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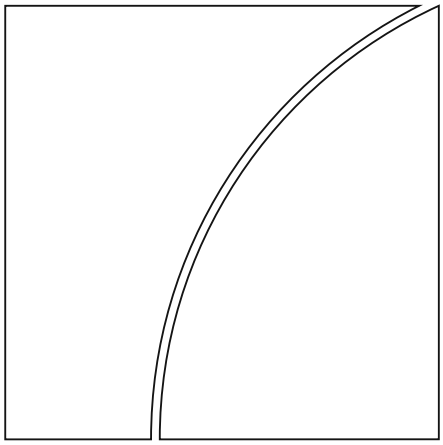

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by Iñaki Aldasoro and Robert Unger

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External financing and economic activity in the euro area – why are bank loans special?*

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Abstract

Using a Bayesian vector autoregression (BVAR) identified with a mix of sign and zero restrictions, we show that a restrictive bank loan supply shock has a strong and persistent negative impact on real GDP and the GDP deflator. This result comes about even though flows of other sources of financing, such as equity and debt securities, expand strongly and act as a "spare tire" for the reduction in bank loans. We show that this result can be rationalized by a recently revived view of banking, which holds that banks increase the nominal purchasing power of the economy when they create additional deposits in the act of lending. Consequently, our findings indicate that a substitution of bank loans by other sources of financing might have negative macroeconomic repercussions.

Keywords: bank loans, Bayesian VAR, credit creation, ECB, euro area, external financing, financing structure

JEL classification: E30, E40, E50, G20, G30

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1 Introduction

The composition of flows of external financing to the non-financial private sector of the euro area, comprising non-financial corporations and private households, has notably changed in recent years.[1] Figure 1 below shows total external financing flows divided into flows of bank loans and flows of all other sources of financing, such as equity, debt securities and loans from non-banks. The 2000s saw a pronounced bank credit boom, with flows of bank loans accounting for almost 55% of total financing flows during the height of the credit upswing. In the period before the global financial crisis they made up on average around 40%. When the global financial crisis hit, bank loan flows slowed down remarkably. Starting with the intensification of the euro-area debt crisis, they even went into negative territory for a considerable period of time. Whereas flows of other financing sources also weakened beginning with the global financial turmoil, they never turned negative and remained relatively stable. Taken together, recent years witnessed a significant shift in the structure of external financing flows away from bank loans to other sources of financing.

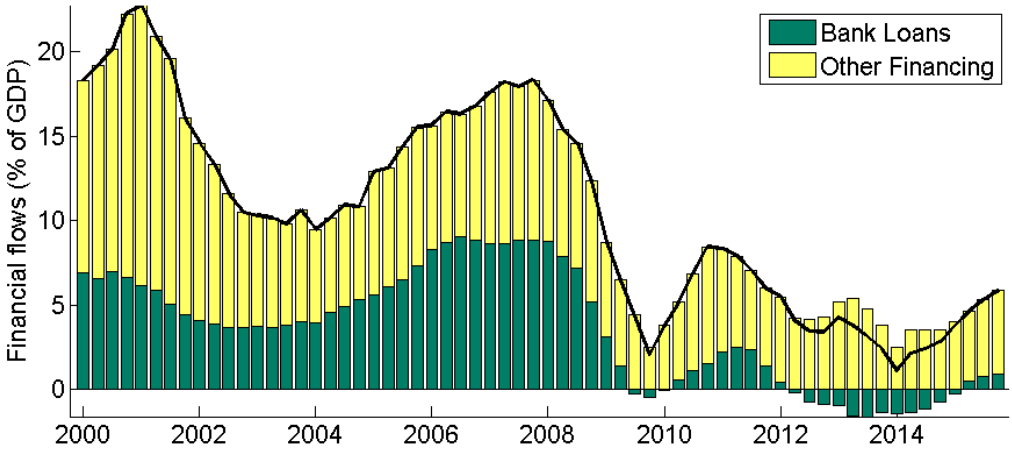

Figure 1: External financing flows to the non-financial private sector of the euro area (Notes: The non-financial private sector comprises non-financial corporations and private households (including non-profit institutions serving households). Bank loans correspond to loans from domestic MFIs according to the MFI balance sheet statistics. Other financing is calculated as the difference between flows of total liabilities according to the quarterly sectoral accounts and flows of bank loans. Sources: ECB Statistical Data Warehouse and own calculations (see Table 2 for details).)

The outbreak of the global financial crisis marked the beginning of a period during which bank loan supply restrictions may have been an important driver of credit growth. Against this background, the divergence in the evolution of the two types of financing flows suggests that other sources of financing acted as a "spare tire" for the loss in bank loan financing (see, for example, Adrian, Colla, and Shin, 2013; Antoun de Almeida and Masetti, 2016; Becker and Ivashina, 2014; Levine, Lin, and Xie, 2016). This endogenous

[1]Throughout the paper we refer to "external financing" as defined in the financial accounts, i.e. financing sources external to the economic agent. This concept should not be confused with external financing as understood in a balance of payments framework.

response of other financing sources can potentially mitigate the negative impact of adverse bank loan supply shocks on the economy. Failing to take this reaction into account might thus bias the inference drawn regarding the impact of bank loan supply shocks on key macroeconomic variables such as real GDP or the GDP deflator.

We address this issue for the euro-area aggregate by enlarging the classic monetary policy vector autoregression (VAR) – which includes a measure of real output, the price level and a monetary policy instrument – with flows of bank loans, the interest rate on bank loans, and flows of alternative sources of financing. We identify three financing shocks, as well as the classic macro shocks commonly identified in monetary policy VARs. Following the spirit of Becker and Ivashina (2014), we identify an adverse bank loan supply shock as an innovation that is characterized by a decrease in the flow of bank loans and an increase in the flow of other sources of financing. The idea behind this (microeconomic) identification strategy is that an economic agent which raises a source of financing other than bank loans has a positive demand for financing and the reduction in bank loans must thus represent a restriction in its supply. To map this identification strategy to the macro level, we follow common practice in VAR analyses and also impose that the interest rate on bank loans increases.

To control for a general demand factor that might influence the evolution of bank loans and other sources of financing, we identify a negative financing demand shock. In this case, both the flows of bank loans and other sources of financing and the interest rate on bank loans decrease. As a third financing shock, and following the logic for the identification of the bank loan supply shock, we identify an innovation that features a decrease in the flow of other sources of financing and has a contemporaneous positive impact on flows of bank loans and the interest rate on bank loans. The positive response of the bank loan variables aims to capture the increase in bank loan demand in reaction to the reduction of other financing sources. Given that we already control for the endogenous response of other sources of financing to bank loan supply shocks and a general financing demand shock, we loosely interpret this shock as an adverse other financing supply shock.

In addition, we identify a restrictive monetary policy shock, which features an increase in the policy instrument as well as in the interest rate on bank loans and a decrease in both flows of financing. To distinguish our three financing shocks and the monetary policy shock from the (real) aggregate demand and supply shocks that we also identify, we follow the seminal paper by Christiano, Eichenbaum, and Evans (1996) and several recent contributions (see, for example, Breitenlechner, Scharler, and Sindermann (2016), Eickmeier and Hofmann (2013), Gambacorta, Hofmann, and Peersman (2014) and Peersman and Wagner (2015)) by imposing zero restrictions on the contemporaneous reactions of real GDP and the GDP deflator. The model is estimated with Bayesian methods using the algorithm developed by Arias, Rubio-Ramírez, and Waggoner (2014).

We find that, whereas shocks to bank loan supply do have an economically important impact on economic activity and prices, shocks to the supply of other sources of financing do not. More specifically, an adverse bank loan supply shock leads to a strong and persistent decline in real GDP and the GDP deflator, despite a marked increase in flows of other sources financing. In terms of the forecast error variance decomposition, bank loan supply shocks account for almost twenty percent of the variance of output and fifteen percent of the variance of prices over a horizon of twenty quarters. In contrast, other financing supply shocks have no noticeable impact on economic activity and prices,

account for only around five percent of the variance of real GDP and hardly explain any of the variation in prices.

Our results confirm a by now voluminous empirical literature, which shows that shocks to bank loan supply have an economically important impact on the real economy (see, for example, Busch, Scharnagl, and Scheithauer, 2010; Cappiello, Kadareja, Kok, and Protopapa, 2010; de Bondt, Maddaloni, Peydró, and Scopel, 2010; Hristov, Hülsewig, and Wollmershäuser, 2012; Moccero, Darracq Pariès, and Maurin, 2014; Altavilla, Darracq Pariès, and Nicoletti, 2015; Gambetti and Musso, 2016). We add to this literature by showing that these results hold even if one allows for an endogenous response of alternative sources of financing, which act as a "spare tire" for the loss of bank loan financing. The strong increase in other sources of financing suggests that a limited ability to substitute a reduction in bank loan supply with other sources of financing might not be the only reason why bank loans are a special source of financing.

An alternative explanation for our results can be found in a recently revived view of the functioning of the banking system. This notion holds that credit institutions differ in a fundamental way from all other financial intermediaries: When banks originate new loans, they create additional means of payment in the form of deposits, increasing the aggregate nominal purchasing power of the economy (see, for example, Borio and Disyatat, 2010, 2011; Disyatat, 2011; McLeay, Radia, and Thomas, 2014; Jakab and Kumhof, 2015). In contrast, all other types of financial intermediation simply reallocate an existing stock of means of payment and the corresponding purchasing power.[2] Accordingly, a bank loan supply shock might have negative repercussions on the real economy even when other sources of financing fully compensate for the reduction in bank loans, since replacing bank loans with other sources of financing implies an effective loss in nominal purchasing power.

We investigate this hypothesis by evaluating two alternative empirical identification strategies. In both cases, we seek to identify an isolated shock to one of the two financing sources – bank loans or other sources of financing – by imposing additional zero restrictions on the respective alternative financing instrument. By doing so, we capture the impact of isolated variations in one source of financing on economic activity and prices, while controlling for monetary policy, aggregate demand and aggregate supply shocks. The results of this exercise suggest that negative shocks to bank loans lead to a strong and persistent decline in real GDP and the GDP deflator. In contrast, we do not find such effects for shocks to other financing sources. Taken together with the results from the benchmark model, this evidence can be interpreted as supporting the view of banking discussed above.

To some degree, our results also speak to the literature on the relation between finance and growth (see, for example, Demirgüç-Kunt and Levine, 2004; Levine, 2002, 2005). One finding of the seminal articles in this literature is that the relative importance of bank- or market-based financing does not have a major impact on real economic growth.[3]

[2]Whereas it is in principle conceivable that this reallocation has a positive effect on economic activity and prices because means of payments that were hoarded get back into circulation, this may not necessarily be the case. Accordingly, one would at least expect that the average effect of changes in other sources of financing on macroeconomic variables is orders of magnitude smaller than the direct one obtained when banks create additional purchasing power by granting new loans.

[3]Unrelated to our results, another insight from the papers cited above is that the overall level of financial intermediation, independent of its composition, has a positive impact on economic activity.

This finding has recently been challenged by Langfield and Pagano (2016), who argue that bank-based financial systems are associated with more financial instability and less growth. The seeming contradiction to our results stems from the different angles of analysis: Whereas they take a stock perspective, we focus on flows of financing. The negative impact on economic growth that the authors find might thus not derive from the size of the banking system per se, but rather from the crisis-driven deleveraging of the banking sector that leads to a reduction in bank loans, which in turn has negative repercussions on economic activity.

We draw two policy conclusions from our analysis. Firstly, persistent negative flows of bank loans, even when fully offset by positive flows of other sources of financing, might lead to subdued economic performance and make it harder for the Eurosystem to achieve its price stability target. Secondly, European policy makers have reacted to the decline in bank loans to the non-financial private sector with efforts to enhance the access to non-bank financing. The most prominent project in this regard is the Capital Markets Union initiated by the European Commission (2015). Whereas this project arguably has a series of benefits, such as increased cross-border risk-sharing, our results suggest that increasing the supply of other sources of financing might only provide a limited stimulus for the economy.

The rest of the paper is structured as follows. In Section 2 we describe our data set and the empirical strategy. In Section 3 we present the main empirical results and various robustness checks. In Section 4 we rationalize our findings with the recently revived view of banking discussed above. Finally, in Section 5 we briefly summarize our findings and draw conclusions.

2 Empirical model and identification

2.1 Empirical strategy

We explore the relation between different sources of external financing and economic activity for the euro area aggregate by means of a VAR analysis. More specifically, we expand the classic VAR commonly used for the analysis of the monetary policy transmission mechanism – which includes real GDP, the GDP deflator and a monetary policy indicator – by incorporating flows of bank loans and the interest rate on bank loans as well as flows of other sources of financing.[4] The structural form of our system of interest

However, more recent contributions such as Gambacorta, Yang, and Tsatsaronis (2014) show that above a certain threshold financial intermediation might become a drag on growth.

[4]The seminal contribution to this literature is Sims (1980). See Weber, Gerke, and Worms (2009); Bonci (2012); and Giannone, Lenza, and Reichlin (2012) for empirical evidence on the impact of monetary policy shocks on the real economy for the euro area. See Christiano, Eichenbaum, and Evans (1999) for a review of the first two decades of research on the US economy. As we extend the classic monetary policy VAR, an analysis at the level of the euro area aggregate is the natural choice. Given that the current account of the euro area as a whole was in balance most of the time, we furthermore avoid having to model the external dimension of the economy. At the individual euro area country level, bank credit creation can lead to strong spillovers across individual member states through the current account balance (Unger, 2017). Focusing on the euro area aggregate comes, however, at the expense of having to disregard potential cross-country heterogeneity.

is given by

$$\mathbf{A_0 y}_t = \mathbf{c} + \mathbf{A_1 y}_{t-1} + \mathbf{A_2 y}_{t-2} + ... + \mathbf{A_p y}_{t-p} + \mathbf{u}_t \tag{1}$$

where $\mathbf{y_t}$ is the $n \times 1$ vector of endogenous variables, $\mathbf{A_i}$ $(i = 0, ..., p)$ are $n \times n$ coefficient matrices, p is the lag order of the system and $\mathbf{u}_t$ is the $n \times 1$ vector of structural shocks. The reduced form representation of the model can be described as follows:

$$\mathbf{y}_t = \mathbf{k} + \mathbf{B_1 y}_{t-1} + \mathbf{B_2 y}_{t-2} + ... + \mathbf{B_p y}_{t-p} + \mathbf{e}_t \tag{2}$$

where $\mathbf{k} = \mathbf{A_0}^{-1}\mathbf{c}$, $\mathbf{B_i} = \mathbf{A_0}^{-1}\mathbf{A_i}$, $i = 1, ..., p$, and $\mathbf{e}_t = \mathbf{A_0}^{-1}\mathbf{u}_t$ represent the reduced form shocks.

The vector of endogenous variables is in turn given by

$$\mathbf{y}_t = \left[\Delta BL_t, i_t^{BL}, \Delta OF_t, RGDP_t, DEF_t, i_t^{MP}\right]' \tag{3}$$

where t is the time subscript, i_t^{MP} is the monetary policy indicator, DEF_t is the GDP deflator, $RGDP_t$ is the real gross domestic product, ΔBL_t and ΔOF_t are respectively flows of bank loans and other financing sources, and i_t^{BL} is the interest rate on bank loans. Over the last years the focus of monetary policy has shifted from conventional monetary policy that adjusts a short-term interest rate to unconventional monetary policy that tries to influence the longer end of the yield curve. Accordingly, we extend the $EONIA$ time series with the shadow rate by Wu and Xia (2016) from Q3 2008 onwards in our benchmark specification. Their shadow rate has a couple of appealing features: It has a low volatility and is therefore consistent with the idea of gradual changes in the stance of monetary policy, and it coincides with the normal policy rate in non-zero lower bound episodes, making it a natural extension of the latter. Furthermore, it does not feature very sharp and deep reductions, which would undermine its credibility as a reliable measure of the monetary policy stance. While a discussion of the technical merits/drawbacks of the different approaches to estimating shadow rates is beyond the scope of this paper, we use some alternative monetary policy indicators when we assess the robustness of the results in Section 3.2.

Whereas i_t^{MP} and i_t^{BL} enter in percentage points, DEF_t and $RGDP_t$ enter in log levels (multiplied by 100). ΔBL_t and ΔOF_t are the first difference of the log levels of the respective financing stock (multiplied by 100).[5] Including the external financing measures as (log) flows instead of as stocks ensures that they can be directly related to the macroeconomic variables, which are flow variables by definition.[6] As commonly done in the literature, we include the macroeconomic variables in levels to take into account potential cointegration relationships between the variables, while not explicitly modeling them (see Sims, Stock, and Watson, 1990). Appendix A provides details on our data sources. We estimate the model over a sample period from Q1 2000 to Q4 2015 using a

[5] As we are interested in changes in the stock of financing that are due to voluntary transactions of economic agents, we construct notional stocks by adding the cumulative flows to the initial stock of the respective form of financing.

[6] Relating macroeconomic *flow* variables to financing *stocks* in an analysis at the business cycle frequency would to some extent amount to comparing apples with oranges. See Biggs, Mayer, and Pick (2009) for a detailed discussion of the relation between credit flows/stocks and economic activity.

Bayesian estimation approach.[7] We use a lag order of $p = 2$ as suggested by the commonly used lag order selection criteria. However, the results for the benchmark model presented below are robust to including up to five lags. All eigenvalues of the different models presented lie within the unit circle, thereby rendering the VAR systems stable. The prior and posterior distributions of the model are of the commonly used Normal-Wishart type.[8]

2.2 Identification of structural shocks

In order to give the residuals obtained from the reduced form VAR estimates an economic interpretation, we identify six structural shocks based on sign and zero restrictions, using the algorithm developed by Arias et al. (2014). This algorithm has the benefit of not introducing additional sign restrictions on seemingly unrestricted variables, thereby avoiding potential biases in impulse response functions (IRFs). In our benchmark estimations we impose all restrictions only on impact. However, we have experimented with imposing the restrictions for up to three quarters and the results remain robust. We choose to identify a large number of structural innovations in order to pin down our shocks of interest as accurately as possible (see Paustian, 2007; Fry and Pagan, 2011).

In total, we identify three financing shocks. Following the spirit of Becker and Ivashina (2014), we identify an adverse bank loan supply shock as an innovation that is characterized by a decrease in the flow of bank loans and an increase in the flow of other sources of financing. The idea behind this (microeconomic) identification strategy is that an economic agent that raises a source of financing other than bank loans has a positive demand for financing and the reduction in bank loans must thus represent a restriction in its supply. To map this identification strategy to the macro-level and to ensure that we actually identify a bank loan supply and not a bank loan demand shock, we furthermore impose that the interest rate on bank loans increases.

To control for a general demand factor that might influence the evolution of bank loans and other sources of financing, we also identify a negative financing demand shock. In this case, both the flow of bank loans and other sources of financing and the interest rate on bank loans decrease. Following the logic for the identification of the bank loan supply shock, as a third financing shock we identify an innovation that features a decrease in the flow of other sources of financing and has a contemporaneous positive impact on flows of bank loans and the interest rate on bank loans. The positive response of the bank loan variables aims to capture the increase in bank loan demand in reaction to the reduction of other financing sources. As we already control for the endogenous response of other sources of financing to bank loan supply shocks and for a general financing demand shock, we loosely interpret this shock as an adverse other financing supply shock.[9]

[7] For all estimations we make use of the BEAR Toolbox for MATLAB developed by Dieppe, Legrand, and van Roye (2016). We thank Björn van Roye for sharing the Toolbox. Given the relatively short sample size, lag order (plus constant) and number of variables in the VAR ($n = 6$), estimating a classic VAR can potentially run into overfitting issues. In this regard, the prior shrinkage allowed for by Bayesian techniques represents an important advantage.

[8] The main results are robust to variations in the tightness of the Normal-Wishart prior and are also similar when using other priors like a Minnesota prior or an uninformative Normal-Diffuse prior.

[9] One obvious alternative would be to try to identify the adverse other financing supply shock by imposing restrictions on the response of the interest rate on other sources of financing. However, given the difficulties in finding a high quality measure for the interest rate on other sources of financing we

Furthermore, we include three structural shocks routinely identified in macro VARs: A monetary policy shock, an aggregate demand shock and an aggregate supply shock.[10] A restrictive monetary policy shock features an increase in the monetary policy indicator as well as in the interest rate on bank loans, and a decrease in the flow of bank loans and other sources of financing. An adverse aggregate demand shock is identified as an innovation that decreases real GDP, the GDP deflator and the monetary policy indicator. An adverse aggregate supply shock is characterized by a decrease in real GDP and an increase in the GDP deflator. The opposing sign restrictions for the reaction of the GDP deflator allow to disentangle these two shocks.[11] To distinguish the aggregate demand and supply shocks from the financing shocks and the monetary policy shock, we impose zero restrictions on the reactions of real GDP and the GDP deflator (see, for example, Breitenlechner et al. (2016) Eickmeier and Hofmann (2013), Gambacorta et al. (2014) and Peersman and Wagner (2015) for a similar identification strategy).

Combing zero and sign restrictions to identify the financing shocks is appealing because we allow economic activity to have an immediate effect on the financing variables via the aggregate demand and supply shocks. At the same time, we are able to uniquely identify financing demand and supply shocks in a clean and tractable manner. By doing so, we implicitly impose that the entire contemporaneous correlation between the real economy and the financing variables reflects causation running from the former to the latter.[12] This can be seen as a conservative approach and prevents us from attributing too much explanatory power to the financing shocks. The two financing supply shocks can be thought of as reflecting changes in the risk-taking behavior or the equity constraints of the respective provider of financing. The financing demand shock in turn can be thought of as representing changes in the propensity of private households and non-financial corporations to leverage/deleverage. Table 1 below summarizes the sign and zero restrictions that we impose to identify our six structural shocks.

refrain from doing so. We also experimented with identifying an adverse other financing supply shock as an innovation that decreases the flow of other sources of financing and has no impact on the flow of bank loans as well as the interest rate on bank loans. By doing so, we avoid the indirect identification of the other financing supply shock via the response of bank loan demand. The results with this kind of identification are very similar to the ones presented below.

[10] As a robustness check we also estimated partially identified models that include only the three financing shocks. The results are almost identical to the ones we show and discuss below.

[11] For the aggregate supply shock we do not put a restriction on the response of the monetary policy indicator, as is sometimes done in the literature. The reason for doing so is that, from a theoretical perspective, the response of the monetary policy authority will depend on the shape of the IS and Philipps curves, as well as on its preferences regarding inflation and output stability. Accordingly, the correct sign of the response of the policy indicator to an aggregate supply shock is undetermined. Note that the restrictions we impose are sufficient to uniquely identify all shocks.

[12] In doing so, we and the papers cited above follow the seminal paper by Christiano et al. (1996), who augment the classical monetary policy VAR by various flow of funds variables and order them last in their Cholesky decomposition, implying that the financing variables have no contemporaneous impact on economic activity.

	Response of					
Shock	**ΔBL**	**i^{BL}**	**ΔOF**	**i^{MP}**	**RGDP**	**DEF**
Bank loan supply	-	+	+	?	0	0
Other financing supply	+	+	-	?	0	0
Financing demand	-	-	-	?	0	0
Monetary policy	-	+	-	+	0	0
Aggregate demand	?	?	?	-	-	-
Aggregate supply	?	?	?	?	-	+

Table 1: Sign and zero restrictions imposed for shock identification.

3 Empirical results

3.1 Benchmark models

We now turn to our main empirical analysis. Figure 2 below shows the IRFs for all shocks (rows) and response variables (columns). Each chart shows the dynamic response of the respective variable to a one standard deviation shock over a time horizon of 20 quarters. The solid black, upper dashed red and lower dashed red lines represent, respectively, the median, the 16th percentile and the 84th percentile of the posterior distribution. We interpret a shock as having an economically important positive or negative impact on the response variable when the mass of the posterior distribution – summarized by the 16th and 84th percentiles – lies above or below the zero line. The median can be thought of as a central tendency of the draws that satisfy the sign and zero restrictions.

We start by reviewing the effects of the three classic macro shocks. In line with the literature, a contractionary monetary policy shock has a negative impact on output which is both immediate and persistent. Prices respond negatively, but it takes several quarters for this effect to materialize. A prize puzzle that can sometimes be observed in monetary VARs is not present. The effect of the monetary policy shock on bank lending also shows some persistence beyond the assumed negative effect on impact. In contrast, the effect on other financing flows fades out relatively quickly. The aggregate demand shock has a persistent effect on both output and prices, while at the same time generating a negative response of bank loan flows and the interest rate on bank loans. Other financing flows are largely unaffected by this shock. Finally, the aggregate supply shock has a persistent negative impact on output (though with a wide credibility set) and a relatively short-lived positive effect on prices. While both interest rates in the model respond negatively, financing flows are not much affected.

Next, we turn to the financing shocks. The adverse financing demand shock induces a negative and relatively persistent response from the interest rate variables in the model, with the negative effect on financing flows being more short-lived. Output reacts negatively to the adverse financing demand shock for the first four quarters, but then fades out gradually. The median effect on prices is negative, with the credibility set almost always including the zero line, the exception being quarters four to nine.

For the financing supply shocks there are some stark differences. First and foremost, adverse bank loan supply shocks have a persistent negative impact on both output and,

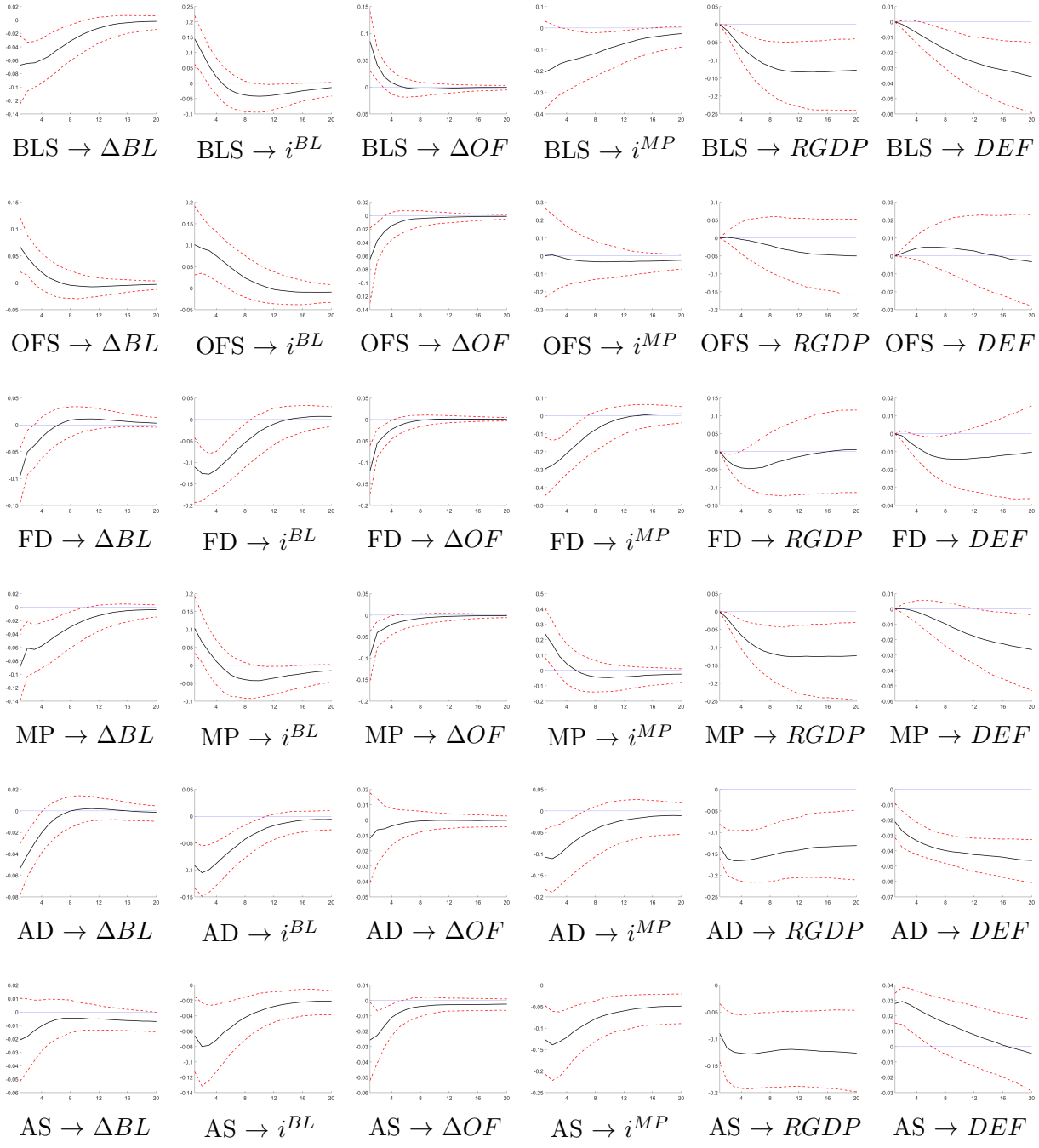

Figure 2: Impulse response functions for a one standard deviation shock for the benchmark model (Notes: BLS=bank loan supply, OFS=other financing supply, FD=financing demand, MP=monetary policy, AD=aggregate demand, AS=aggregate supply. The solid black, upper red dashed and lower red dashed lines represent respectively the median, the 16th percentile and the 84th percentile of the posterior distribution.)

with a time lag of five quarters, prices with a high posterior probability. This effect comes about in spite of a strong increase in flows of other financing sources. In contrast, an adverse other financing supply shock does not lead to a significant response of output or prices. Negative bank loan supply shocks also result, after some quarters, in a negative response of the monetary policy variable. Other financing supply shocks, in contrast, lead to no reaction from the monetary policy variable, with the median response almost exactly on the zero line and bands roughly symmetric around it.

An additional way to gauge the importance of shocks in a VAR system is by means of a forecast error variance decomposition (FEVD). Figure 3 below presents the results for the benchmark model. We base the FEVD on the so-called median target IRFs as suggested by Fry and Pagan (2011). They argue against using the median values of the posterior distribution, as these might come from different models, thereby potentially being correlated and not summing up to one.[13]

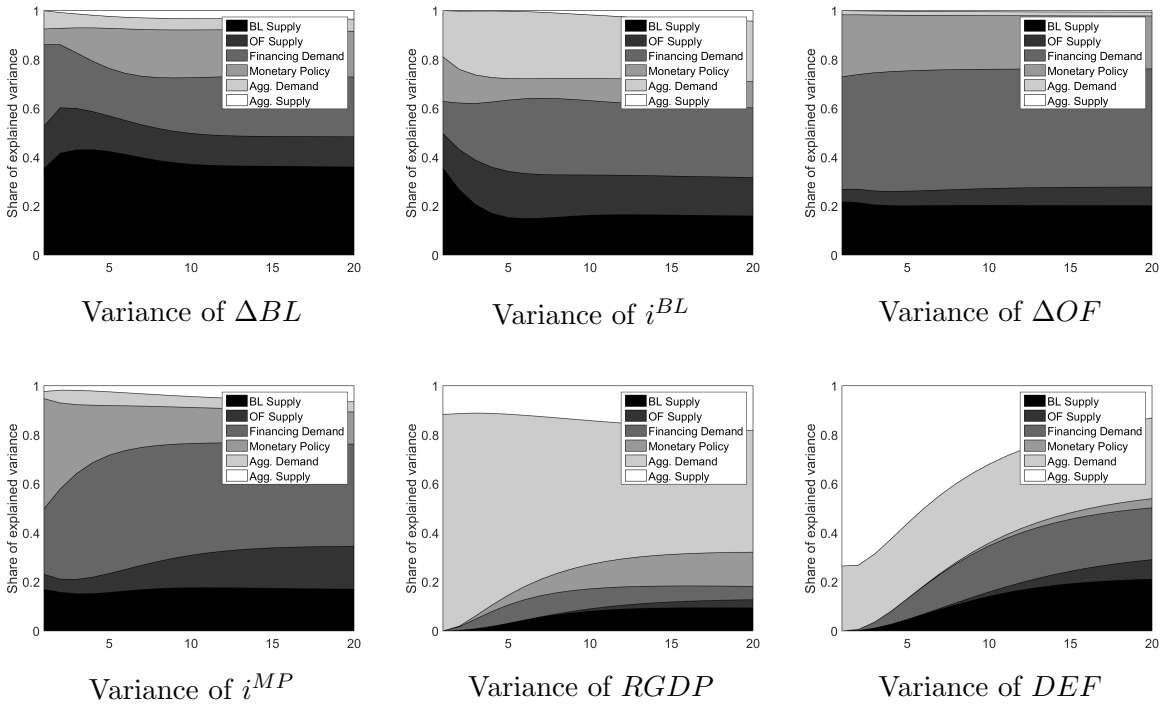

Figure 3: Forecast error variance decomposition for the benchmark model (Notes: The forecast error variance decomposition is based on the median target approach according to Fry and Pagan (2011).)

At a horizon of twenty quarters the three financing shocks taken together explain on average sixty percent of the variance of bank loan flows, the interest rate on bank loans and the monetary policy indicator, and eighty percent of the variance of other financing flows. They can also account for around one third of the variation of real GDP and the GDP deflator. Comparing the explanatory power of the two supply shocks, we confirm

[13] As we draw inference based on the mass of the probability distribution and not on a central tendency such as the median IRFs, we do not show the median target in the figures with the IRFs in order to improve readability.

our results from the analysis of the IRFs: Bank loan supply shocks are responsible for almost twenty percent of the variance of output and around fifteen percent of the variance of prices. In contrast, other financing supply shocks explain only around five percent of the variation of real GDP and essentially nothing of the variance of the GDP deflator. Financing demand shocks account for around five percent of the variation of output and almost fifteen percent of prices. As expected, the bulk of the variance of economic activity and prices is explained by aggregate demand and aggregate supply shocks, with monetary policy only playing a recognizable role for real GDP.

Our findings regarding the effect of bank loan supply shocks on economic activity and prices are in line with the existing literature (see, for example, Busch et al., 2010; Cappiello et al., 2010; de Bondt et al., 2010; Hristov et al., 2012; Moccero et al., 2014; Altavilla et al., 2015; Gambetti and Musso, 2016). However, these contributions do not include alternative sources of financing, which might act as a "spare tire" for the loss of bank loan financing. We strengthen the results from the existing literature by showing that they still hold even when accounting for the endogenous response of alternative (i.e. non-bank) sources of financing. Given that other sources of financing react strongly to the reduction in bank loans, our findings suggest that an imperfect substitutability of bank loans – i.e. the inability to obtain other sources of financing when faced with a negative bank loan supply shock – might not be the only reason that makes bank loans a special source of financing. We provide a potential rationalization of our findings after demonstrating that the results of our benchmark model are robust to various modifications.

3.2 Robustness

The following subsection is devoted to checking the robustness of our benchmark model along two dimensions. Firstly, we explore whether our results still hold when we use a different measure for the monetary policy indicator. Secondly, we evaluate whether we can confirm our findings for non-financial corporations and when restricting other financing sources to debt instruments only. To keep the main body of the paper at a reasonable length, we focus the discussion on the response of real GDP and the GDP deflator to our two shocks of main interest – the bank loan supply and the other financing supply shock – and, in case of different measures of the monetary policy indicator, also on the monetary policy shock.[14]

3.2.1 Alternative monetary policy indicators

Given the complexity of unconventional monetary policies, the estimates for the (unconventional) monetary policy indicator strongly depend on theoretical assumptions on how developments on the long end of the yield curve can be mapped to a single short-term interest rate. In our benchmark model, we have chosen an established contribution to the literature, the shadow rate by Wu and Xia (2016), which can be retrieved from the authors' website and also from the website of the Federal Reserve Bank of Atlanta. While a discussion of the technical merits of different estimates for the monetary policy indicator

[14]For all specifications considered in the robustness checks, the responses of the three classic macro shocks and the financing demand shock are very much in line with those of the benchmark specification shown in Figure 2. The full set of IRFs is available upon request.

at the lower bound of interest rates is beyond the scope of this paper, we investigate some alternatives to the benchmark specification to assess the robustness of our results.

Firstly, given that one could argue that the first set of unconventional monetary policies of the Eurosystem such as the full allotment policy still worked mainly through the short end of the yield curve, we extend the EONIA series with the Wu and Xia (2016) shadow rate only from Q2 2011 onwards. Monetary policy measures implemented after that point, such as the Securities Market Program (SMP) or the long-term refinancing operations (LTROs), certainly had an impact on longer rates and thus provide another potential cut-off date. Secondly, we use an alternative to a shadow rate, namely a measure for the effective monetary stimulus, developed by Halberstadt and Krippner (2016). This indicator incorporates current and expected interest rates along the whole yield curve more directly and is less subject to alterations in modeling choices. Thirdly, given the inherent difficulty in capturing unconventional monetary policy appropriately, we simply use the EONIA for the whole sample period. Our results are presented in Figure 4 below.

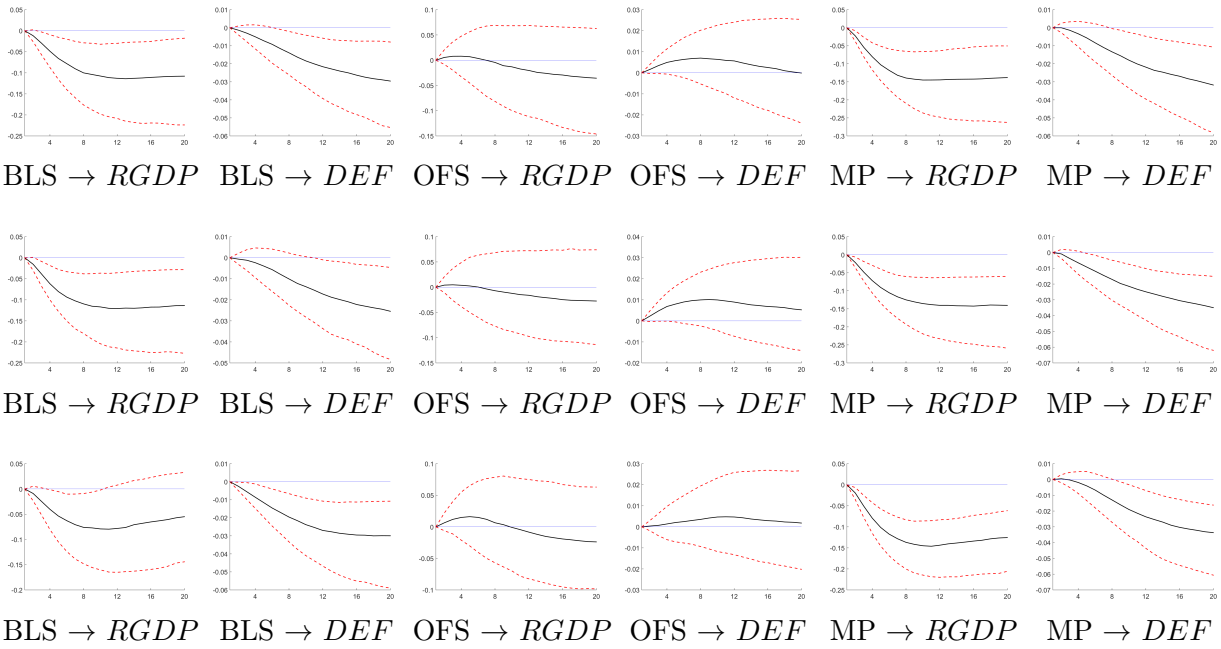

Figure 4: Impulse response functions for a one standard deviation shock using alternative monetary policy indicators (Notes: BLS=bank loan supply, OFS=other financing supply, MP=monetary policy. Monetary policy indicator: First row: Wu and Xia (2016) shadow rate from Q2 2011. Second row: Halberstadt and Krippner (2016) effective monetary stimulus. Third row: EONIA. The solid black, upper red dashed and lower red dashed lines represent respectively the median, the 16th percentile and the 84th percentile of the posterior distribution.)

Whereas the responses to the monetary policy shock remain unaffected in all cases, we can observe some smaller differences for the bank loan supply shock. More specifically, for the estimations using EONIA, the response of real GDP is no longer different from zero with a high posterior probability from around quarter ten onwards and features a more hump-shaped response. In the other two cases the bank loan supply shock continues to have an economically important and persistent impact on real GDP and the GDP deflator. For the other financing supply shock, we confirm in all specifications that neither real GDP

nor the GDP deflator show a reaction that is different from zero with a high posterior probability.

3.2.2 Sector and instrument decomposition

In a next step, we test the robustness of our results to variations in the sectoral composition, and to the financial instruments included in the flows of other financing sources. One of the assumptions underlying our identification scheme is that an adverse financing demand shock will reduce the flow of both bank loans and flows of other sources of financing. Given that other sources of financing include a quite diverse subset of financing instruments, that might not necessarily be the case. For example, highly leveraged non-financial corporations might want to reduce their indebtedness by paying down debt instruments, while still issuing equity instruments to finance their investments. Accordingly, we re-estimate the benchmark model for the non-financial private sector with other financing sources limited to debt instruments. Given that debt can be defined in various ways, we focus on two polar approximations. On the one hand, we define debt very narrowly and limit it to include only loans from non-banks and debt securities – narrow debt. On the other hand, we construct a very broad measure by defining debt as all sources of external financing other than bank loans and equity – broad debt. The results are shown in Figure 5 below.

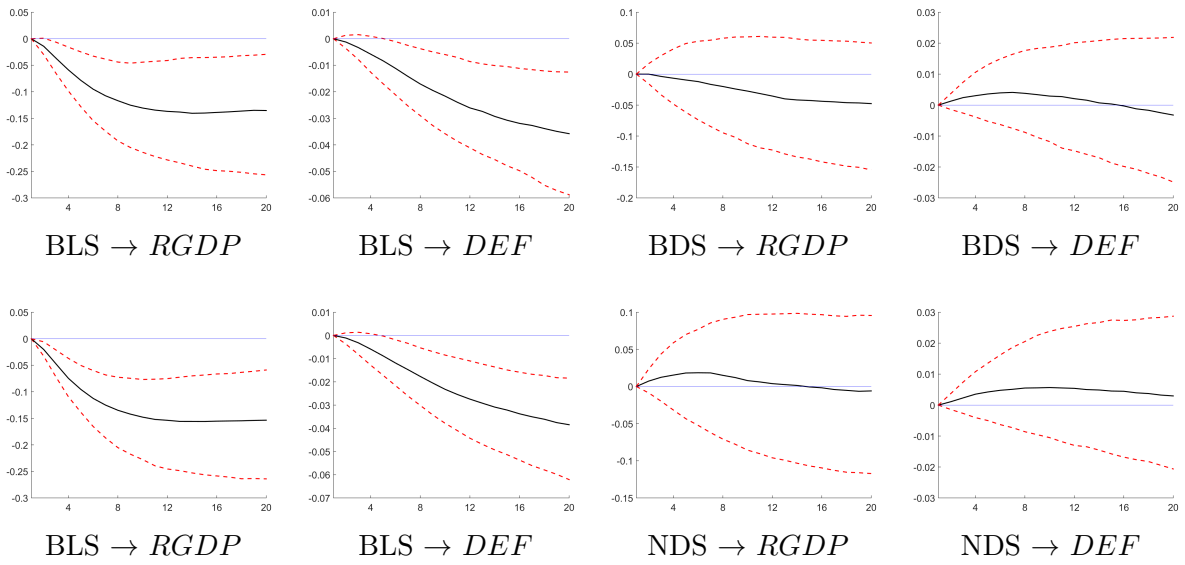

Figure 5: Impulse response functions for a one standard deviation shock using different decompositions of other financing instruments for the non-financial private sector (Notes: BLS=bank loan supply, NDS=narrow debt supply, BDS=broad debt supply. First row: Broad debt (all financing other than bank loans and equity). Second row: Narrow debt (loans from non-banks and debt securities). The solid black, upper red dashed and lower red dashed lines represent respectively the median, the 16th percentile and the 84th percentile of the posterior distribution.)

The estimates suggest that for the non-financial private sector an adverse bank loan supply shock again has a negative and persistent effect on real GDP and the GDP deflator for both approximations of debt with a high posterior probability. In contrast and as in the

benchmark model, negative shocks to the supply of other debt, be it broadly or narrowly measured, do not have an economically important impact on our two macroeconomic variables of interest.

Our benchmark model includes flows of financing to both non-financial corporations and private households, as these two sectors together represent the majority of the total spending power of the economy. Among these two sectors non-financial corporations are commonly perceived as particularly important for the transmission of monetary policy to the real economy. Accordingly, we re-estimate the benchmark model as well as the two models with financing sources limited to debt instruments for non-financial corporations only. The results are shown in Figure 6 below.

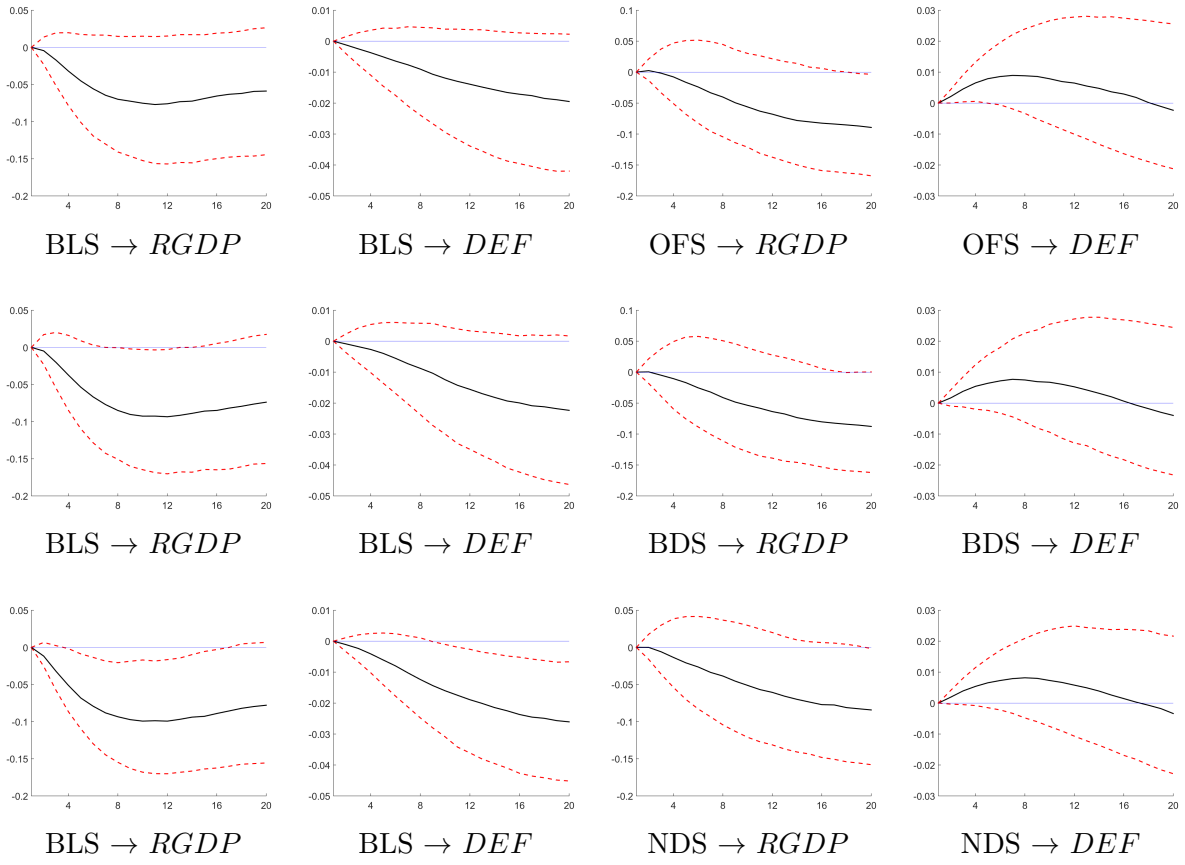

Figure 6: Impulse response functions for a one standard deviation shock using different decompositions of other financing instruments for non-financial corporations (Notes: BLS=bank loan supply, OFS=other financing supply, NDS=narrow debt supply, BDS=broad debt supply. First row: Other financing (all financing other than bank loans). Second row: Broad debt (all financing other than bank loans and equity). Third row: Narrow debt (loans from non-banks and debt securities). The solid black, upper red dashed and lower red dashed lines represent respectively the median, the 16th percentile and the 84th percentile of the posterior distribution.)

For the benchmark model with non-financial corporations and other financing sources, we can confirm the negative and persistent effect of an adverse bank loan supply shock on real GDP and the GDP deflator for the median response, but the upper bound of the posterior distribution is always sightly above zero. When a broad definition of debt

is used, the upper bound is again slightly above zero as in our estimates with other financing including equity instruments. However, the adverse bank loan supply shock has a persistent negative impact on real GDP and the GDP deflator with a high posterior probability when debt is defined narrowly. Note that this latter setup corresponds most closely to the one used in the papers cited above on which we base our identification strategy. Furthermore, we again confirm in all our models that adverse shocks to the supply of broadly and narrowly defined debt do not have an economically important impact on real GDP or the GDP deflator.

4 Why are bank loans special?

Bank loans are commonly perceived as a special source of financing, particularly for small and medium-sized enterprises (SMEs), because presumably there is only a limited ability to substitute a reduction in bank loan supply with other sources of financing.[15] Accordingly, when banks reduce their supply of loans to the non-financial private sector, spending on investment and consumption has to be cut back, since no alternative sources of financing can be obtained. However, our empirical results show that other financing sources expand quite strongly in response to a negative bank loan supply shock. Since the impulse responses for flows of bank loans and other sources of financing are not directly comparable, we do not know whether the reduction in funding obtained via bank loans is balanced one-to-one by an increase in other sources of financing. Nonetheless, the findings suggest that imperfect substitutability might not be the only reason why bank loans have a strong impact on economic activity.

Another potential explanation for our results can be found in a recently revived view of the functioning of the banking system. This notion holds that credit institutions differ in a fundamental way from all other financial intermediaries: When banks originate new loans, they create additional means of payment in the form of deposits and increase the aggregate nominal purchasing power of the economy.[16] In contrast, all other types of financial intermediation simply reallocate an existing stock of means of payment and the corresponding purchasing power. Accordingly, a bank loan supply shock might have negative repercussions on the real economy even when other sources of financing could fully compensate the reduction in bank loans, since replacing bank loans with other sources of financing implies an effective loss in nominal purchasing power.

We provide some intuition for this idea with the help of simple balance sheet diagrams. Our stylized economy consists of four agents: A bank, a financial intermediary (for example, a pension fund or a shadow bank), and two households. The economy is endowed

[15] We focus here on the question of why bank *loans* are a special source of financing. On top of that question, there are many features or functions that make *banks* a special kind of financial institution, such as relationship lending, liquidity insurance and transformation, maturity transformation, delegated monitoring and the reduction of asymmetric information. See Freixas and Rochet (2008) for a good overview and references.

[16] See, for example, Borio and Disyatat (2010, 2011); Disyatat (2011); McLeay et al. (2014); Jakab and Kumhof (2015). This view has a long tradition in the history of economic thought, and can be traced back at least to Wicksell (1936) and Schumpeter (1934), among others. In relation to the argument put forward in this section, the latter wrote: "The banker, therefore, is not so much primarily a middleman in the commodity 'purchasing power' as a *producer* of this commodity" (Schumpeter (1934, p. 74), emphasis in original).

with a fixed amount of goods that are purchased by the households. The bank creates new deposits when it extends loans. These deposits are used as the means of payment by all agents. The financial intermediary issues debt instruments to obtain deposits and then lends them on to borrowers. One household has at the beginning no assets and liabilities and wants to borrow. A second household already holds deposits and has a positive net worth. Figure 7 below shows a stylized example of financial intermediation that is, however, representative of more complex financial intermediation chains.

The balance sheets described above are the starting point. In a first step, household II lends its deposit to the financial intermediary and receives in return a claim on the financial intermediary in the form of a debt instrument. In a second step, the financial intermediary then lends the deposits to household I. Household I thereby incurs a liability to the financial intermediary in the form of the loan. In both steps the deposits are transferred between the households and the financial intermediary by the bank, whose liabilities remain unchanged. By lending its deposits to household I via the financial intermediary, household II simultaneously transfers its purchasing power, as it no longer possesses means of payment to purchase goods. Accordingly, the aggregate purchasing power of the economy remains unchanged.

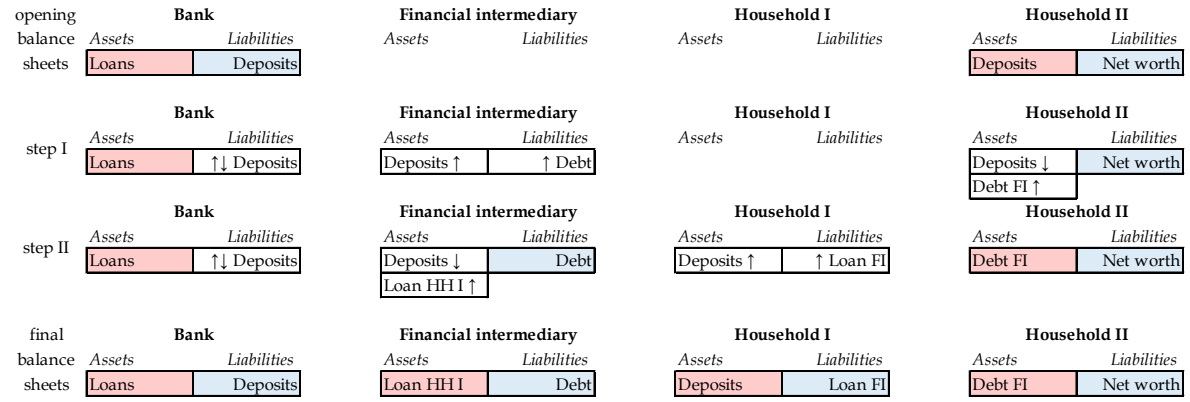

Figure 7: Financial intermediation (Source: The authors' own illustration. Notes: Balance sheet items highlighted in red and blue represent stocks of assets and liabilities, respectively. Non-highlighted items with accompanying arrows represent flows of asset and liabilities, with ↑ indicating an inflow and ↓ indicating an outflow of the respective asset or liability.)

Consider next credit creation by a bank as illustrated in Figure 8 below. Instead of borrowing the already existing deposits from the financial intermediary, household I now approaches the bank for a loan. The bank satisfies this request by simultaneously creating a new deposit and a claim in the form of the loan to household I. The deposit balance of household II remains unaffected by this process. As deposits are used as the means of payment, the nominal aggregate purchasing power of the economy has increased by the amount of the newly created deposits.[17]

[17]Note that whereas new deposits are initially created when the bank loan is originated, they might be ultimately replaced by other funding instruments such as bonds, depending on the financing choice of the bank and the preferences in terms of asset allocation of the bank's creditors.

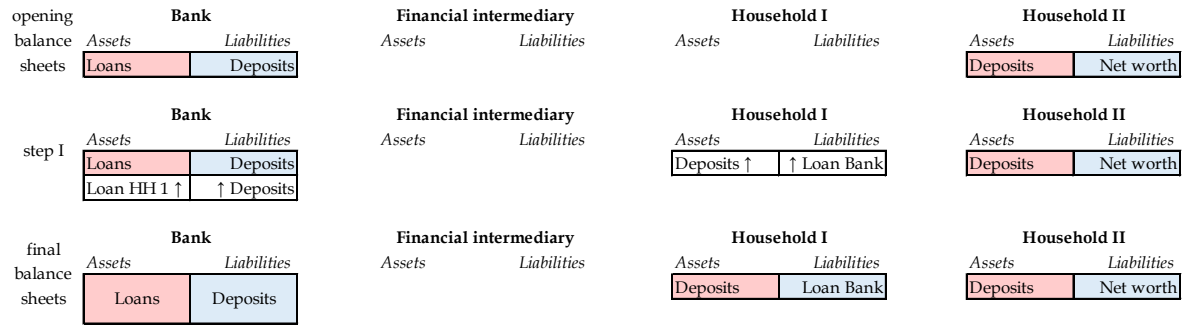

Figure 8: Bank credit creation (Source: The authors' own illustration. Notes: Balance sheet items highlighted in red and blue represent stocks of assets and liabilities, respectively. Non-highlighted items with accompanying arrows represent flows of asset and liabilities, with ↑ indicating an inflow and ↓ indicating an outflow of the respective asset or liability.)

Given that in our highly stylized example the supply of goods is assumed to be fixed, this increase in nominal aggregate purchasing power will simply raise the price of these goods. In a more complex setup, with rigid prices, potential spare capacity and/or hysteresis effects, this increase in nominal aggregate purchasing power will also have at least a temporary positive effect on real output.

A logical consequence of this view of banking is that an increase in bank loans, independent of whether this is driven by supply or demand factors, should have a positive impact on real GDP and the GDP deflator, because there is an effective increase in nominal purchasing power. In contrast, an increase in the supply of or demand for other sources of financing will simply reallocate nominal purchasing power between creditors and debtors. Whereas it is in principle conceivable that this reallocation has a positive effect on economic activity and prices because means of payments that were hoarded get back into circulation, this may not necessarily be the case. Accordingly, one would at least expect that the average effect of changes in other sources of financing on macroeconomic variables is orders of magnitude smaller than the direct one obtained when banks create additional purchasing power by granting new loans.

We test this hypothesis by investigating two alternative identification strategies. In the first alternative we explore, we alter the original identification scheme by imposing zero restrictions on flows of other financing for the bank loan supply shock and correspondingly on flows of bank loans and the interest rate on bank loans for the other financing supply shock. In this way we identify bank loan supply and other financing supply shocks that do not affect the flows of the alternative source of financing, allowing us to evaluate the response of economic activity and prices to shocks that move *only* one source of financing. The three classic macro shocks as well as the financing demand shock are identified as in the benchmark model. The identification scheme is summarized in Table 3 in Appendix C, while the results are shown in Figure 9 below.

Bank loan supply shocks move bank loans and leave other financing roughly unchanged. This shock has a negative impact on both the real GDP and the GDP deflator with a high posterior probability. In contrast, other financing supply shocks are characterized by a strong decline in other financing, with no noticeable change in bank loans, and do not have an economically important effect on either economic activity or prices.

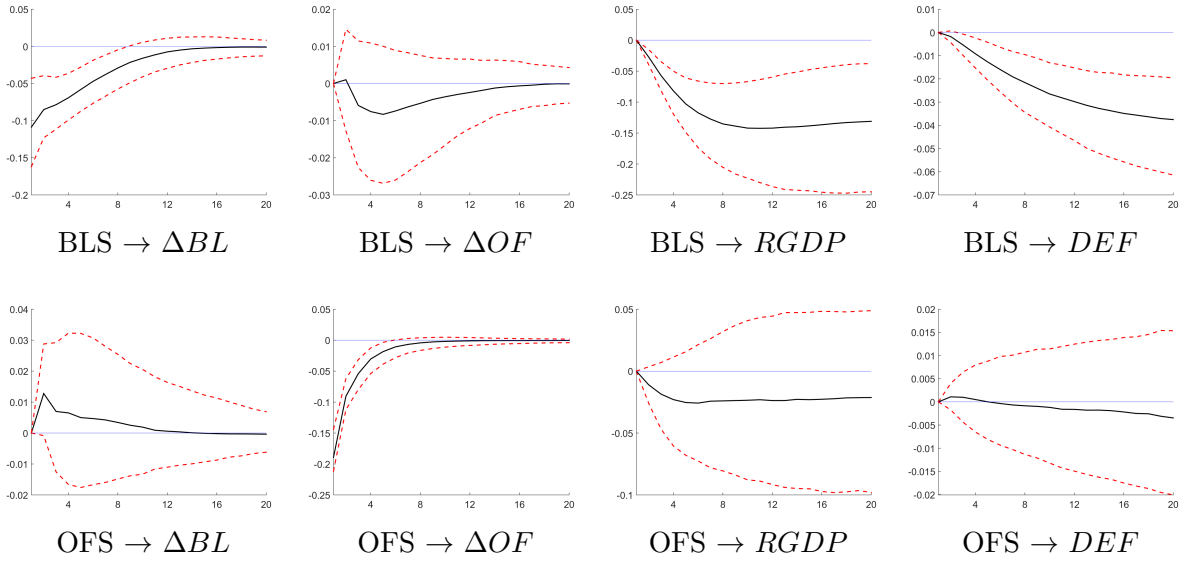

Figure 9: Impulse response functions for a one standard deviation shock for alternative specification I (Notes: BLS=bank loan supply, OFS=other financing supply. The solid black, upper red dashed and lower red dashed lines represent respectively the median, the 16th percentile and the 84th percentile of the posterior distribution.)

In the second alternative, we simplify both our model and identification scheme. In terms of the model, we drop the interest rate on bank loans, which was previously used to disentangle the bank loan supply shock from other financial innovations. As before, we still identify the three classic shocks. But instead of having three financing shocks that discriminate between supply and demand factors, we now estimate only a "bank loan" shock and an "other financing" shock. In both cases, the response of the respective alternative source of financing is restricted to zero, along with the response of real GDP and the GDP deflator. Whereas these two shocks lack a clear interpretation with respect to the question of whether they are driven by supply or demand factors, they have the benefit of showing the response of economic activity to an isolated shock to one of the two sources of financing. Furthermore, we still control for the structurally interpretable three classic shocks. The sign and zero restrictions we impose are summarized in Table 4 in Appendix C. Figure 10 below presents the results of this restricted model, focusing again on our two shocks of main interest.

The bank loan shock leads to a strong and persistent decline in bank loan flows. In contrast, other financing sources respond neither on impact nor later on. Accordingly, the shock captures the pure impact of flows of bank loans on our two macroeconomic variables of interest. Both real GDP and the GDP deflator decrease sharply and persistently in response to the bank loan shock with a high posterior probability. The other financing shock leads to a reduction in the flow of other sources of financing that is on impact stronger than the response of flows of bank loans to the bank loan shock, but less persistent. Flows of bank loans show a small positive reaction on impact, but the effect quickly fades out. As in the case of the bank loan shock, this shock thus captures to a reasonable degree an isolated movement of other financing sources. In contrast to the bank loan shock, both real GDP and the GDP deflator show no response in reaction to the negative

shock to other sources of financing. Taken together, both identification strategies lead to the conclusion that an isolated negative shock to bank loans has a negative impact on key macroeconomic variables, whereas a shock to other sources of financing does not.

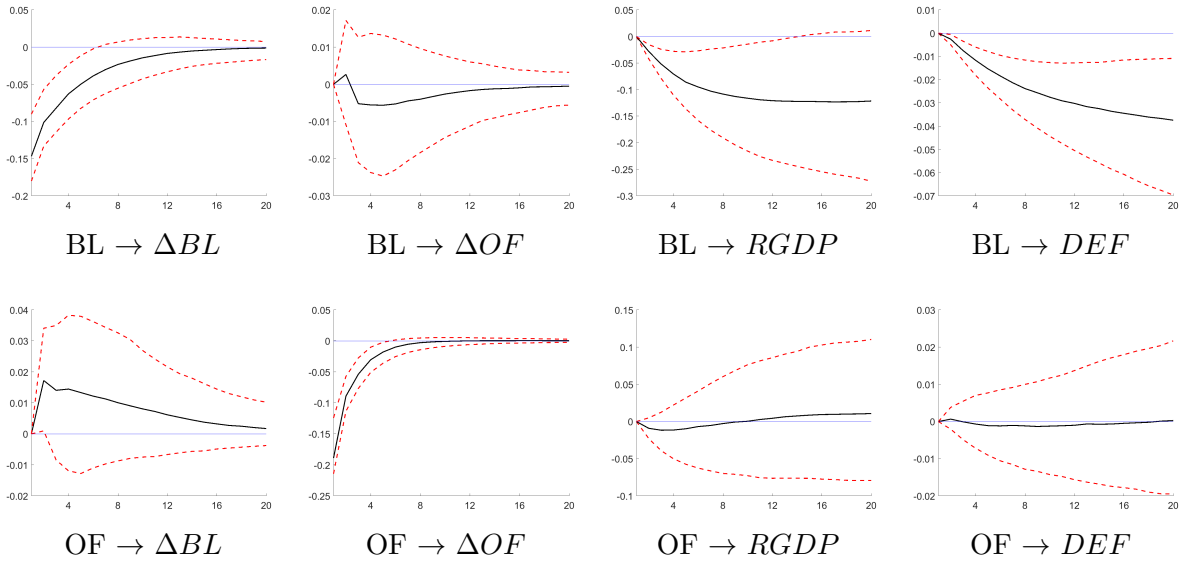

Figure 10: Impulse response functions for a one standard deviation shock for alternative specification II (Notes: BL=bank loans, OF=other financing. The solid black, upper red dashed and lower red dashed lines represent respectively the median, the 16th percentile and the 84th percentile of the posterior distribution.)

Our interpretation of bank loans as a special financing instrument due to the creation of additional nominal purchasing power can be seen as complementary to the work of Adrian et al. (2013), cited in the introduction. They argue that one dollar of bank financing is different from one dollar of bond financing because a reduction in bank credit supply leads to a spike in the risk premium as measured by the "excess bond premium" (Gilchrist and Zakrajšek, 2012). The latter is then linked to a decline in macroeconomic activity. Arguably, the changes in the nominal purchasing power of the economy as a result of reductions in the supply of bank loans that we highlight might be the deeper link between the procyclicality of bank's balance sheets and spikes in risk premiums documented by Adrian et al. (2013).[18] Put differently, the increase in risk premiums can be regarded as the *proximate* cause for the decline in activity, whereas the *ultimate* cause can be found in the destruction of nominal purchasing power associated with the (procyclical) reduction in bank loans.

5 Conclusions

The outbreak of the global financial crisis marked the beginning of a time period during which bank loan supply restrictions may have been an important driver of bank credit growth. The post-crisis years have also been characterized by a significant shift in the

[18]See Park (2016) for a detailed discussion of this idea.

composition of flows of external financing instruments of the non-financial private sector of the euro area from bank loans to other sources of financing such as equity, debt securities and loans from non-banks. Taken together, these developments suggest that other sources of financing acted as a "spare tire" and potentially mitigated the negative impact of adverse bank loan supply shocks on the economy. To take this endogenous reaction of other sources of financing into account, we identify adverse bank loan supply shocks as innovations that feature a decrease in the flow of bank loans and the interest rate on bank loans and an increase in flows of other sources of financing.

Our empirical results indicate that negative bank loan supply shocks do have a strong and persistent negative impact on real GDP and the GDP deflator with a high posterior probability even though other sources of financing strongly increase in response to the reduction in bank loans. This finding suggests that a limited ability to substitute a reduction in bank loan supply with other sources of financing might not be the only reason why bank loans are a special source of financing. Instead, we argue that our results may be rationalized by a recently revived view of banking, which holds that banks increase the nominal purchasing power of the economy when they create additional deposits in the act of lending. We substantiate this hypothesis by showing that for shocks that only move either bank loans or other sources of financing, only the former has a strong and persistent impact on economic activity and prices.

We draw two policy conclusions from our analysis. Firstly, persistent negative flows of bank loans, even when fully offset by positive flows of other sources of financing, might lead to subdued economic performance and make it harder for the Eurosystem to achieve its price stability target. Secondly, European policy makers have reacted to the decline in bank loans to the non-financial private sector with efforts to enhance the access to non-bank financing. The most prominent project in this regard is the Capital Markets Union initiated by the European Commission (2015). Whereas this project arguably has a series of benefits, such as increased cross-border risk-sharing, our results suggest that increasing the supply of other sources of financing might only provide a limited stimulus for the economy.

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A Data sources

Variable	Time series identifier	Transformation
i^{MP}	EONIA (FM.Q.U2.EUR.4F.MM.EONIA.HSTA) & shadow rate from Wu and Xia (2016)	EONIA until 08 Q2, shadow rate from 08 Q3
DEF	MNA.Q.N.I8.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.D.N	4-quarter moving average
$RGDP$	MNA.Q.N.I8.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.LR.N	4-quarter moving sum
BL	BSI.M.U2.N.A.A20.A.1.U2.2240.Z01.E + $\sum$ BSI.M.U2.N.A.A20.A.4.U2.2240.Z01.E + BSI.M.U2.N.A.A20.A.1.U2.2250.Z01.E + $\sum$ BSI.M.U2.N.A.A20.A.4.U2.2250.Z01.E	initial stock updated with monthly flows
i^{BL}	MIR:M:U2:B:A2A:A:R:A:2240:EUR:N ($i^{BL,NFC}$) MIR.M.U2.B.A2B.A.R.A.2250.EUR.N ($i^{BL,CON}$) MIR.M.U2.B.A2C.A.R.A.2250.EUR.N ($i^{BL,HOU}$) MIR.M.U2.B.A2D.A.R.A.2250.EUR.N ($i^{BL,OTH}$)	See Appendix B
OF	QSA.Q.N.I8.W0.S11.S1.N.L.LE.F._Z._Z.XDC._T.S.V.N._T + $\sum$ QSA.Q.N.I8.W0.S11.S1.N.L.F.F._Z._Z.XDC._T.S.V.N._T + QSA.Q.N.I8.W0.S1M.S1.N.L.LE.F._Z._Z.XDC._T.S.V.N._T + $\sum$ QSA.Q.N.I8.W0.S1M.S1.N.L.F.F._Z._Z.XDC._T.S.V.N._T	initial stock updated with quarterly flows minus BL

Table 2: Variable definitions and sources for the benchmark models (Notes: All time series except for the shadow rate are obtained from the ECB's Statistical Data Warehouse.)

B Constructing interest rates on bank loans

The interest rates on bank loans in general represent weighted averages for the respective sectors and instruments. More specifically, the interest rate on bank loans for the non-financial private sector i_t^{BL} is calculated as follows:

$$i_t^{BL} = \frac{|\Delta BL_t^{NFC}|}{|\Delta BL_t^{NFC}| + |\Delta BL_t^{PH}|} * i_t^{BL,NFC} + \frac{|\Delta BL_t^{PH}|}{|\Delta BL_t^{NFC}| + |\Delta BL_t^{PH}|} * i_t^{BL,PH} \quad (4)$$

where $|\Delta BL_t^{NFC}|$ and $|\Delta BL_t^{PH}|$ are respectively the absolute values of flows of bank loans to non-financial corporations and private households, $i_t^{BL,NFC}$ is the interest rate on bank loans to non-financial corporations and $i_t^{BL,PH}$ is the interest rate on bank loans to private households, which is constructed as an average of the interest rates on loans to private households for consumption ($i_t^{BL,CON}$), house purchase ($i_t^{BL,HOU}$) and other lending ($i_t^{BL,OTH}$) weighted by the share of the absolute value of flows of bank loans of the corresponding subcategories in the sum of the absolute values of flows of these

subcategories of bank loans to private households.[19] When we estimate models for non-financial corporations separately, we use ΔBL_t^{NFC} and $i_t^{BL,NFC}$.

C Additional tables

	Response of					
Shock	**ΔBL**	**i^{BL}**	**ΔOF**	**i^{MP}**	**RGDP**	**DEF**
Bank loan supply	-	+	0	?	0	0
Other financing supply	0	0	-	?	0	0
Financing demand	-	-	-	?	0	0
Monetary policy	-	+	-	+	0	0
Aggregate demand	?	?	?	-	-	-
Aggregate supply	?	?	?	?	-	+

Table 3: Sign and zero restrictions imposed for shock identification: Alternative identification II

	Response of				
Shock	**ΔBL**	**ΔOF**	**i^{MP}**	**RGDP**	**DEF**
Bank loan	-	0	?	0	0
Other financing	0	-	?	0	0
Monetary policy	-	-	+	0	0
Aggregate demand	?	?	-	-	-
Aggregate supply	?	?	?	-	+

Table 4: Sign and zero restrictions imposed for shock identification: Alternative identification III

[19] As the time series for the interest rate on other lending does not start until the first quarter of 2003, we use the interest rate on lending for house purchase instead up until then.

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