difference between the two bank lending surveys. In the Euro area BLS there is information on the reasons why banks have changed lending standards both for business and household loans, whereas in the US SLO this information is available only for business loans. As a consequence, we can analyze the household balance-sheet channel only for the Euro area. In the next subsections, we first analyze the firm balance-sheet channel and the bank lending channel for both the US and the Euro area (Model 3). Next, we analyze the household and firm balance-sheet channels for the Euro area and we compare their strength with the bank lending channel (Model 4).

3.2.1 Firm balance-sheet channel and bank lending channel (Model 3)

Figure 3A shows the responses to a monetary policy shock of demand and supply of corporate loans in the Euro area and in the US. The response of loan supply is further disentangled between the effect working through the bank lending channel and the firm balance-sheet channel. In the Euro area a monetary tightening reduces loan supply through the bank lending channel (pure supply, i.e. banks tighten the standards because of bank balance sheet constraints and competitive pressures) and the firm balance-sheet channel (borrower's quality, i.e., banks tighten their standards because of worse firm risk, outlook and collateral). The responses are significantly estimated and show a comparable positive impact (tightened credit standards) peaking at around four to five quarters. In the US, responses are subject to a higher degree of uncertainty. Nevertheless the estimates show that the impact of a monetary tightening affects significantly the bank lending channel at 68%, while the response of factors related to firms' quality is generally not significant. There are also some differences in the timing of responses between the two economies. The impacts in the Euro area peak at slightly longer horizons than in the US, though qualitatively the dynamic of the responses is similar, with pure supply peaking slightly earlier than firm's quality in both economies.

Figure 3B plots the responses of GDP growth and inflation to a shock to bank pure supply and firms' quality factors for the Euro area and for the US. In the Euro area the

two loan supply channels are significantly affecting GDP growth and – to a lesser extent – inflation, with a comparable lag: the responses of output growth peak between three and four quarters, whereas the responses of inflation reach a maximum approximately after five to six quarters. In terms of magnitude, the impact on GDP growth and inflation of shocks to the pure supply (bank lending) channel is on average twice as big as the effect of shocks to firm's quality.

In the US only shocks to the firm's quality (firm channel) have a significant impact on GDP, while the responses to the bank pure supply factors are not significant. This difference between the responses in the Euro area and in the US may reflect differences in the banking structure of the two economies. In particular, the corporate sector in the US is less reliant on bank loans, and thus restrictions of firms' access to bank credit may have a lower impact on GDP growth (see Allen et al., 2004).

Overall, these results confirm that both a firm balance-sheet and a bank-lending channel play a significant role in the transmission mechanism in the Euro area and in the US at least concerning the impact on GDP growth. To further investigate and better quantify the relative importance of the two channels, we use counterfactual experiments, similar to the ones performed in the previous sections. We analyze which factors amplify more the responses of output growth and inflation to a monetary policy shock. Figure 3C shows the results of this analysis. Note that in the Euro area the effect on GDP growth of a monetary policy shock is amplified more by the mechanisms of the bank lending channel (pure supply factors) compared to the effect working through firm's quality (balance-sheet channel) or through loan demand; the effect on inflation is instead higher through the borrower's quality and the loan demand channel. On the other hand, in the US the firm balance-sheet and loan demand channels are more important both for GDP and inflation.

The results on the bank lending channel give support to the somewhat different policies that were put in place during the current crisis. In the US the central bank has implemented policies directed to support both banks and firms (e.g. in commercial paper), whereas in the Euro area interventions have mainly targeted banks (e.g. the credit enhancement of the ECB).

3.2.2 All subchannels including the household balance-sheet channel (Model 4)

In the last VAR specification considered, we include loan demand, pure supply and borrower's quality factors for loans to all borrowers: firms, mortgages and consumer loans. This specification (Model 4 in section 3) is used to analyze the importance of the transmission channels working through the balance sheet of banks and non-financial borrowers (banks, firms and households, respectively). As observed earlier, we can do this analysis

only for the Euro area since we have information from the BLS on whether changes in lending standards for households (either for house purchase or for consumption) are due to changes in bank pure supply factors (bank capital, liquidity and competition) or in households' quality (outlook and risk of collateral).

Figure 4A shows the responses of loan demand and loan supply to firms and households to a monetary tightening through the bank lending and the non-financial borrower balance-sheet channels. A monetary tightening reduces loan supply through the bank lending channel (pure supply) and also through the firm and household balance-sheet channels. The responses are significant and show a comparable positive impact (tightened credit standards) with peaks around four to five quarters and similar magnitudes. The responses are broadly similar across type of loans.

Figure 4B shows the responses of GDP growth and inflation to shocks to loan supply for firms and households (through the bank lending and the firm/household balance-sheet channels). Concerning the impact on GDP growth, the results relative to the firm bank lending channel (i.e. pure bank supply restrictions to firms) are similar to what shown in Figures 3A to 3C. The supply for consumer loans is not very relevant. For loans for house purchase the household balance-sheet channel is more important than the (household) bank lending channel. This implies that shocks to the supply of mortgages are relevant for GDP growth because of mechanisms working through households' quality channels, consistently with Bernanke et al. (1996), who point out that households may be more financially constrained due to human capital inalienability (see also Hart and Moore 1994), implying that monetary policy has stronger effects through household loans.

The results for inflation suggest also a difference across lending markets. The impact on inflation is more significant for business loans through the bank lending channel. On the other hand, credit to households affects inflation by channels working through borrower's quality and demand. These results may have interesting policy implications. Policies aimed at sustaining aggregate demand and improving balance sheet of non-financial borrowers may be more effective in supporting the credit markets for mortgages. However, they may also have more impact on inflation.

To assess the relevance of the different channels of transmission of credit supply we run a counterfactual analysis as done in the previous sections (Figure 4C). All in all the results confirm that in terms of impact on GDP growth, the bank lending channel is more important for firms and the household balance-sheet channel is more important for mortgage loans. On the other hand, demand for business and consumer loans and household balance sheet channel for house purchase generates more significant effects on inflation.

3.3 The financial crisis

In this section, the VAR methodology is used to analyze the relative importance of different shocks during the financial and economic crises and to shed some light on the relationship between the financial sector and the macroeconomy (in crises periods). Specifically, we assess the role played by the impairment of the financial sector and the consequent credit crunch on the economy and also the effectiveness of monetary policy interventions – namely overnight interest rates cuts.

We report in Figure 5A a shock decomposition for both economies using the specification of Model 2. The bars in the charts represent the effects at time t of innovations to other variables which explain movements in the variables of interest.[27]

In the Euro area, apart from the own shocks, changes in GDP growth were mostly affected by restrictions of bank loan supply to business loans. Therefore, the impairment of the financial sector due to the crisis seems to have affected primarily business loans (which on average have shorter maturity) and this, in turn, had a negative impact on GDP growth. In the last quarters also the decline in demand for loans for house purchase reduced significantly output growth. This is consistent with a deteriorating outlook for the real economy which dampens demand for loans from the household sector. At the same time, monetary policy shocks (primarily policy rate cuts but also indirectly the full allotment policy) have supported GDP growth, which presumably would have been lower if an accommodative monetary policy stance had not been put in place.[28] The policies aimed at sustaining bank's liquidity may have partly relaxed the liquidity position of banks and been conducive to less tight lending standards than otherwise.

The same analysis for the US yields qualitatively different results. Apart from "own shocks", restrictions to the supply of mortgage loans are among the most important shocks to explain changes in GDP growth over the period 2007Q3-2009Q2. Restrictions to the supply of business loans are also important. At the same time, monetary policy shocks play an almost neutral role. These results may be due to differences in the structure of the financial system between the US and the Euro area, but also to our identification strategy. Concerning the latter, the Fed has engaged in a diversified and multifaceted strategy of non-conventional monetary policy measures, aimed at supporting not only the financial sector (by increasing the number of financial institutions, and the quality of collateral, which could draw on central bank liquidity) but also the corporate sector, for example by buying commercial papers. This may partly explain why restrictions to business loans

[27] The decomposition is technically performed by estimating the VAR, projecting the variables of interest over the crisis sample (2007Q3-2009Q2), and decomposing the difference between the realised and the projected values in the sum of the innovations to all variables. See, e.g. Doan (2009) for more details.

[28] As explained in Section 3.4 the level of EONIA rate embeds also the effect of the full allotment policy.

play a minor role than in the Euro area, and why shocks to the Fed funds rate may not be able to capture fully the importance of a monetary policy shock.

Finally, we investigate the relative importance of all the channels of loan supply. Figure 5B shows the shock decomposition using Model 4 for the Euro area (no comparable data are available for the US). Apart from the own shock, the most important shock affecting negatively GDP growth are loan supply restrictions to firms due to banks' balance-sheet weaknesses, i.e. the bank lending channel. This suggests that problems in bank capital and liquidity significantly reduced GDP growth before and during the crisis, and hence that the financial crisis has contributed to generate the economic recession.

4 Concluding remarks

Most developed countries around the world have experienced the worst banking crisis of the post-war period. The global economic recession that has followed also appears to be the most severe of this era. The role played by the banking sector in affecting the macroeconomy, in particular through the supply of credit to the private sector, has become a central issue of concerns for academics and policy makers alike. The issues of interest revolve around three main questions: (i) whether problems to liquidity and capital position of banks affect their lending decisions; (ii) whether this, in turn, has an impact on aggregate output and inflation; and (iii) whether and how monetary policy impulses are transmitted to the rest of the economy, in particular through the banking sector. Our objective in this paper is to test the credit channel of monetary transmission and to explore the dynamics of credit during the current crisis.

There are two key identification problems that the empirical literature on the credit channel has to face: (i) disentangling of loan demand and loan supply; (ii) the separation of the mechanisms related to the bank lending and the (non-financial borrower) balance-sheet channels. Our identification strategy is based on the use of the answers from the confidential Euro area Bank Lending Survey and the U.S. Senior Loan Officer Survey. National central banks of the Eurosystem and regional Feds carry out these surveys to gather quarterly information on the loan demand that banks receive and on the lending standards that banks apply to firms and households, including the *factors* affecting banks' decisions to change their lending standards.

Our results suggest that the credit channel is broadly operational for all type of channels and loans. Moreover, the impact of a monetary policy shock on GDP growth is higher through loan supply than through loan demand, whereas the latter affects more inflation. In addition, the bank lending channel amplifies the effect on GDP growth more than the firm balance-sheet channel both in the Euro area and in the US. At the same time, the firm

balance-sheet channel and the loan demand channel have a larger impact on inflation (at least in the Euro area). Finally, the household balance-sheet channel is more important than the bank lending channel for *mortgage* loans.

In the last part of the paper we also address the important question whether the strong evidence we find for the credit channel is due to our identification of loan demand and supply or to the current crisis. A shock decomposition of GDP growth during the crisis period suggests that a key factor is the restriction of loan supply to businesses due to bank liquidity and solvency problems in the Euro area. In the U.S., restrictions to the supply of mortgage loans are among the most important shocks to explain changes in GDP growth during the crisis period. Finally, our analysis suggests that the policies of central banks based on very low interest rates and measures aimed at relaxing banks' balance-sheets constraints have been providing a significant support to the real economy.

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Appendix

Bank Lending Survey (BLS)

1. Questions on changes to credit standards and to loan demand

QUESTION	MARKET SEGMENT	VARIABLE	DEFINITION
Supply of loans			
Over the past three months, how have your bank's credit standards as applied to the approval of loans…	or credit lines to enterprises changed? (Q1) to households changed? (Q8)	Net percentage of banks reporting a tightening of credit standards	Difference between the sum of banks answering "tightened considerably" and "tightened somewhat" and the sum of banks answering "eased somewhat" and "eased considerably" in percentage of the total number of banks.
Demand for loans			
Over the past three months, how has the demand for loans or credit lines to [...] changed at your bank, apart from normal seasonal fluctuations?	enterprises (Q4) households (Q13)	Net percentage of banks reporting an increase of the demand for loans	Difference between the sum of banks answering "increased considerably" and "increased somewhat" and the sum of banks answering "decreased somewhat" and "decreased considerably" in percentage of the total number of banks.

Note: Q* indicates the number of the question in the survey
Source: ECB, http://www.ecb.europa.eu/stats/money/surveys/lend/html/index.en.html

2. Questions on factors affecting changes in credit standards

QUESTION	FACTORS	VARIABLE	DEFINITION
Q2 Over the past three months, how have the following factors affected your bank's credit standards as applied to the approval of loans or credit lines to enterprises?	**A. Costs of funds and balance sheet constraints** Costs related to your bank's capital position Your bank's ability to access market financing Your bank's liquidity position **B. Pressure from competition** Competition from other banks Competition from non-banks Competition from market financing **C. Perception of risk** Expectations regarding general economic activity Industry or firm-specific outlook Risk on the collateral demanded	Net percentage of banks reporting that each of these factors has contributed to the tightening of standards to enterprises. *Pure supply* =average of the responses to A and B; *Borrower quality* =average of the responses to C	Difference between the sum of the banks answering "contributed considerably to tightening" and "contributed somewhat to tightening" and the sum of the banks answering "contributed somewhat to easing" and "contributed considerably to easing" in percentage of the total number of banks.
Q9 Over the past three months, how have the following factors affected your bank's credit standards as applied to the approval of loans to households for house purchase?	**A. Costs of funds and balance sheet constraints** **B. Pressure from competition** Competition from other banks Competition from non-banks **C. Perception of risk** Expectations regarding general economic activity Housing market prospects	Net percentage of banks reporting that each of these factors has contributed to the tightening of standards to enterprises. *Pure supply* =average of the responses to A and B; *Borrower quality* =average of the responses to C	Difference between the sum of the banks answering "contributed considerably to tightening" and "contributed somewhat to tightening" and the sum of the banks answering "contributed somewhat to easing" and "contributed considerably to easing" in percentage of the total number of banks.
Q11 Over the past three months, how have the following factors affected your bank's credit standards as applied to the approval of consumer credit and other lending to households?	**A. Costs of funds and balance sheet constraints** **B. Pressure from competition** Competition from other banks Competition from non-banks **C. Perception of risk** Expectations regarding general economic activity Creditworthiness of consumers Risk on the collateral demanded	Net percentage of banks reporting that each of these factors has contributed to the tightening of standards to enterprises. *Pure supply* =average of the responses to A and B; *Borrower quality* =average of the responses to C	Difference between the sum of the banks answering "contributed considerably to tightening" and "contributed somewhat to tightening" and the sum of the banks answering "contributed somewhat to easing" and "contributed considerably to easing" in percentage of the total number of banks.

Note: Q* indicates the number of the question in the survey
Source: ECB, http://www.ecb.europa.eu/stats/money/surveys/lend/html/index.en.html

Senior Loan Officer Survey (SLO)

1. Questions on changes to credit standards and to loan demand

QUESTION	MARKET SEGMENT	VARIABLE	DEFINITION
Supply of loans			
Over the past three months, how have your bank's credit standards for …	approving applications for C&I loans or credit lines - other than those to be used to finance mergers and acquisitions - to large and middle-market firms changed? Q1 from individuals for mortgage loans to purchase homes changed? (Q9) for consumer loans other than credit card loans changed? (Q15)	Net percentage of banks reporting a tightened of credit standards	Difference between the sum of banks answering "tightened considerably" and "tightened somewhat" and the sum of banks answering "eased somewhat" and "eased considerably" in percentage of the total number of banks
Demand for loans			
Apart from normal seasonal variation, how has demand for…	C&I loans changed over the past three months? (Q4) mortgage to purchase homes changed over the past three months? (Q10) consumer loans of all types changed over the past three months? (Q18)	Net percentage of banks reporting an increased of the demand for loans.	Difference between the sum of banks answering "increased considerably" and "increased somewhat" and the sum of banks answering "decreased somewhat" and "decreased considerably" in percentage of the total number of banks.

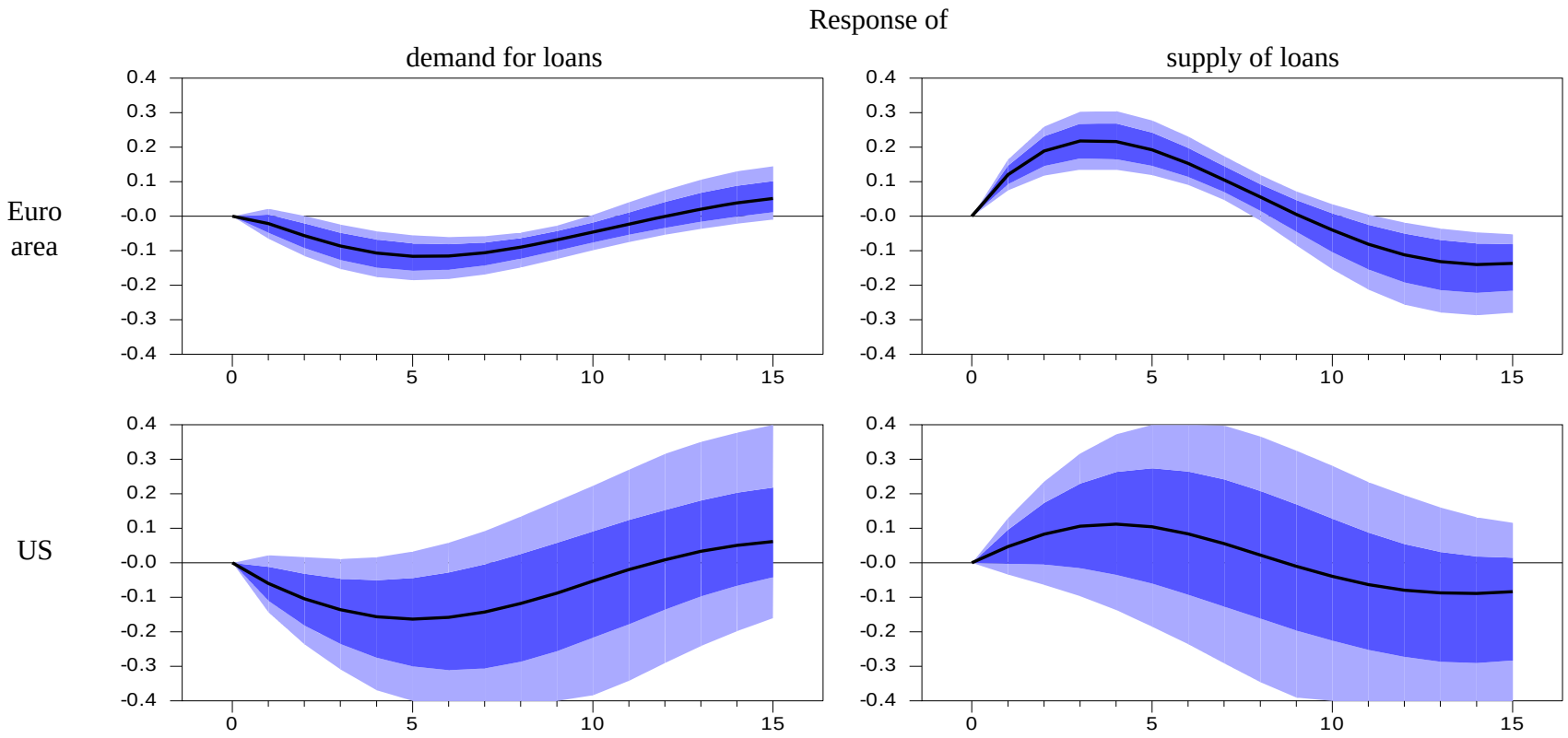
Note: Q* indicates the number of the question in the survey
Source: Federal Reserve Board,
http://www.federalreserve.gov/boarddocs/snloansurvey/

2. Questions on factors affecting changes in credit standards

QUESTION	FACTORS	VARIABLE
Q3 if your bank has tightened or eased its credit standards or its terms for C&I loans or credit lines over the past three months, how important have been the following possible reasons for the change?	**A. Current or expected capital position** **B. Economic outlook and its uncertainty** **C. Industry specific problems**	*Pure supply* = responses to A *Borrower quality* = average of the responses to B and C

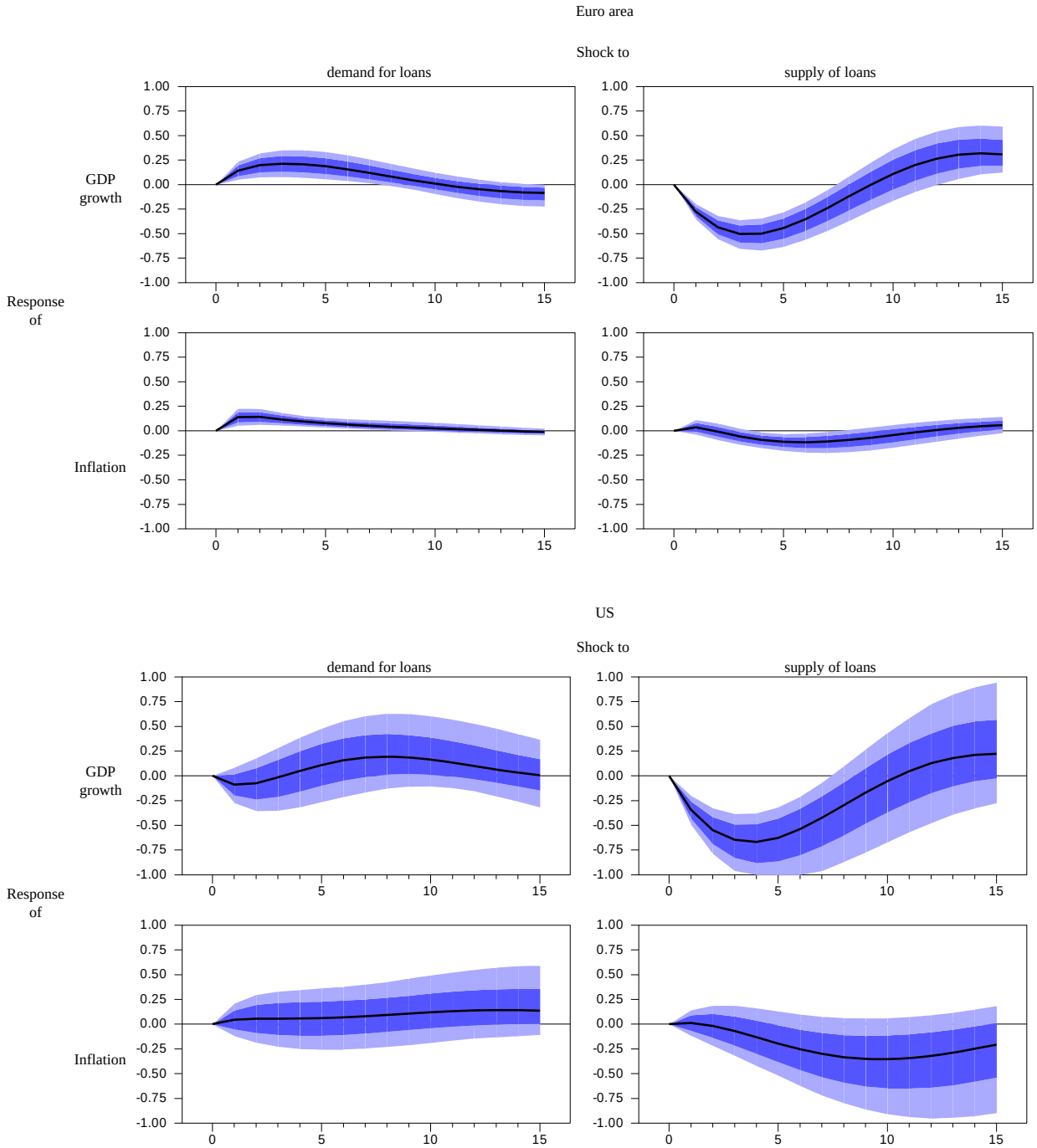
Note: Q* indicates the number of the question in the survey
Source: Federal Reserve Board,
http://www.federalreserve.gov/boarddocs/snloansurvey/

Figure 1A. Responses of demand and supply of business loans to a monetary policy shock



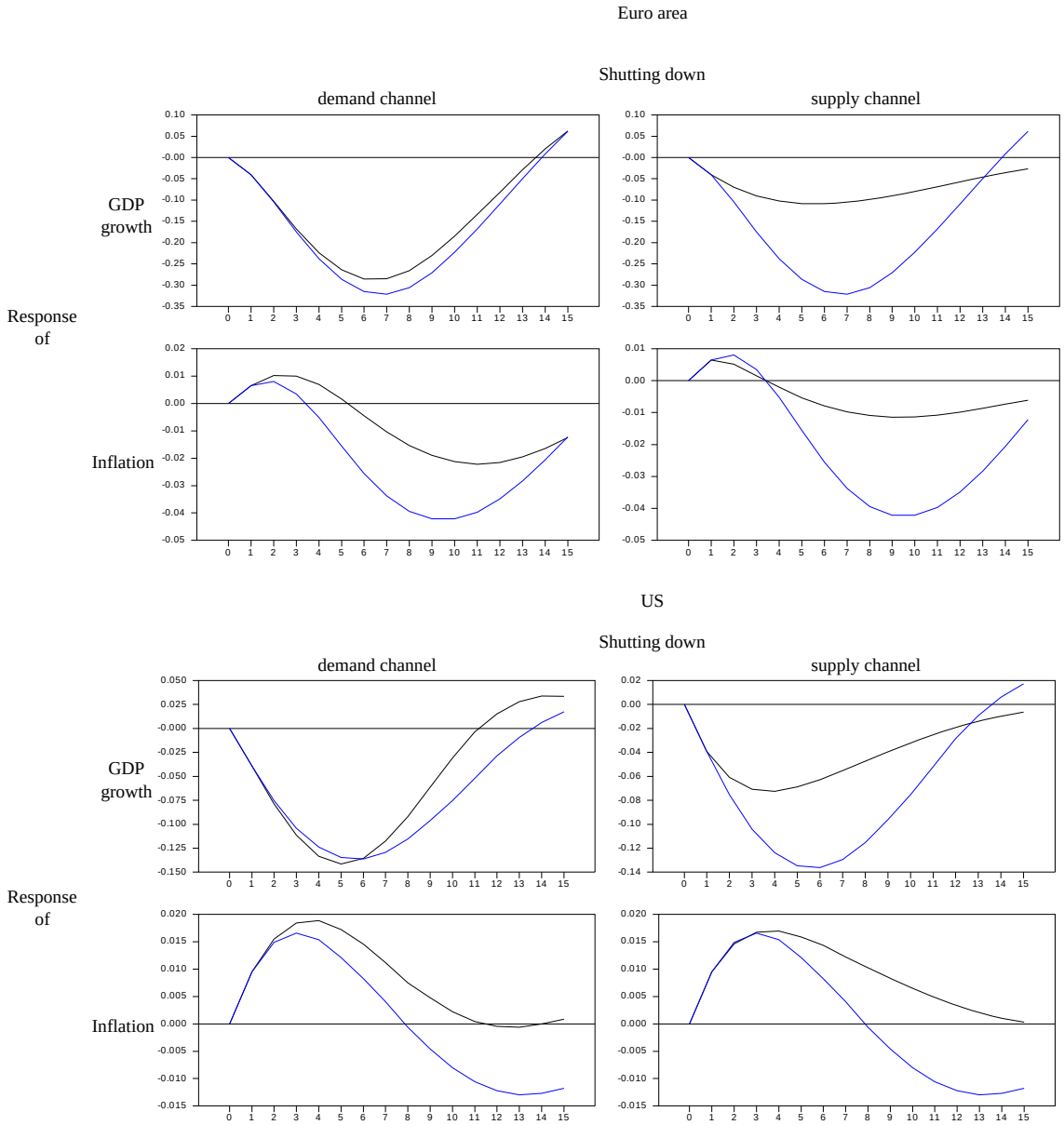
Note: These graphs plot the responses of loan demand and loan supply to a one-standard deviation shock to the overnight rate. Only business loans (loans to non-financial corporations) are considered. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs on the first row refer to the Euro area, while the second row shows the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 5 variables: GDP growth, inflation, total demand of loans from NFC and total supply of loans to NFC (see specification of MODEL 1 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

Figure 1B. Responses of GDP growth and inflation to shocks to demand and supply of business loans



Note: These graphs plot the responses of GDP growth and inflation to a one-standard deviation shock to demand for and supply of loans. Only business loans (loans to non-financial corporations) are considered.. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs on the first two rows refer to the Euro area, while the others show the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 5 variables: GDP growth, inflation, total demand of loans from NFC and total supply of loans to NFC (see specification of MODEL 1 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

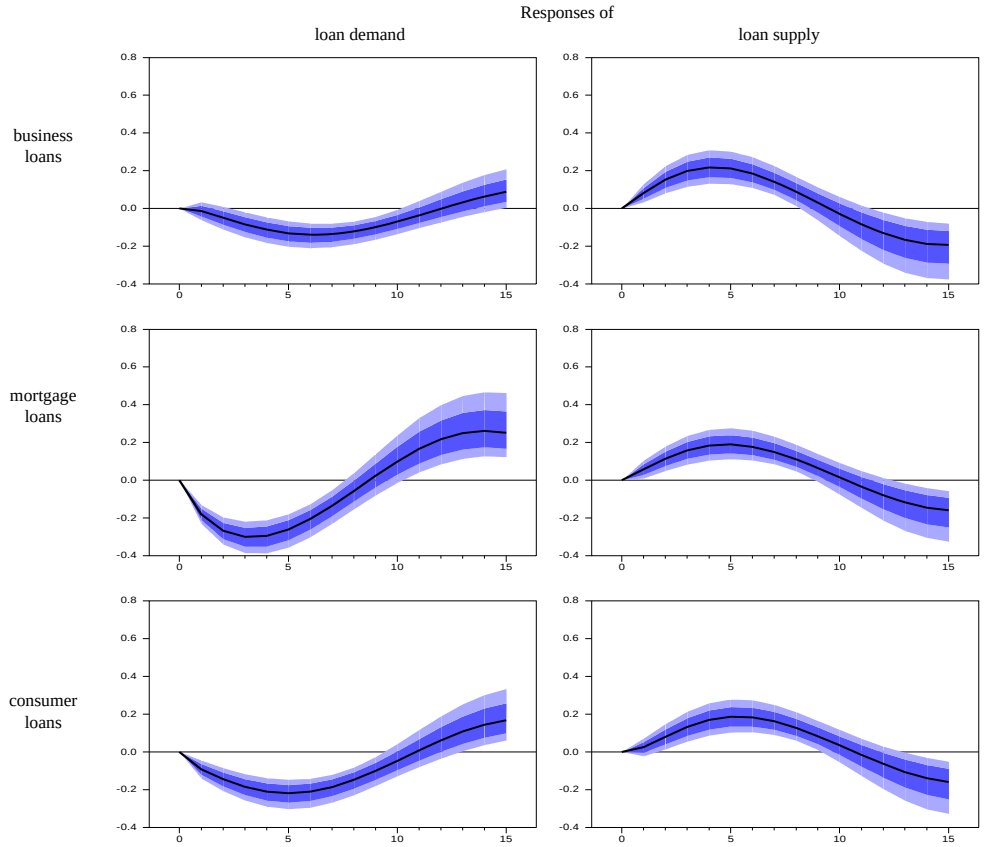
Figure 1C. Counterfactual analysis. Responses of GDP growth and inflation to a monetary policy shock with and without credit channels (for business loans)



Note: These graphs report the results of counterfactual experiments. The responses of output growth and inflation to a one-standard deviation monetary policy shock are compared with the responses obtained when closing down the supply (supply channel) or the demand (demand channel) of business loans in the system. The black lines are computed from a system where the supply or demand channel has been closed down. The blue lines are the responses for the system where all the channels are active. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The graphs on the first two rows refer to the Euro area, while the others show the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 5 variables: GDP growth, inflation, total demand of loans from non-financial corporations (NFC) and total supply of loans to non-financial corporations (see specification of MODEL 1 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

Figure 2A. Responses of loan demand and supply to a monetary policy shock

Euro area



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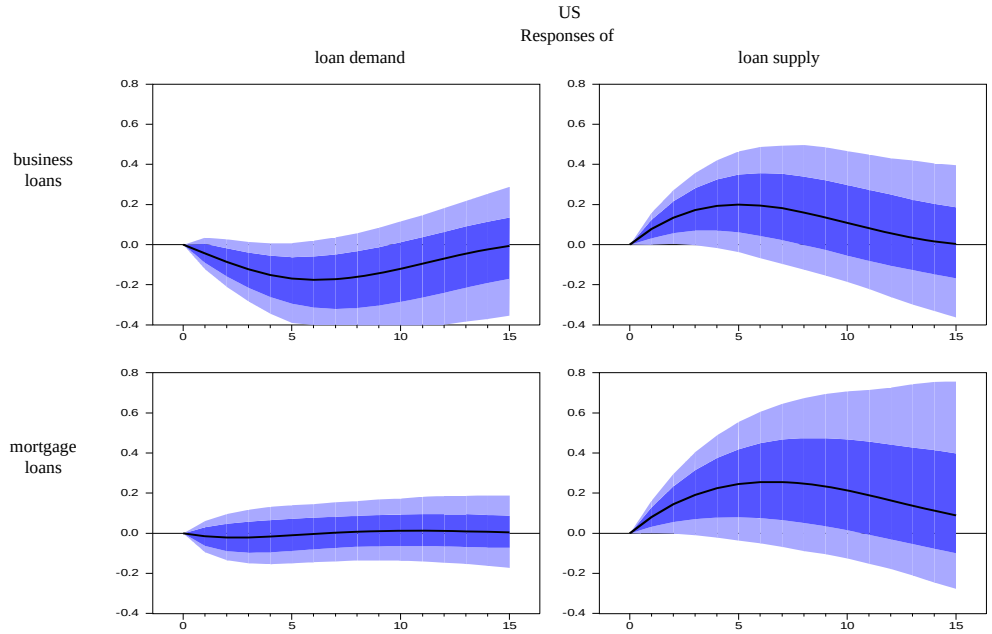
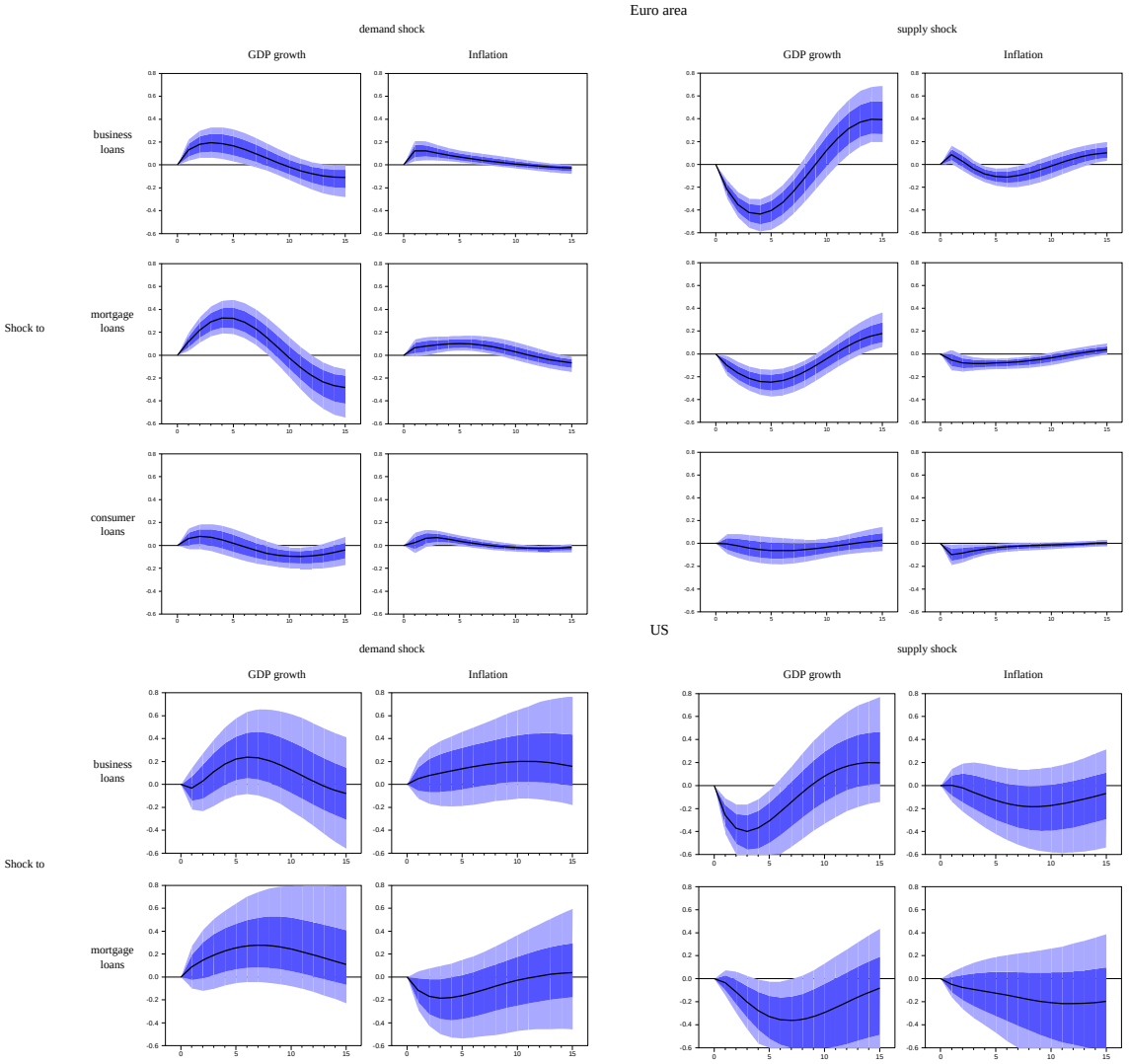


Note: These graphs plot the responses of loan demand and loan supply to a one-standard deviation monetary policy shock. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs on the first three rows refer to the Euro area, for which business, mortgage and consumer loans are considered. The last two rows show the responses for the United States (US), where only business and mortgage loans are considered. The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 9 variables: GDP growth, inflation, overnight rates, demand and supply for business, mortgages and consumer credit (see MODEL 2 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

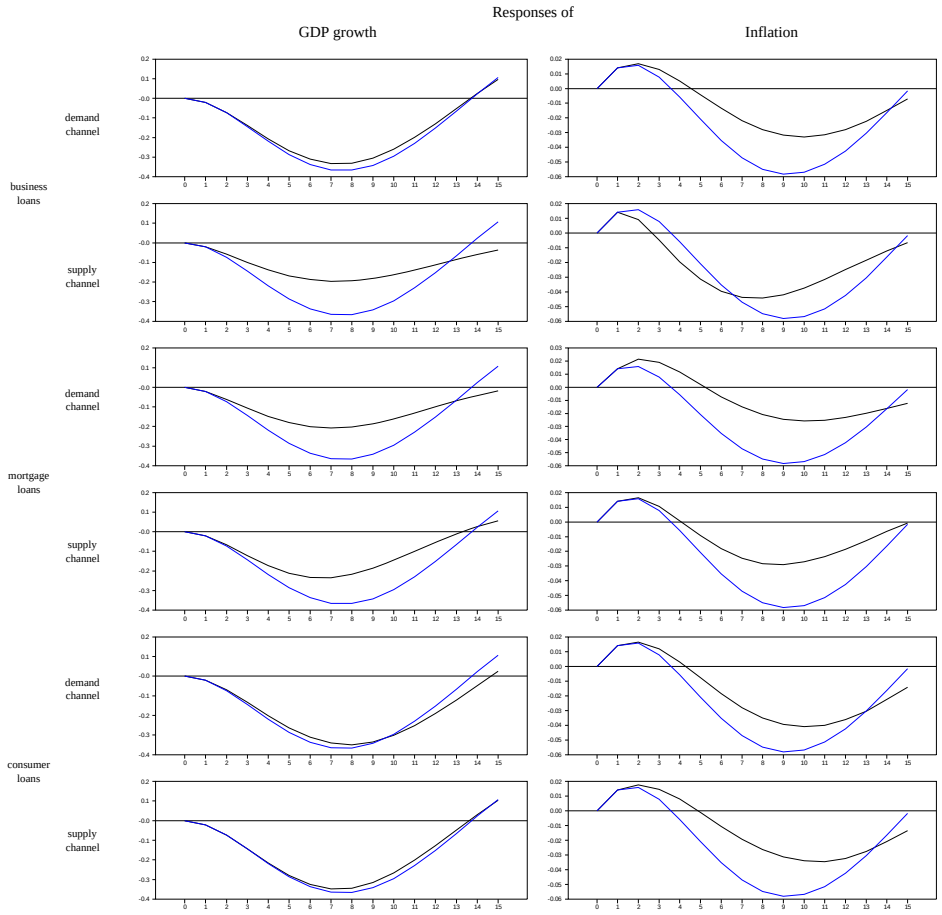
Figure 2B. Responses of GDP growth and inflation to loan demand and supply shocks



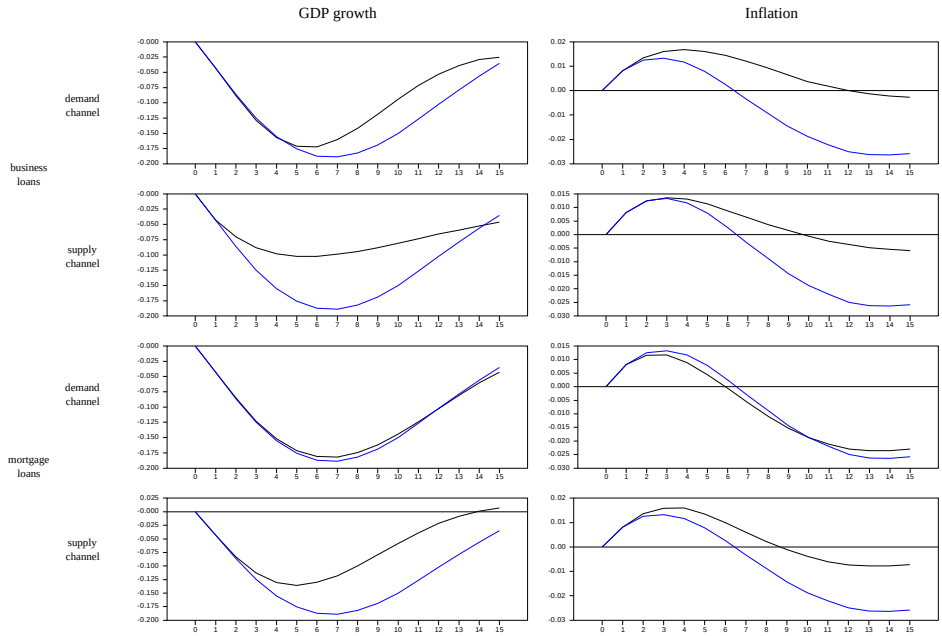
Note: These graphs plot the responses of GDP growth and inflation to a one-standard deviation shock to loan supply. Responses of the series are normalised and divided by their innova variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, comp by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs on the first three rows refer to the Euro area, for which business, mortgage consumer loans are considered. The last two rows show the responses for the United States (US), where only business and mortgage loans are considered. The panel VAR for the Euro Ar estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 9 variables: GDP growth, infla overnight rates, demand and supply for business, mortgages and consumer credit (see MODEL 2 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

Figure 2C. Counterfactual analysis. Responses of GDP growth and inflation to a monetary policy shock with and without loan demand and supply channels and for specific borrower categories

Euro area



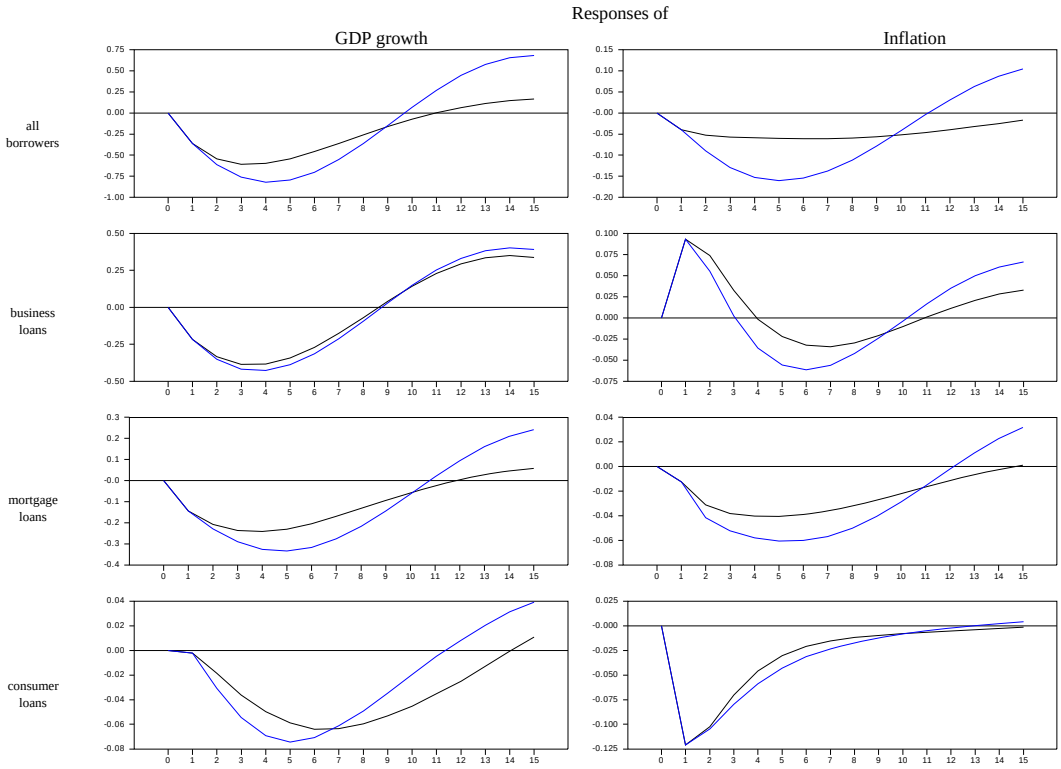
US



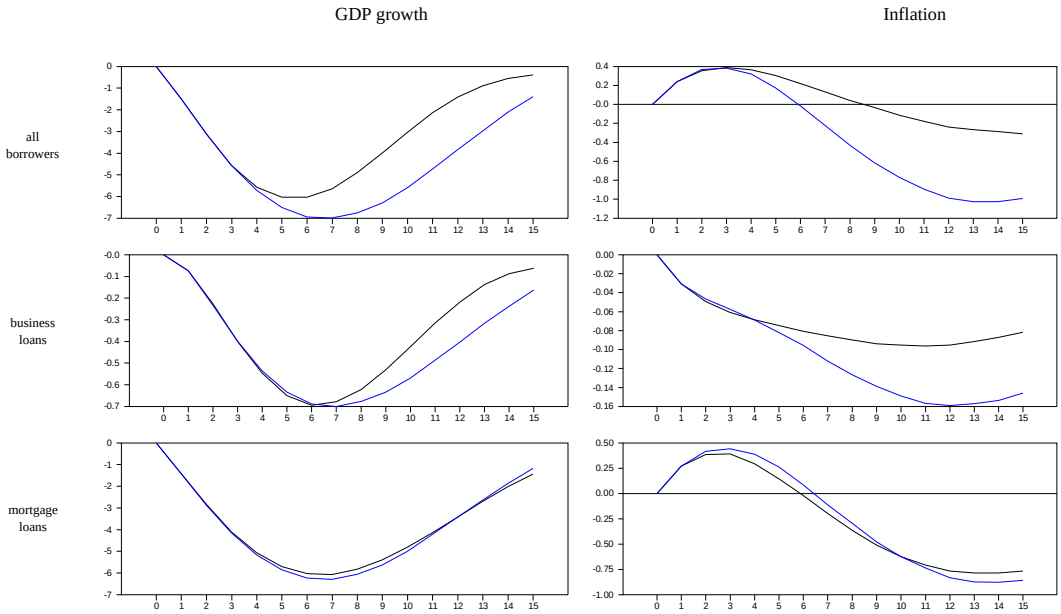
Note: These graphs report counterfactual experiments. The responses of output growth and inflation to a one-standard deviation monetary policy shock are compared with the responses obtained when closing down the credit channels (demand or supply). All types of loans are considered. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The graphs on the first six rows refer to the Euro area. The last four rows shows the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 9 variables: GDP growth, inflation, overnight rates, demand and supply (two channels) for each type of loans (see MODEL 2 in Section 3.5). See Section 3 and Appendix for a detailed definition of the variables.

Figure 2D. Counterfactual analysis. Responses of GDP growth and inflation to a loan supply shock with and without loan demand channels (for a specific borrower category)

Euro area

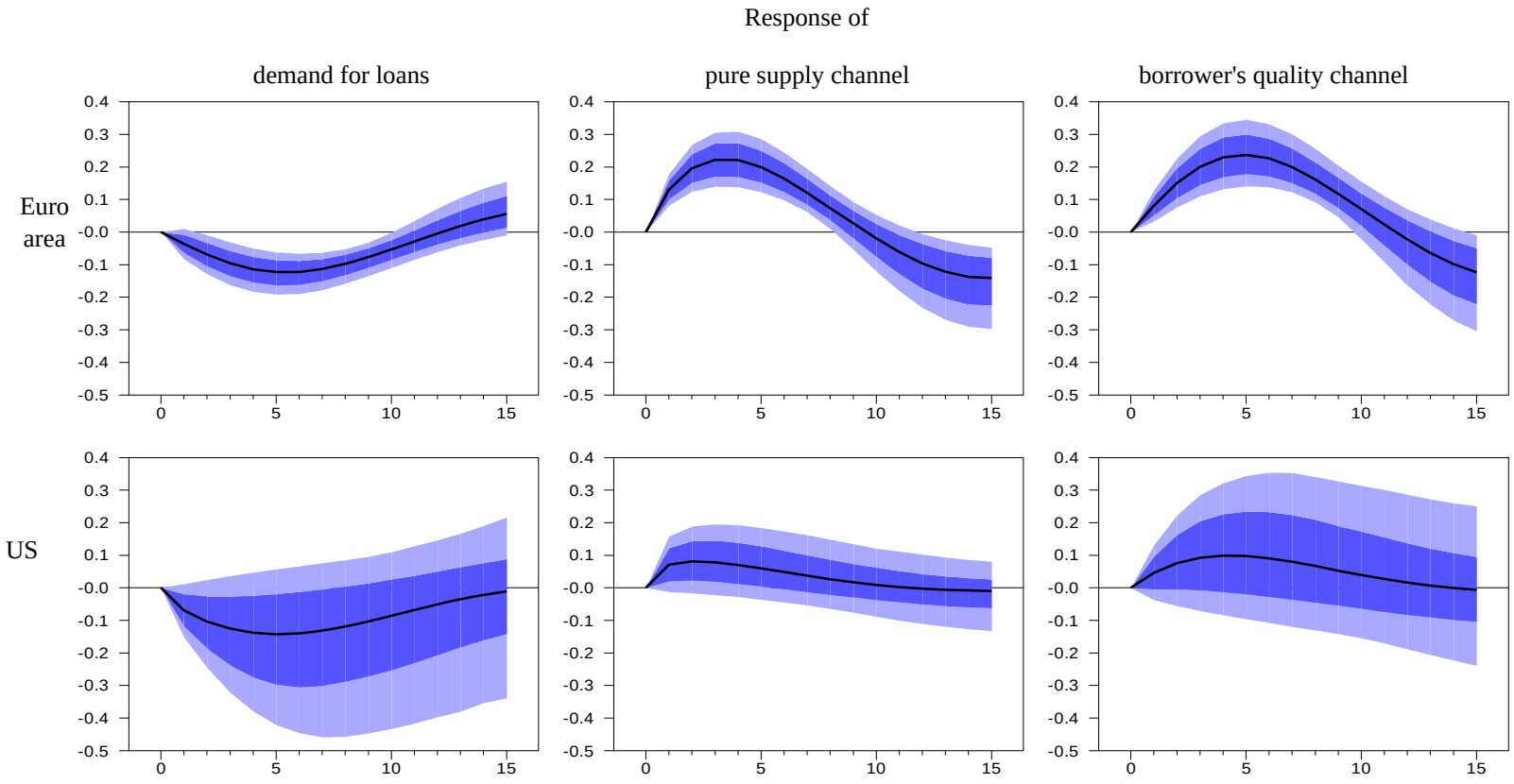


US



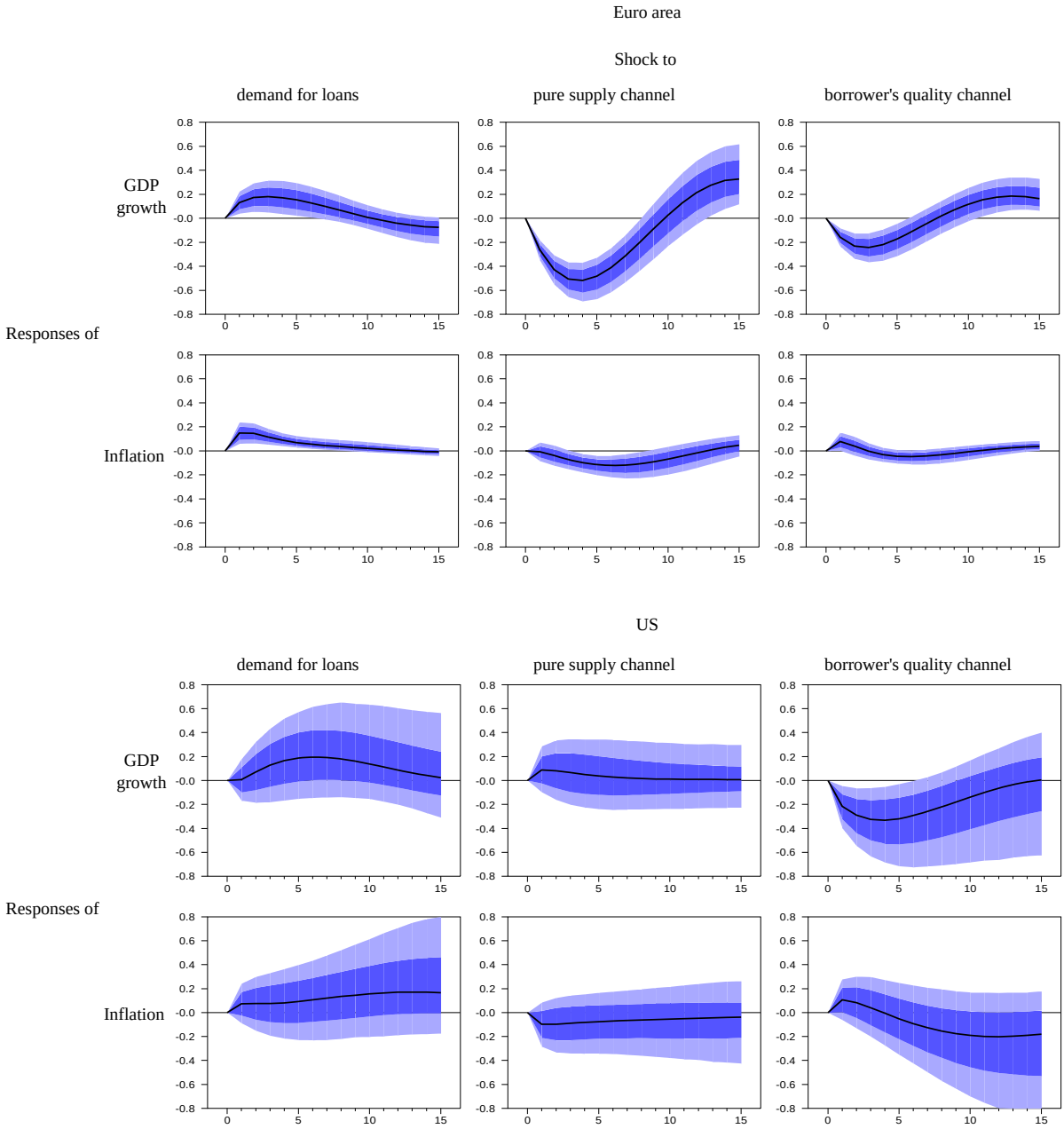
Note: These graphs report counterfactual experiments. The responses of output growth and inflation to a credit supply shock are compared with the responses obtained when closing down the demand channel. All types of loans are considered. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The graphs on the first six rows refer to the Euro area. The last four rows shows the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 9 variables: GDP growth, inflation, overnight rates, demand and supply (two channels) for each type of loans (see MODEL 2 in Section 3.5). See Section 3 and Appendix for a detailed definition of the variables.

Figure 3A. Firm balance-sheet and bank lending channel. Responses of demand and supply of business loans to a monetary policy shock



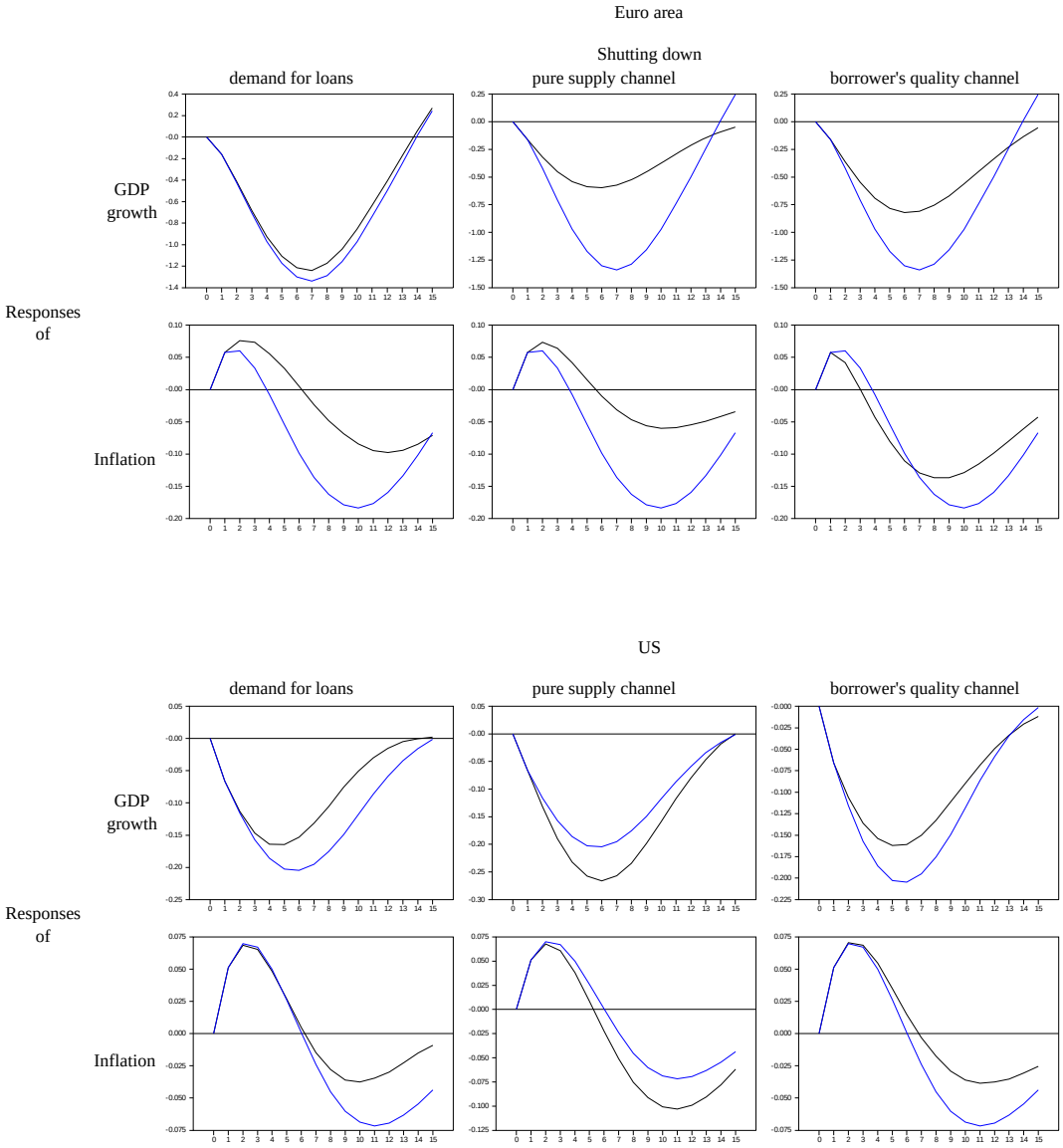
Note: These graphs plot the responses of loan demand and loan supply to a one-standard deviation monetary policy shock. Only business loans (loans to non-financial corporations) are considered. Loan supply is represented by two different channels: the pure supply and the borrower's quality channel (proxy for the bank lending and the firm balance-sheet channel). Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs on the first row refer to the Euro area, while the second row shows the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 6 variables for the euro area: GDP growth, inflation, demand and supply (two variables) for business loans (see MODEL 3 in Section 3.5.). See Section 3 and Appendix for a detailed definition of the variables.

Figure 3B. Firm balance-sheet and bank lending channel. Responses of GDP growth and inflation to a shock to loan demand and loan supply



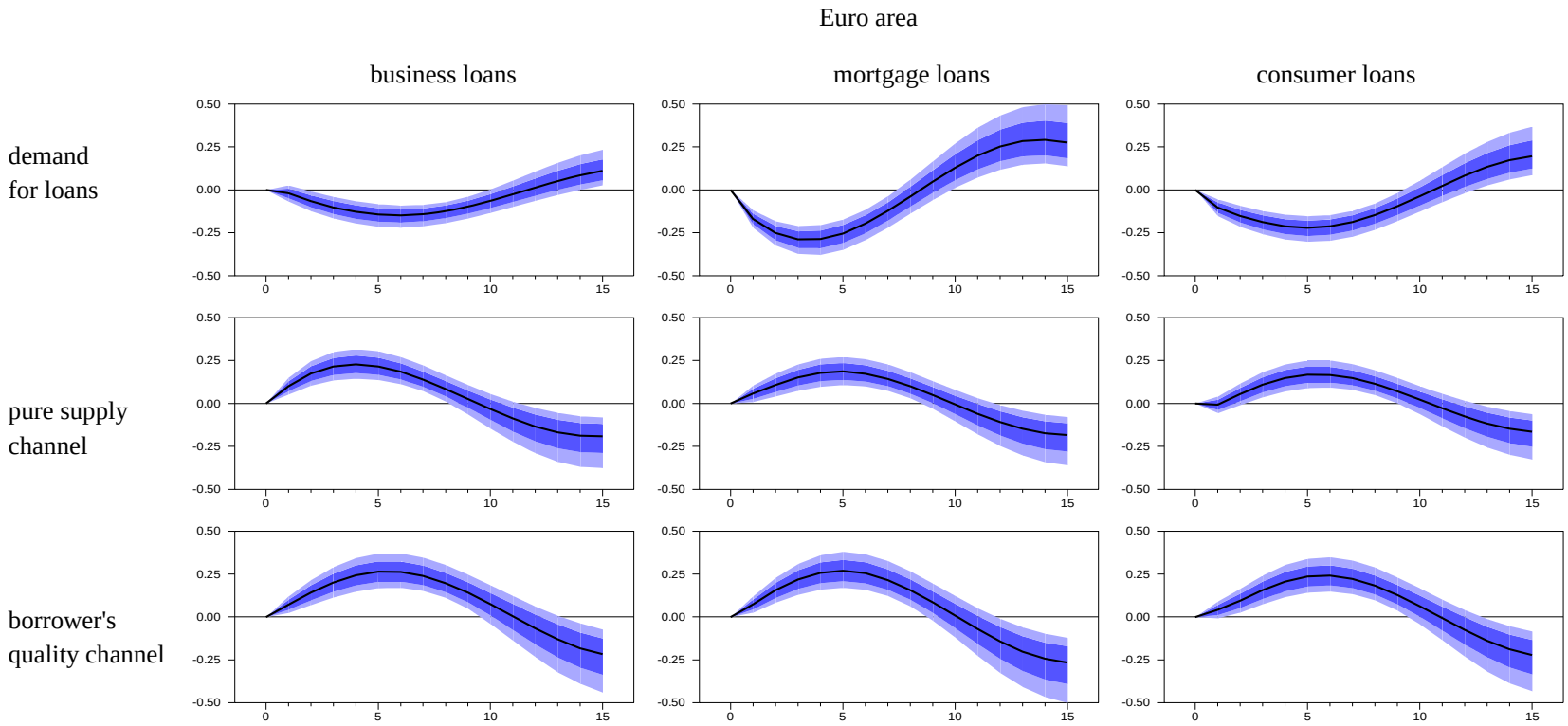
Note: These graphs plot the responses of GDP growth and inflation to a one-standard deviation shock of loan demand and loan supply. Only business loans (loans to non-financial corporations) are considered. Loan supply is represented by two different channels: the pure supply and the borrower's quality channel (proxy for the bank lending and the firm balance-sheet channel). Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs on the first two rows refer to the Euro area (EA), while the other rows show the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 6 variables for the euro area: GDP growth, inflation, demand and supply (two variables) for business loans (see MODEL 3 in Section 3.5.). See Section 3 and Appendix for a detailed definition of the variables.

Figure 3C. Counterfactual analysis. Firm balance-sheet and bank lending channel. Responses of GDP growth and inflation to a monetary policy shock.



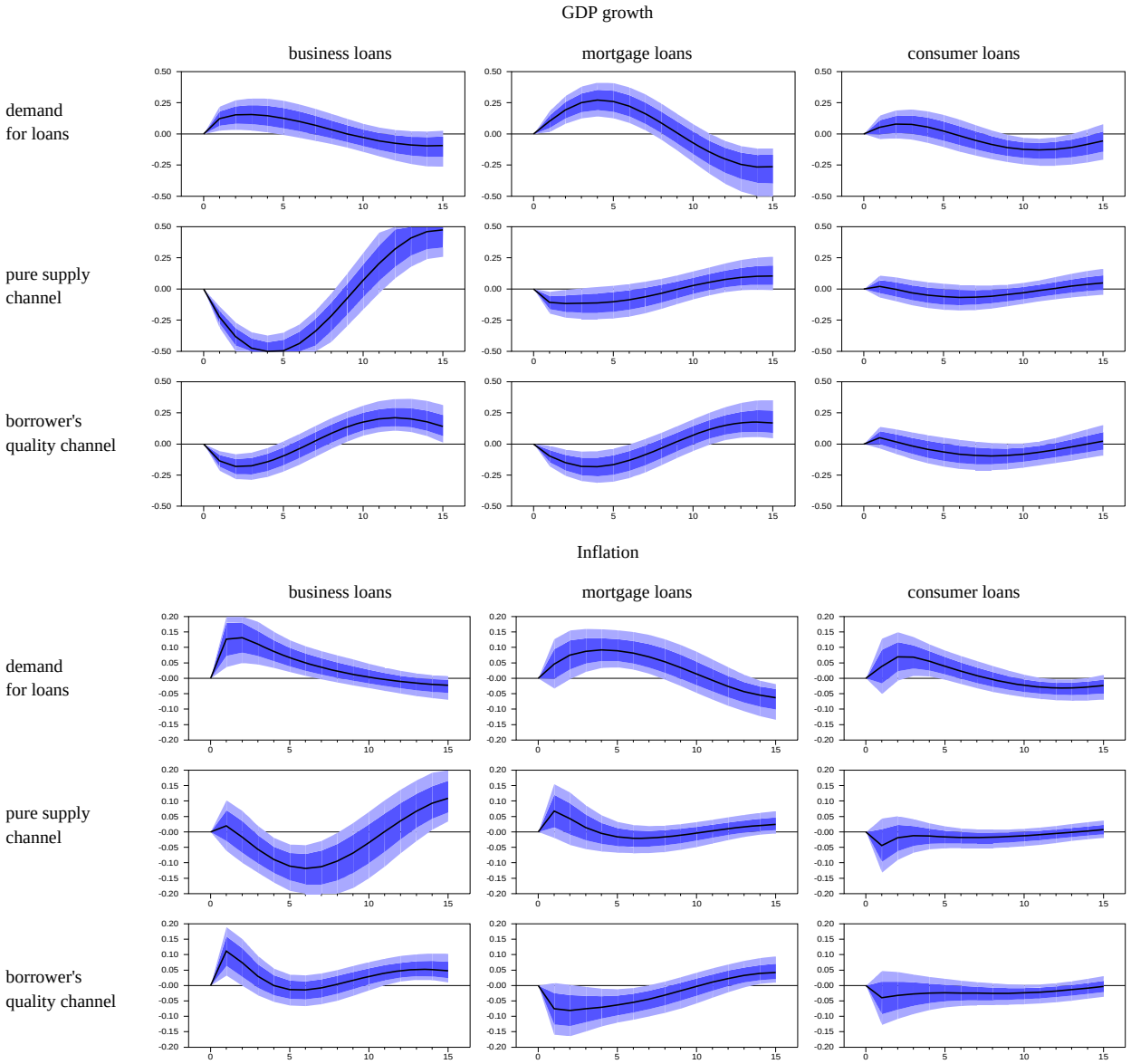
Note: These graphs report counterfactual experiments. The responses of output growth and inflation to a one-standard deviation monetary policy shock are compared with the responses obtained when closing down the credit channels (one demand channel and two supply channels). Only business loans are considered. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The graphs on the first two rows refer to the Euro area. The last two rows show the responses for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 6 variables: GDP growth, inflation, overnight rates, demand and supply (two channels) for business loans (see MODEL 3 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

Figure 4A. Responses of loan demand and supply (bank lending and borrower's bank lending channels) to a monetary policy shock (all category of borrowers).



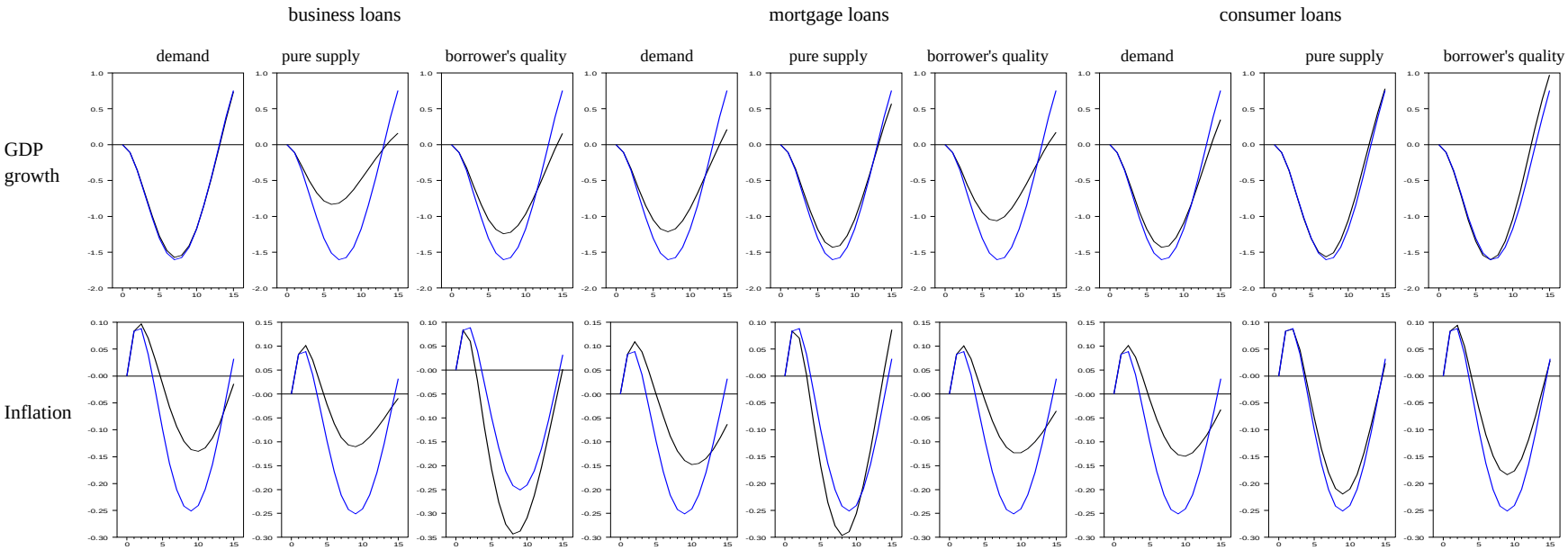
Note: These graphs report the responses of loan demand and loan supply (via bank lending and borrower's balance sheet channels) to a monetary policy shock for all borrower's category. Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs refer to the Euro area. The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 9 variables: GDP growth, inflation, overnight rates, demand and supply (two channels) for all type of loans (see MODEL 4 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

Figure 4B. Responses of Euro area GDP growth and inflation to a shock to loan demand and loan supply (bank lending and borrower's balance sheet channel), all category of borrowers.



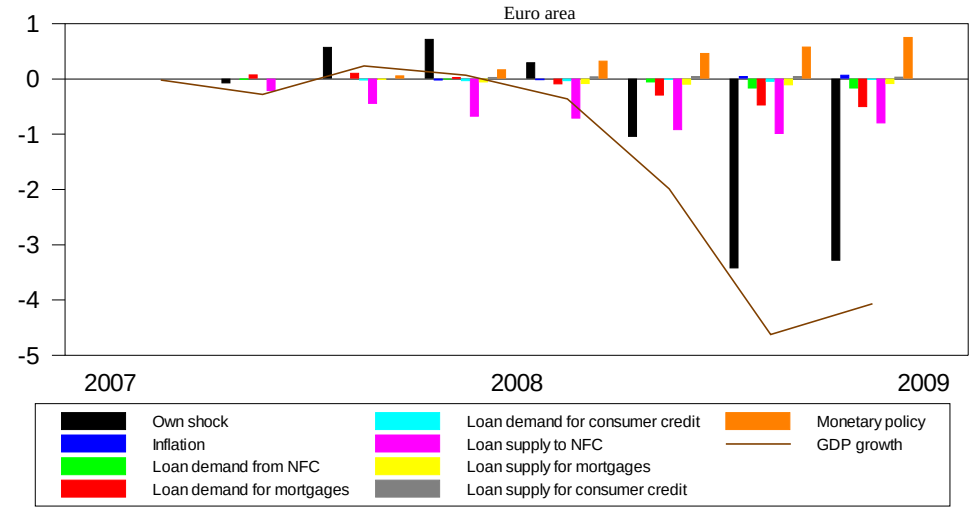
Note: These graphs report the responses of GDP growth and inflation to a shock to loan demand and loan supply (via bank lending and borrower's balance sheet channels) for all category of borrowers (business, mortgage and consumer loans). Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. The median response is shown along with 68 (dark blue) and 90 (light blue) percent Bayesian credible intervals, computed by estimating the VAR with a flat prior on the parameters and assuming normality of the error terms. The graphs refer to the Euro area. The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 9 variables: GDP growth, inflation, overnight rates, demand and supply (two channels) for all type of loans (see MODEL 4 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

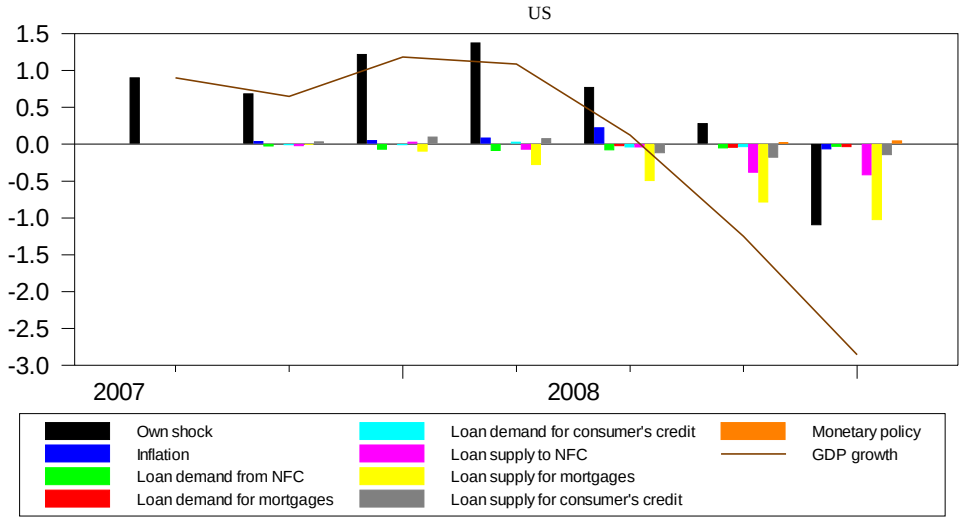
Figure 4C. Counterfactual analysis. Firm, household and bank balance-sheet channels in the Euro area. Responses of GDP growth and inflation to a monetary policy shock when closing down loan demand and loan supply (pure supply and borrower's quality) channels for each category of loans at a time.



Note: These graphs report counterfactual experiments. The responses of output growth and inflation to a one-standard deviation monetary policy shock are compared with the responses obtained when closing down the credit channels (one demand channel and two supply channels) for each type of loan at a time. The results of the full system (blue line) are compared with the results of the system where the correspondent channel has been closed down (black line). Responses of the series are normalised and divided by their innovation variances so that all responses to a shock are comparable on a single scale. All the responses refer to the Euro area. The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 12 variables: GDP growth, inflation, overnight rates, demand and supply (two channels) for all type of loans (see MODEL 4 in Section 3.5.) See Section 3 and Appendix for a detailed definition of the variables.

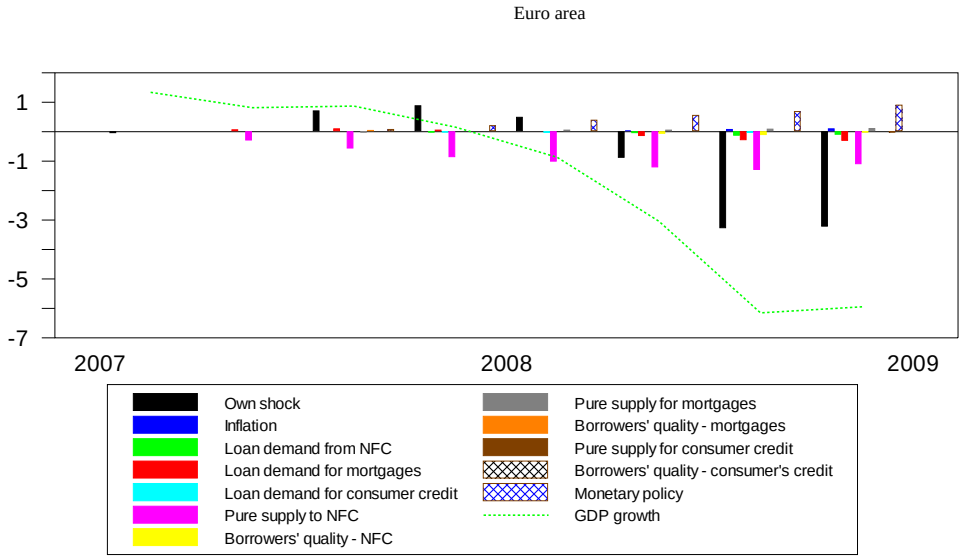
Figure 5A. Historical decomposition. The impact of different shocks during the financial crisis





Note: These graphs report the results of a historical decomposition. The decomposition is technically performed by estimating the VAR model until the beginning of the financial crisis (2007Q2), projecting the variables of interest over the crisis sample (2007Q3-2009Q2) and decomposing the difference between the realised and the projected values in the sum of the innovations to all variables. The bars in the charts represent the accumulated effects up to time t of current and past innovations to other variables which explain movements in GDP growth. All types of loans are considered for the Euro area and for the United States (US). The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 9 variables: GDP growth, inflation, overnight rates, demand and supply for business loans (loans to NFC), mortgage loans and consumer loans (see Model 2 in Section 3.5). See Section 3 and Appendix for a detailed definition of the variables.

Figure 5B. Historical decomposition. The impact of different shocks during the financial crisis (bank lending and borrower's balance sheet channels)



Note: These graphs report the results of a historical decomposition. The decomposition is technically performed by estimating the VAR model until the beginning of the financial crisis (2007Q2), projecting the variables of interest over the crisis sample (2007Q3-2009Q2) and decomposing the difference between the realised and the projected values in the sum of the innovations to all variables. The bars in the charts represent the accumulated effects up to time t of current and past innovations to other variables which explain movements in GDP growth. Only the Euro area and all types of loans are considered. The panel VAR for the Euro Area is estimated assuming fixed effects, slope homogeneity and the country identification strategy as explained in Section 3. The specification of the VAR includes 12 variables: GDP growth, inflation, overnight rates, demand and supply (pure supply and borrower's quality channels) for business loans (loans to NFC), mortgage loans and consumer loans (see Model 4 in Section 3.5). See Section 3 and Appendix for a detailed definition of the variables.