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The Loan Puzzle. A Study of Loans to Different Groups in the USA.

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The Loan Puzzle.
A Study of Loans to Different Groups in the USA.

Abstract

We study loans from banking and non-banking lenders to different groups of borrowers in order to unveil significant differences on how those respond to a shock and evaluate possible alternative explanations for such differences. The objective is to gain insights useful to explain the loan puzzle: the unexpected increase of loans to firms in case of a monetary tightening. The analysis is based on a vector autoregression, estimated using Bayesian techniques, and has as object the US economy.

JEL-Codes: E440, E510, G200, G210, C110.

Keywords: loan puzzle, households, corporate businesses, non-corporate businesses, VAR, Bayesian estimation.

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Contents

1 Introduction **1**

2 The loan puzzle **2**

3 VAR analysis **8**

3.1 Data 9

3.2 Estimation 14

3.3 Robustness of the estimation 16

4 The effect of shocks: loans and the other variables **16**

4.1 Impulse-Response Functions 16

4.1.1 The response of loans 17

4.1.2 Sales and inventories. 21

4.1.3 Interest rates. 22

4.1.4 GDP and prices. 22

4.2 Inside *advances and other loans*. 23

4.3 From the IRFs to an explanation of the loan puzzle 24

5 Conclusions **26**

References **28**

Appendix **31**

1 Introduction

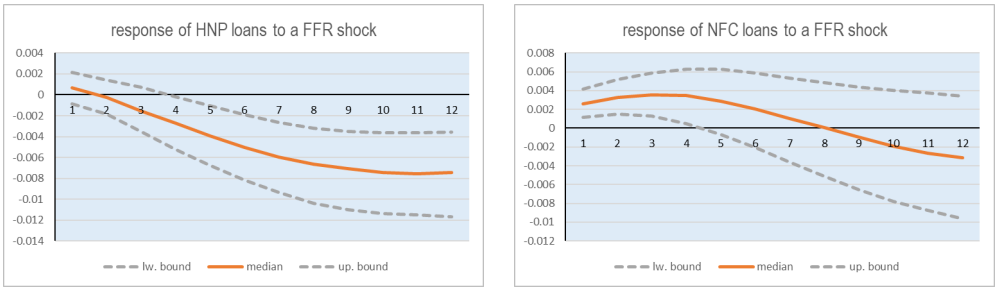
In normal times the cost of credit is indirectly driven by monetary policy (ECB 2011). When the transmission mechanism works fine, a monetary policy change causes all the rates to change in the same direction. As a consequence, even though quite slowly, the amount of loans adjusts. As for this, a puzzling result emerges from empirical research works (Den Haan et al. 2007): loans to corporations are observed at first to increase in case of a positive shock to the main money-market rate (assumed to reflect the monetary policy stance). Differently, loans to households are observed to decrease as expected. This result highlights the importance of considering heterogeneous agents in order to understand how different groups respond to the same shock and to quantify the weight of each group in the aggregate result (Kaplan et al. 2018, Guerrieri & Lorenzoni 2017).

The main objective of our research is to reassess two possible alternative explanations for the puzzling response of corporation loans, these are founded respectively on demand and supply factors as outlined in two seminal contributions: Bernanke & Gertler (1995) and Den Haan et al. (2007). To this end, we split businesses into corporations and non-corporations and consider loans from different sources and for different scopes. This enriches the analysis and serves to evaluate more in details the alternative explanations. The hedge of our analysis with respect to the current literature consists in the following improvements. First, we distinguish between large and small corporations, this is useful to verify Bernanke and Gertler's explanation based on Gertler & Gilchrist (1993*a*,*b*, 1994). Second, we consider loans from banks and finance companies separately; this is useful to check whether the motivations for the loan supply increase suggested by Den Haan et al. (2007) can work also for non-depository institutions. Third, we include inventories and sales to assess whether a counter-cyclical component of the loan demand emerges as hypothesized by Bernanke & Gertler (1995). Fourth, we distinguish between mortgages and other loans; this helps to understand how much the scope of the loan matters for its response. Fifth, we estimate a large vector autoregression able to take into account all the interactions across the variables.

The paper is structured as follows. Section 2 discusses the puzzling response of corporation loans and

Figure 1: Response to a monetary shock: loan aggregates

Households and NPO *Corporate Business*



its possible explanations. Section 3 provides the details on the estimation of the vector autoregression using the Bayesian approach. We report and discuss the results of our analysis in Section 4, in which we include also our assessment of the alternative explanations of the loan puzzle. Section 5 draws the conclusions of our research.

On the whole, our analysis suggests that a loan supply recomposition is more likely to explain the increase of loans to corporations.

2 The loan puzzle

The idea behind this research paper comes from a puzzling empirical result. This consists in observing an increase of loans to non-financial corporate business in case of a monetary tightening. Such a result appears even more difficult to explain when compared to the response of loans to households, which are observed to decrease as expected. This finding emerges from VAR analyses in which the monetary tightening is identified as a positive shock to the benchmark money-market rate (to wit, the Federal Funds Rate for the USA). Figure 1 shows this empirical puzzle in our data, it reports the IRFs from our vector autoregression to contextualize the discussion here; full information on the data and on how such IRFs are obtained is provided further on in section 3.

At our knowledge, the first to find and provide an explanation for this puzzle are Gertler & Gilchrist (1993*a*,*b*, 1994). The same emerges also in a number of subsequent contributions; among the others, Den Haan et al. (2007) for the US, Busch et al. (2010) for Germany, Giannone et al. (2012) for the Euro Area aggregate. It emerges also when the larger debt aggregate, instead of just loan liabilities, is used for the analysis as in Cafiso (2019).

The two contributions we focus on in our discussion are Bernanke & Gertler (1995) (BG1995, hereinafter), who explain the puzzle in their discussion of the credit channel on the basis of Gertler & Gilchrist (1993*a*,*b*, 1994), and Den Haan et al. (2007) (DSY2007, hereinafter). The latter is the benchmark contribution on this topic because they focus exclusively on the puzzle and explain it differently than BG1995. More recently, also Ciccarelli et al. (2015) provide further useful insights by means of survey data that help to understand better the roots of the puzzle. In section 4 we search for evidence in support of these alternative explanations of the loan puzzle, while we discuss them in the remainder of this section.

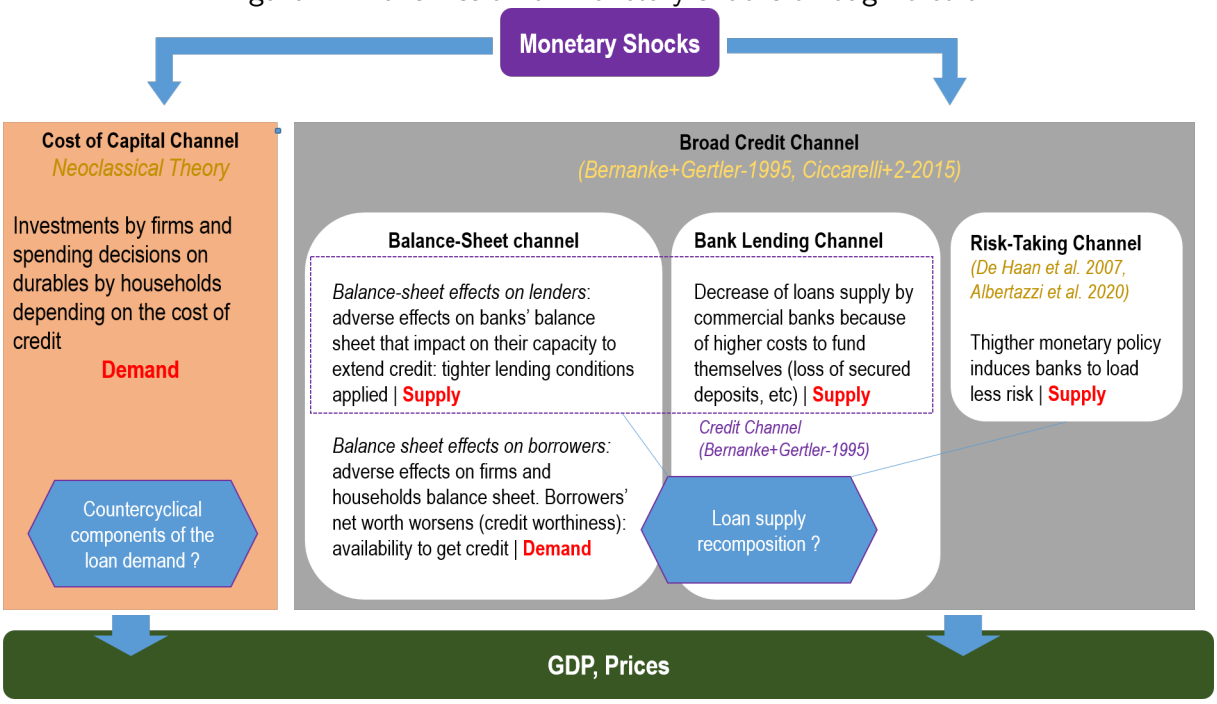
The effect of a monetary shock on credit

The loan puzzle is to read and explain in the context of that part of the monetary policy transmission that regards lending (ECB 2011). This is made of the more intuitive *Cost of Capital Channel* -A- (or, more easily, cost of credit) and of the so-known *Broad Credit Channel* -B- (expression used in Ciccarelli et al. 2015). Jointly, they describe how credit aggregates respond to a monetary policy change as the result of both demand and supply factors (Kashyap & Stein 2000, Bernanke 2007, Ciccarelli et al. 2015). The broad credit channel is made of the *balance-sheet channel* (BG1995), the *bank-lending channel* (BG1995) and *the risk-taking channel* (den Haan 2011, Albertazzi et al. 2020). The cost of capital channel (A) pertains to the demand side, the balance sheet channel regards both demand (B1i) and supply (B1ii), the bank lending channel (B2) concerns the supply side as the risk-taking channel (B3). Figure 2 provides a summary of these terms and a sketch. At least in very general terms, we need to clarify these effects.[1]

How does a monetary tightening affect the demand of credit? First of all, since the cost of credit increases, the demand from borrowers (both firms and households) should decrease; this is the cost of capital channel. Secondly, the monetary tightening has adverse effects on borrowers' balance sheet impairing their capacity to get credit (credit worthiness): their net worth or capacity to provide collateral diminishes. This is the balance-sheet effect on borrowers. This might not be the end though. Indeed,

[1]The bank-lending channel plus balance-sheet effects on lenders are jointly referred as credit channel by BG1995. With reference to the terminology in Albertazzi et al. (2020), who provide a contemporaneous comprehensive discussion of the transmission of monetary policy via credit, the capitalization channel is included in the balance-sheet effects on lenders (B1ii). Ciccarelli et al. (2015) use the term bank lending channel as synonym of credit channel.

Figure 2: Transmission of monetary shocks through credit



when the focus is on the loan puzzle, we need to extend our analysis to the consideration of economic activity.

A monetary tightening is believed to have a negative effect on economic activity and therefore on borrowers' revenues/cash-flow; BG1995 show that a monetary tightening decreases firms' cash-flows. Even though the evolution of loans is pro-cyclical in general, on this ground, loan demand could also have significant counter-cyclical components (BG1995 page 44). To wit, firms could demand more loans at first to counterbalance their cash-flow decrease. At the same time, some households could demand more credit to smooth their consumption. These are demand components whose weight could be concealed in the net effect observed.

How does a monetary tightening affect the supply of credit? A monetary tightening is likely to increase banks' funding costs (external finance premium) and those would therefore reduce their supply; this is the bank-lending channel. Secondly, banks too bear adverse balance sheet effects and these reduce their capacity to extend credit, this should take them to apply tighter lending conditions. This is the balance-sheet effect on lenders. The same channel includes what Albertazzi et al. (2020) call *banks' capitalization channel*.[2] Furthermore, a monetary change triggers risk-related changes in banks' assets and liabilities. To wit, a monetary tightening pushes interest rates up and diminishes asset and collateral

[2]This refers to the banks' change of credit supply necessary to meet the capital-adequacy regulation.

value. This modifies banks' evaluation of its potential borrowers and makes them rule out some who previously were eligible: its credit supply decreases consequently. This is the risk-taking channel.[3]

For credit supply too, however, some components could evolve in a different direction with respect to the aggregate evolution observed, at least shortly after a monetary tightening. As we discuss further on in this section, recomposition effects could emerge and lenders might therefore extend more credit to just some demand groups in case of a monetary tightening. For instance, banks could reshuffle their portfolio towards comparatively less-risky borrowers such as large corporations.

Before discussing the possible explanations of the loan puzzle, we highlight the identification problem that marks the analysis of monetary shocks on credit variables. What observed is an increase of the credit variables, but it is very problematic to understand whether that variation is due to the demand or supply. Credit aggregates conceal the push behind their variation, which can be hypothesized only through other variables that impact on those aggregates and are imagined to mirror demand or supply factors.

Demand-side explanations of the loan puzzle

Some possible explanations of the loan puzzle focus on the demand side, those explain the observed increase through a higher loan demand by firms in case of a monetary tightening. We focus on Bernanke & Gertler (1995).

BG1995 found their explanation on Gertler & Gilchrist (1993*a*,*b*, 1994) contributions, who suggest why large firms might increase their borrowing in case of a monetary tightening while small firms cannot. All firms want to borrow more to cope with the decrease of their cash-flow linked to the economic downturn caused by the monetary tightening. Large firms are not financially constrained and therefore manage to borrow more, on the contrary, small firms have less access to credit and, even though they wished, they therefore do not succeed to borrow more. This is why loans to corporations are observed to increase immediately after a monetary hike, while loans to small firms decrease (Gertler & Gilchrist 1994).

[3] At the same time, a monetary tightening pushes the return of assets up (such as government bonds). Then, banks could reshuffle their portfolio away from more risky engagements (i.e. loans to sub-prime borrowers) and prefer those assets with a now-increased expected return. Jiménez et al. (2014) provide further evidence on the fact that a monetary expansion induces banks to reshuffle their portfolio towards more risky loans.

BG1995 affirm that firms' cash-flow is squeezed from two sources (page 38): *first*, an increase of interest expenditures due to the monetary hike; *second*, decreasing revenues due to lower consumers' demand compared to stickier costs. Since large firms manage to borrow more in the short run, they maintain their production and employment level constant. Nonetheless, the decrease of consumer demand at a constant production level causes at first an increase of inventories, which is absorbed afterwards. The evolution of inventories is a specific feature of BG1995's explanation. The inventories increase should be observed only if firms borrow more to maintain their production level constant. In this perspective, inventories are financed with loans and therefore can be imagined to cause them; this is the setting used by DSY2007 in testing BG1995's hypothesis.[4] The differential response between small and large firms in case of a decreasing cash flow is another specific feature of Gertler & Gilchrist (1993*a*,*b*, 1994) explanation. Clearly, this is a demand-based explanation of the puzzle.

Said differently, the observed response of corporation loans could therefore depend on whether the counter-cyclical components of credit demand play a significant role, at least in the short-run, as outlined by BG1995 (page 44). DSY2007 make notice that the evolution outlined by BG1995 is initiated by a cash-flow decrease, it therefore makes sense to expect the same also in case of a cash-flow decrease caused by an adverse real-activity shock. In this regard, they suggest that the loan increase should be even higher in this last case since interest rates do not increase (compared to the monetary tightening case).[5]

Giannone et al. (2019) suggest another possible explanation of the loan puzzle; the loan puzzle emerges also in their analysis (page 20). They affirm that "facing the upward pressure on their cost of borrowing induced by a monetary tightening, firms may be encouraged to draw-down their pre-committed credit lines with banks". Accordingly, at first, loans increase as long as those lines are still available at the previously-contracted interest rate, subsequently they decrease when those lines extinguish. This explanation too is demand-based but, unfortunately, there is no chance to test it with our data since we cannot infer through macro data what's the reason why firms ask loans.

[4] Differently, if large firms borrow more at first to cover the initial hike of interest expenditures, inventories should not increase significantly since production should decrease along with consumers demand.

[5] We add to this point that this should be only if firms demand more loans to contrast lower revenues from sales and not to pay higher interest expenditures since, given constant interest rates, interest expenditures are not expected to increase when a real-activity downturn occurs.

A supply-side explanation

Credit supply is at the core of DSY2007's discussion of the loan puzzle. They explain that a monetary tightening causes a *recomposition of the loan supply* because it determines a change in the relative value of loans to lenders. In particular, they affirm that following a monetary tightening, banks increase their short-term commercial and industrial loans:

> "As an alternative [*with respect to BG1995*] we propose the hypothesis that after a monetary tightening—when interest rates are high and economic activity is low—banks rather invest in short-term assets, such as C&I loans, that earn a high return (because short-term interest rates are high) and are relatively safe, than invest in long-term and risky assets such as real estate loans. The behavior of mortgage rates is consistent with such a shift in the supply of real estate loans. Moreover, the substitution out of long-term and risky assets and into C&I loans makes it possible that the supply of C&I loans increases even if deposits decrease" (Den Haan et al. 2007, page 906).

A point to grasp in DSY2007 explanation is that the interest rates on commercial and industrial loans respond quickly at the deepest to the monetary policy hike, while the others do at a smaller extent, with the mortgage rates lagging behind. Such a differential response of interest rates changes the relative value of the different loans to banks, those therefore reshuffle their portfolio towards short-term loans and away from long-term assets when a monetary policy downturn takes place.[6] *The first* reason why banks reshuffle towards short-term business loans relates to differences in risk between households and other borrowers. *The second* to changes in the relative profitability of consumer and firm loans; these last two motivations recall the risk-taking channel recalled in the previous section. *The third* reason refers to hedging by adjusting the portfolio in order to align the maturities of assets and liabilities. *The fourth* is related to bank capital regulations and to the effect on current-period profit margins; these last two motivations recall the balance-sheet channel mentioned in the previous section.

[6] Interestingly, in the words of DSY2007, the same differential response may be also a consequence of the banks' portfolio recomposition; see section 4.3 of their article.

Features of the US loan market

In their general discussion of the credit channel, BG1995 include also changes on the supply side in response to a monetary tightening. Accordingly, banks' loan supply decreases after a monetary downturn because banks find more expensive to fund themselves and because of deposit loss: their loan supply curve shifts inwards. This is the bank lending channel. Clearly, it cannot help to explain the puzzle since it involves a supply decrease, while a loan increase is at the basis of the puzzle. Nonetheless, it helps to clarify how intermediaries get funds in the USA.

Bernanke (2007), Ciccarelli et al. (2015) affirm that the bank lending channel plays an insignificant role in the US because the monetary tightening is likely to cause only a limited increase of the cost of funds to US intermediaries. Indeed, US banks get funds predominantly on the market by issuing own liabilities or certificates of deposit, the monetary tightening causes a higher cost to the extent that those liabilities became more onerous to issue. In other words, banks' external finance premium is only marginally impacted by the monetary tightening. The same applies to corporations too: large firms finance themselves on the market either through on liabilities or by issuing equities. On the contrary, small firms are more dependent on intermediaries and this is why a difference between the two might emerge since these cannot avoid intermediaries for their financing needs.[7]

3 VAR analysis

The analysis is based on the estimation of a vector autoregression (VAR, Stock & Watson 2001), the estimation is performed through the Bayesian approach. The choice in favor of Bayesian techniques is to avoid some typical drawbacks of frequentist estimations. First and foremost, Bayesian techniques allow the estimation of large VARs with a standard number of observations, they shrink the parameter space and overcome the over-parametriziation problem (Bańbura et al. 2010). Second, the likely non-stationarity of the series under considerations is embedded in the prior distribution by appropriate values of its hyperparameters.

We identify the structural shocks from the reduced-form residuals using the Choleski decomposition

[7] Ciccarelli et al. (2015) observe a by-far stronger and predominant role of the bank lending channel in the euro area (compared to the US). Their conclusions on the credit channel reflect such peculiarities of the US market: a monetary policy shock is transmitted to real activity mainly through the balance sheet channel. Differently, this is transmitted mainly through the bank lending and cost of capital channel in the euro area.

(recursive VAR, Wald causal chain). We concentrate on structural Impulse-Response Functions (IRFs, hereinafter) in order to study the effect of a monetary shock on the loan aggregates and figure its explanation out. Our contribution with respect to the explanation of the loan puzzle discussed in section 2 consists in a non-partisan evaluation of the demand-side explanation by BG1995 and of the supply-side explanation by DSY2007, evaluation enriched by some specific assets of our analysis. These assets are the inclusion of a third group of borrowers (non-corporate business), of non-depository lenders (finance companies, etc.) and of specific loans (mortgages, etc.). At the same time, we pay attention also to the response of the interest rate on short versus long-term loans, to the evolution of inventories and sales.

3.1 Data

The analysis is based on US quarterly data and is developed around the loan series extracted from the Financial Accounts of the United States (Federal Reserve Board of Governors). The loan series are for the borrower groups: *Households and Non-Profit organizations* (HNP), *non-financial Corporate Businesses* (CBs), *non-financial Non-Corporate Business* (NCBs).

Loans are from all sources, depository and non-depository institutions; this is most important for households since a large part of their loans are granted by non-depository institutions (Gambetti & Musso 2017). For each group we have the following aggregates. *Total Mortgages* (TM), this aggregate includes home, multifamily residential, commercial and farm mortgages granted by government and private institutions (banking and non-banking). *Consumer credit* (CC), which is available only for households, includes loans granted by depository and non-depository institutions, both public and private; some student loans are an example of consumer credit granted by government agencies, also automobile loans are part of this aggregate. *Depository Institution Loans n.e.c.* (DIL), this aggregate includes all loans by banks except for open market papers, mortgages and consumer credit, which are shown in other aggregates. *Advances and Other Loans* (AOL), these are mainly loans from non-banking institutions, the US government and the rest of the world. Table 1 lists all the aggregates available by borrower.[8] A graph reporting the loan levels for the three borrower groups is in Figure 4.

[8]The loan series data are made available non-seasonally adjusted, we have seasonally adjusted them by using the X-13ARIMA-SEATS program developed at the U.S. Census Bureau; loan series exhibit a strong seasonality on the 4th quarter.

Table 1: US loans by borrower group

Households and Non-Profit **-HNP-** (FL15 4123005.Q)	Corporate Businesses **-CB-** (FL10 4123005.Q)	Non-Corporate Businesses **-NCB-** (FL11 4123005.Q)
TM: total mortgages (FL15 3165005.Q)	**TM**: total mortgages (FL10 3165005.Q)	**TM**: total mortgages (FL11 3165005.Q)
CC: consumer credit (FL15 3166000.Q)		
DIL: depository institution loans (FL15 3168005.Q)	**DIL**: depository institution loans (FL10 3168005.Q)	**DIL**: depository institution loans (FL11 3168005.Q)
AOL: advances and other loans (FL15 3169005.Q)	**AOL**: advances and other loans (FL10 3169005.Q)	**AOL**: advances and other loans (FL11 3169005.Q)

Notes: The code in parenthesis identifies the series in the system of US Financial Accounts (FRBG). Bold letters are for the acronyms of the loan items used throughout the paper.

The other variables are: the gross domestic product, inventories, sales, a world index of consumer prices, the consumer price index, the federal funds rate, and a group of interest rates applied to private loans. We construct the inventories series in levels from variations (national accounts records), we scale it in a way to make it directly comparable to the sales index series in levels made available by the OECD.[9] The Federal Funds Rate is used to identify monetary policy shocks. The other interest rates included are meant to reflect the cost of private loans: an average interest rate on short term business loans (Bank Prime Loan rate), an average interest rate on personal loans with 24 months maturity, an average interest rate on automobile loans with 48 months maturity, an average interest rate on mortgages with 30 years maturity; these are plotted together with the Federal Funds Rate in Figure 3. The list of all the variables with the respective source is in Table 2. To sum up, variables 1-3 are real variables, variable 4 and 5 are price indices, variable 6 is meant to reflect the monetary stance, variables 7-10 are the interest rate variables, variables 11-20 are the loan aggregates. The order of the variables in the VAR is important because identification is based on the Wald causal chain (Choleski decomposition). Reasoning in terms of groups, real variables and prices are imagined to respond with a lag to a monetary policy shock, on the contrary, interest rates on private loans and loan volumes respond contemporaneously (within the same quarter) to a monetary policy shock; the order is inspired by Giannone et al. (2019).

Data are available starting from different dates and up to the end of 2018, however the analysis is

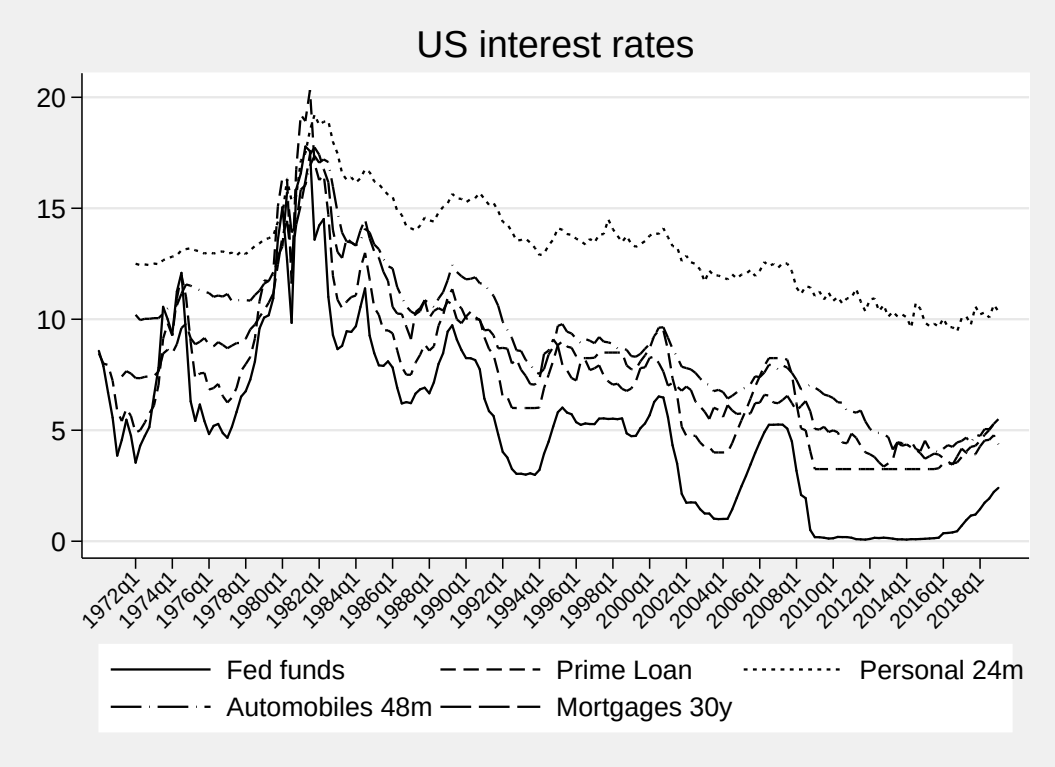
[9] Inventory variations are indirectly compiled based on the identity: production is equal to sales plus inventory variation ($P_t = S_t + \triangle I_t$) (Ramey & West 1999).

Table 2: List of variables

#	group	name	short	source	code
1		Gross Domestic Product	GDP	OECD	gdp
2		Sales	SALES	OECD	sales
3		Inventories	INVENT	OECD	inven
4		World index of commodity prices	WICP	Datastream	wicp
5		Consumer Price Index	CPI	OECD	cpi
6		Fed funds rate	FFR	FRED	ir_fedfunds
7		Interest rate on short-term business loans	IRBPL	FRED	ir_mprime
8		Interest rate on 24 months personal loans	IR24M	FRED	ir_pers24m
9		Interest rate on 48 months automobile loans	IR48M	FRED	ir_auto48m
10		Interest rate on 30 years mortgages	IR30Y	FRED	ir_mort30y
11	Households and Non-Profit	Total Mortgages	HNP-TM	BGFRS	hnp_tm
12		Consumer Credit	HNP-CC	BGFRS	hnp_cc
13		Depository Institutions Loans nec	HNP-DIL	BGFRS	hnp_di
14		Advances and Other Loans	HNP-AOL	BGFRS	hnp_oa
15	Corporate Businesses	Total Mortgages	CB-TM	BGFRS	nfc_tm
16		Depository Institutions Loans nec	CB-DIL	BGFRS	nfc_di
17		Advances and Other Loans	CB-AOL	BGFRS	nfc_oa
18	Non-corporate Businesses	Total Mortgages	NCB-TM	BGFRS	nfNc_tm
19		Depository Institutions Loans nec	NCB-DIL	BGFRS	nfNc_di
20		Advances and Other Loans	NCB-AOL	BGFRS	nfNc_oa

Notes: As for the sources, OECD stands for Organization for Economic Cooperation and Development, BGFRS for Board of Governors of the Federal Reserve System, FRED is the Saint Louis Fed's online application to extract data. The column 'short' reports the acronyms of the loan items used throughout the paper.

Figure 3: Interest Rates



for the period 1971q1-2007q4, we exclude the most recent period to avoid the Global Financial crisis (2008) and the Great Recession (2009).

Some statistics on loans The evolution of loans for each borrowing group is plotted in Figure 4. To gain information on the amount of each component over the total, we report weights in Table 3 and plot them in the second column of Figure 4.

As for each group contribution to the total amount of loans, at the end of the period used for the analysis (2007q4), loans to households represent 67% of the total and 50% of the total without mortgages (first row in Table 3), loans to corporations amount to 14% and to 32% of the total without mortgages, loans to small firms amount to 18% with and without mortgages.

In terms of structural composition (within each group), loans to households and non-corporate business are very much stable overtime. Differently, loans to corporate business exhibit a structural change well before the global financial crisis and recession, as shown by the decreasing weight of loans from depository institutions; this is linked to the growing importance of finance companies in the US financial system.

Figure 4: Loans by component, levels and weights

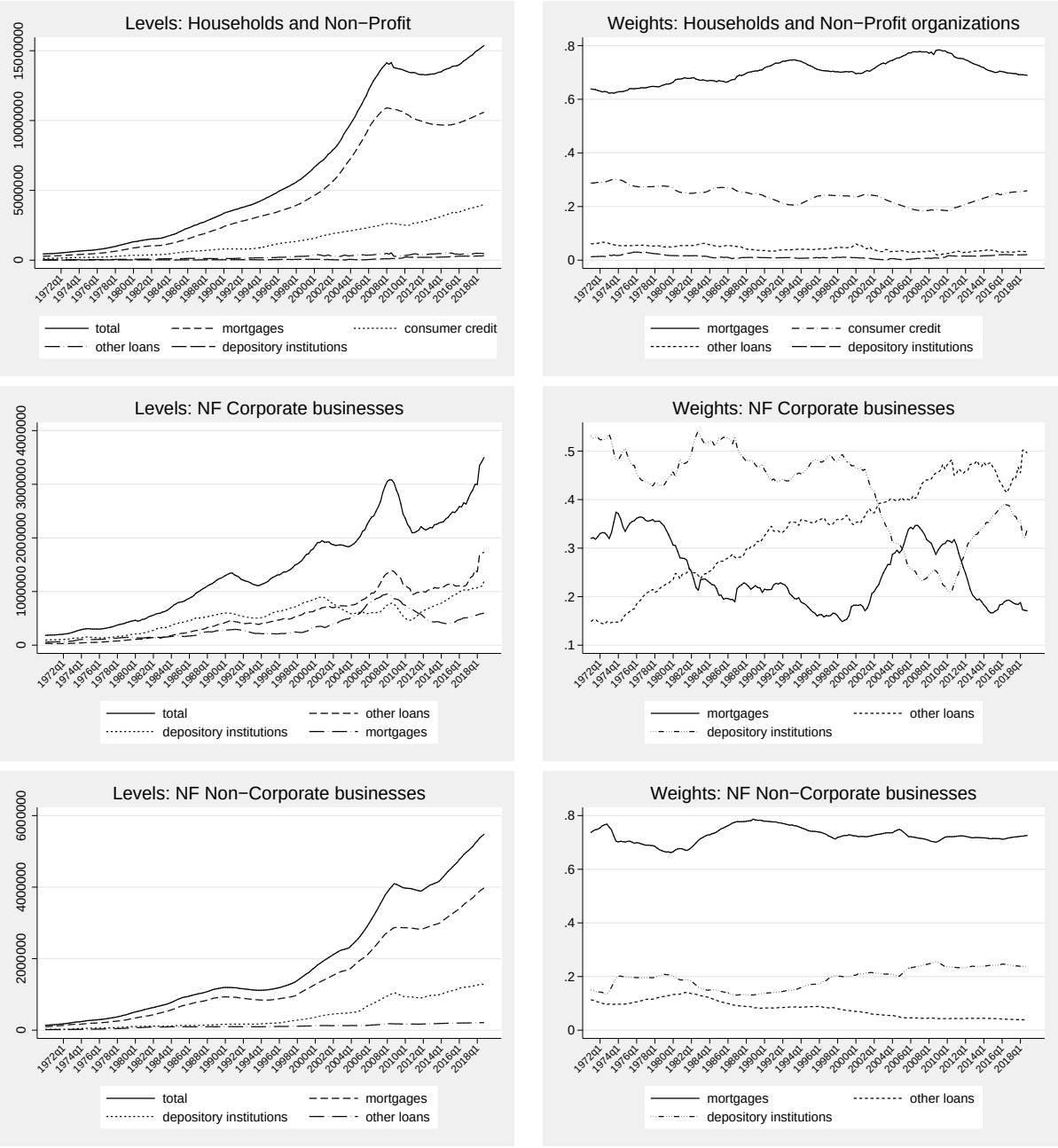


Table 3: Loan weights

	Households and Non-Profit				Corporate Business			Non-Corporate Businesses		
2007q4	67% | 50%*				14% | 32%*			18% | 18%*		
2018q4	63% | 52%*				14% | 32%*			23% | 16%*		
	TM	CC	DIL	AOL	TM	DIL	AOL	TM	DIL	AOL
(1971q1,1975q4)	0.63	0.29	0.02	0.06	0.34	0.51	0.15	0.73	0.17	0.10
(1976q1,1980q4)	0.65	0.27	0.02	0.05	0.34	0.44	0.22	0.68	0.20	0.12
(1981q1,1985q4)	0.67	0.26	0.01	0.06	0.23	0.51	0.26	0.71	0.16	0.12
(1986q1,1990q4)	0.70	0.25	0.01	0.04	0.21	0.48	0.30	0.78	0.13	0.09
(1991q1,1995q4)	0.74	0.22	0.01	0.04	0.20	0.45	0.35	0.76	0.15	0.09
(1996q1,2000q4)	0.70	0.24	0.01	0.05	0.17	0.48	0.36	0.72	0.20	0.08
(2001q1,2005q4)	0.74	0.22	0.00	0.04	0.26	0.35	0.39	0.73	0.21	0.06
(2006q1,2010q4)	0.78	0.19	0.01	0.03	0.32	0.24	0.44	0.71	0.24	0.04
(2011q1,2015q4)	0.73	0.22	0.02	0.03	0.21	0.33	0.46	0.72	0.24	0.04
(1971q1,2007q4)	0.69	0.25	0.01	0.05	0.25	0.45	0.30	0.73	0.18	0.09

Notes: TM is for mortgages, CC for consumer credit, DIL for depository institution loans, AOL for advances and other loans. Asterisks refer to total aggregates without mortgages.

3.2 Estimation

We estimate the reduced-form VAR:

$$Y_t = \alpha + \sum_{i=1}^{p} \beta_i Y_{t-i} + \epsilon_t$$

in which Y_t is a 20-variable vector. Apart for the interest rate series, all the other variables are in log-levels. The VAR includes 2 lags for each variable as other estimations in this branch of literature; among the others, see Gambetti & Musso (2017), Hristov et al. (2012), Ciccarelli et al. (2015). This results in 820 parameters (41 by equation) to estimate with approximately 144 observations.[10] In order to deal with such over-parametrization (curse of dimensionality), which comes with the estimation of such large systems (Bańbura et al. 2010, Giannone et al. 2015), we resort to the Bayesian approach that allows to shrink such dimension; in this perspective our analysis is similar to Giannone et al. (2019).[11]

The posterior distribution is summarized by its median value. We specify the prior distribution as a Normal-InverseWishart (among the others, see Dieppe et al. 2018):

- Prior for the mean: $\beta \sim N(\beta_0, \Sigma \otimes \Phi_0)$

[10] $(n \times p + 1) \times n$ is the formula for the number of parameters in the VAR according to the number of n variables and the number of p lags.

[11] Giannone et al. (2019) estimate a VAR with 28 variables and include 7 lags, this sums to 5516 parameters to estimate with around 190 observations.

- Prior for the variance-covariance matrix: $\Sigma \sim IW(S_0, \alpha_0)$

so that the posterior is also a Normal-InverseWishart (natural conjugate prior). The hyperparameters for the prior are defined as follows:

- Autoregressive coefficient: 1
- Overall Tightness (λ_1): 0.1
- Cross-variable weighting (λ_2): 0.5
- Lag decay (λ_3): 2

The total number of iterations is 1000, the number of burn-in iterations is 500. As for the overall-tightness parameter (λ_1), we follow Bańbura et al. (2010) and set a shrinkage level based on the number of variables in the VAR. For $\lambda = 0$ the posterior equals the prior and the data do not influence the estimates (maximum shrinkage), if $\lambda \to \infty$, on the other hand, the posterior expectations coincide with the Ordinary Least Squares estimates (no shrinkage). Then, the more the coefficients to estimate, the closer to zero λ_1 should be (higher tightness, Bańbura et al. 2010, see Table I). We set λ_1 equal to 0.1, which is close to the 0.108 optimal value found by Bańbura et al. (2010) for a VAR of 20 variables.[12]

Given the VAR structural-form:

$$\Phi \cdot Y_t = \Lambda_0 + \Lambda_1 \cdot Y_{t-1} + ... + \Lambda_p \cdot Y_{t-p} + u_t \tag{1}$$

the residuals u_t are identified through the Choleski decomposition from the reduced-form residuals ϵ_t:

$$u_t = \Phi \epsilon_t,$$

Φ is therefore lower triangular and the order of the variables reflects the Wald causal chain implicit to the recursive identification; the order of the variables is the one in Table 2.

[12] In their work, such optimal value is found as the one minimizing the in-sample mean squared forecast error.

3.3 Robustness of the estimation

The robustness of the IRFs discussed in this paper has been proved through major variations of the estimation. First, we have estimated a single VAR for each group of borrowers:

1. VAR for households (HNP). This includes: GDP, sales, inventories, world index of commodity prices, consumer price index, federal funds rate, 24-month personal loan interest rate, 48-month automobile loan interest rate, 30-year mortgage interest rate, total mortgages to HNP, consumer credit to HNP, depository institutions loans to HNP, advances and other loans to HNP. 13 variables in total, 2 lags. Overall tightness parameter (λ_1) equal to 0.17.

2. VAR for corporate business (CBs). This includes: GDP, sales, inventories, world index of commodity prices, consumer price index, federal funds rate, loan prime interest rate, 30-year mortgage interest rate, total mortgages to CBs, depository institutions loans to CBs, advances and other loans to CBs. 11 variables in total, 2 lags. Overall tightness parameter (λ_1) equal to 0.19.

3. VAR for non-corporate business (NCBs). This includes: GDP, sales, inventories, world index of commodity prices, consumer price index, federal funds rate, loan prime interest rate, 30-year mortgage interest rate, total mortgages to NCBs, depository institutions loans to NCBs, advances and other loans to NCBs. 11 variables in total, 2 lags. Overall tightness parameter (λ_1) equal to 0.19.

Second, we have altered the order of the variables to have a different Wald causal chain. Third, we have performed the estimation of the 20 variables VAR using different overall tightness (λ_1) values.[13]

4 The effect of shocks: loans and the other variables

4.1 Impulse-Response Functions

We study the response to a Federal Funds Rate (FFR) shock, which is commonly used to identify monetary policy shocks in this branch of literature (Christiano et al. 1999, Kilian & Lewis 2011, Angeloni et al. 2015). The structural IRFs from the recursive VAR are displayed in Figure 5; we focus on a 12

[13] The IRFs obtained from such robustness checks are not reported here, but those are promptly available upon request.

quarters horizon (shock at step 1). IRFs are ordered in rows for the group of variables in Table 2. A detailed discussion for the different groups of response variables is in the following subsections. Figure 11 in the appendix shows the response of the same variables to a real-activity shock, this is to use for comparison.

4.1.1 The response of loans

Loans by group To gain a better picture of what happens at the aggregate level, we combined the IRFs of consumer credit (only for households), depository institution loans and advances and other loans into a unique one for the three borrower groups in Figure 6 (first column); we used the weight of each component over the total at the bottom of Table 3. With respect to Figure 1 in section 2, Figure 6 adds loans to non-corporate business. Figure 6 shows that *small firms behave as large firms* (**R1**), but the latter respond in a stronger and more persistent way than the former.[14] Based on this first evidence, Gertler & Gilchrist (1994)'s hypothesis that small firms respond differently because they have less access to external finance does not find support in our data.

The charts in the second column of Figure 6 show the response of the same loan aggregates to a real-activity shock (GDP decrease); these are obtained through the same aggregation described above. Comparing the response to a real activity shock with the response to a monetary shock is useful because DSY2007 affirm that if firms demand more loans to cope with a cash-flow decrease (as suggested by BG1995) then they should do the same in case of a real-activity shock, which is likely to cause a similar cash-flow decrease. Nonetheless, the Figure shows that the loan puzzle emerges only in case of a monetary shock and not in case of a real activity shock (*peculiarity of monetary shocks*, **R2**).

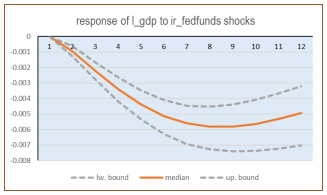
Disaggregated loans: mortgages, depository-institution loans, advances and other loans Figure 5 shows the response of each loan item to a FFR shock for the three borrower groups. Consumer credit evolves as expected since it exhibits a clear decrease after a FFR shock; this is in line with its response to an adverse real-activity shock (Figure 11 in the appendix).

Unlike mortgages to households, mortgages to corporate business exhibit an appreciable increase at the time of the shock, which is only temporary though; such an increase is specific to the FFR shock

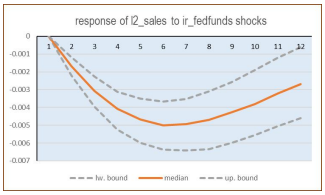
[14] The bold letter "R" followed by a number marks the main results of our analysis. **R1** is for the first result, **R2** is for the second, etc.

Figure 5: Response to a FFR shock: all variables

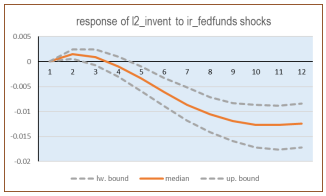
GDP



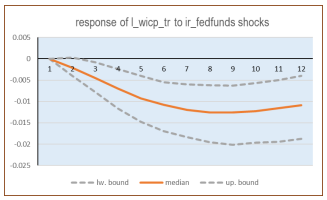
sales



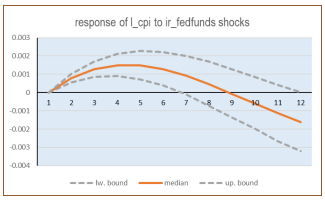
inventories



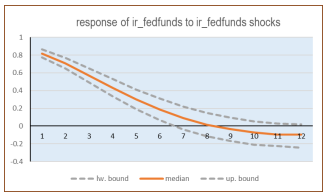
commodity prices



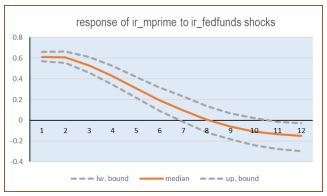
CPI



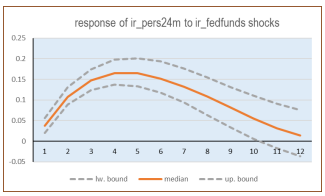
funds rate



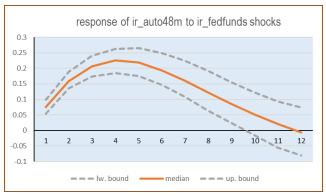
loan prime i.rate



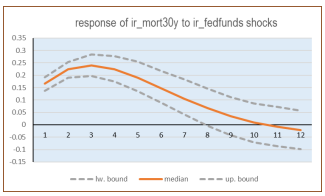
24 months loans i.rate



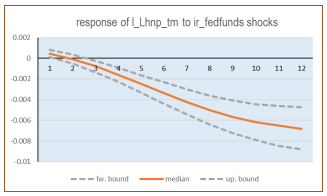
48 months loans i.rate



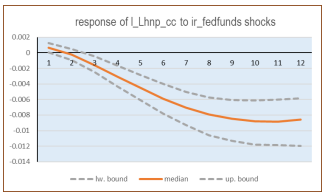
30 years mortgages i.rate



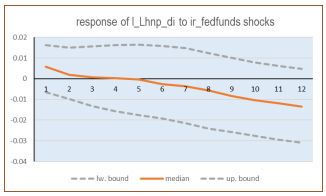
HNP - mortgages



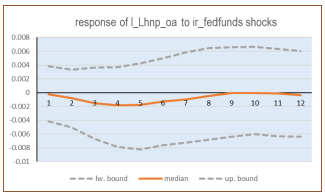
HNP - consumer credit



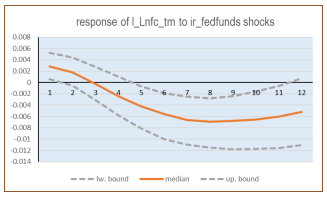
HNP - depository institution loans



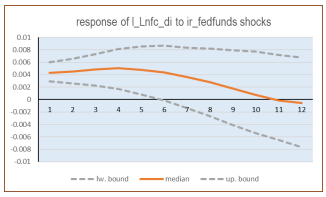
HNP - other loans



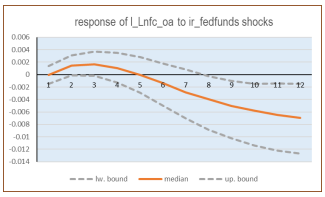
CB - mortgages



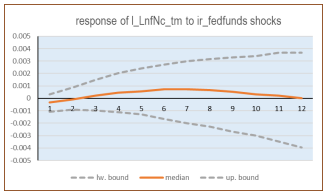
CB - depository institution loans



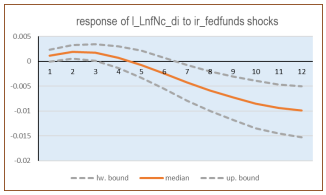
CB - other loans



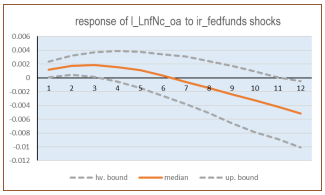
NCB - mortgages



NCB - depository institution loans

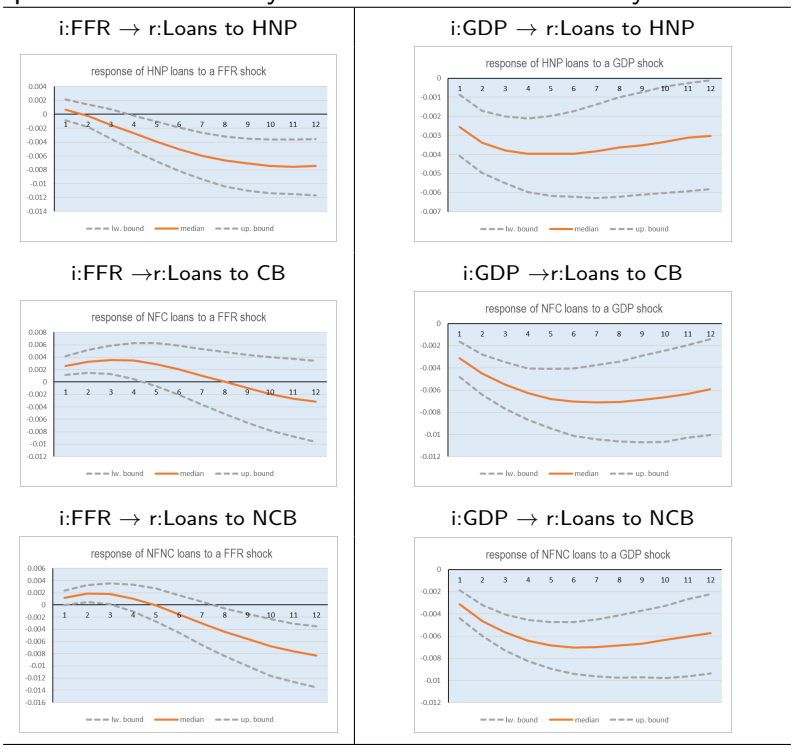


NCB - other loans



Notes: HNP is for households and non-profit, CB for corporate-business, NCB for non-corporate business. TM is for mortgages, CC for consumer credit, DIL for depository institution loans, AOL for advances and other loans. *i* marks the impulse variable, *r* marks the response variable.

Figure 6: Response to a monetary shock and to a real-activity shock: loan aggregates



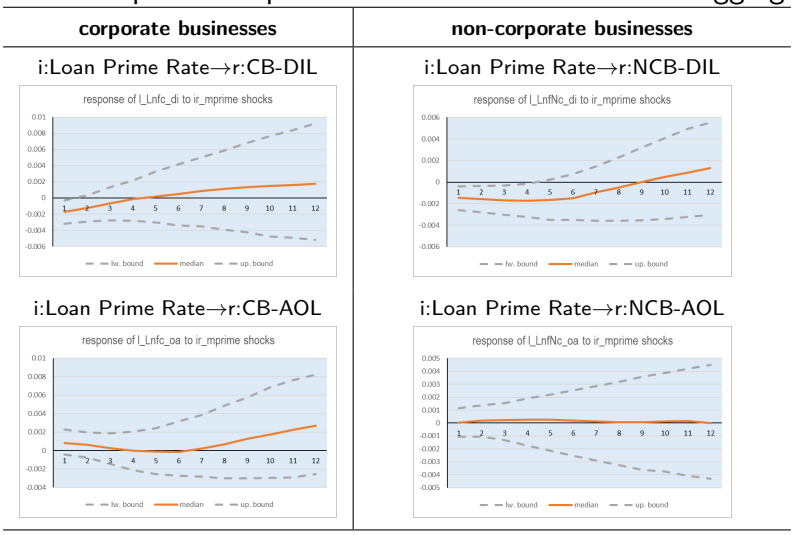
Notes: HNP is for households and non-profit, CB for corporate-business, NCB for non-corporate business. *i* marks the impulse variable, *r* marks the response variable.

since it does not emerge in case of a real-activity shock (Figure 11 in the appendix). Such response of mortgages recalls what observed for depository-institution loans (the loan puzzle). Based on this result, lenders might not increase just short-term loans to corporate-business but also long-term loans to corporations, at least at the time of the shock (*mortgages somehow comparable to corporation loans*, **R3**).

As for bank loans to households (depository-institution loans), which are neither mortgages nor consumer credit, they do not seem to respond to a FFR shock, probably because the most responsive part of bank loans to households is in the form of consumer credit and mortgages. Bank loans to corporate and non-corporate business exhibit the loan puzzle; the discussion here is centered around such a response. The loan increase is definitely clearer for corporate than for non-corporate business

Since advances and other loans are from non-depository institutions, disaggregated loans show that non-bank loans (AOL) respond similarly to bank loans (DIL); *bank and non bank loans are comparable* (**R4**). The significance of the AOL-puzzle is, however, dubious for corporate business since its response at the shock (step 1) is weak. A detailed analysis of AOL is important because, given their different

Figure 7: Response to specific interest rate shocks: loan aggregates



Notes: HNP is for households and non-profit, CB for corporate-business, NCB for non-corporate business. TM is for mortgages, CC for consumer credit, DIL for depository institution loans, AOL for advances and other loans. *i* marks the impulse variable, *r* marks the response variable.

source, they can serve to draw conclusions on banks indirectly through comparison. This is an important point, we study AOL further in the next section; the composition of AOL is in Table 6 in the appendix.

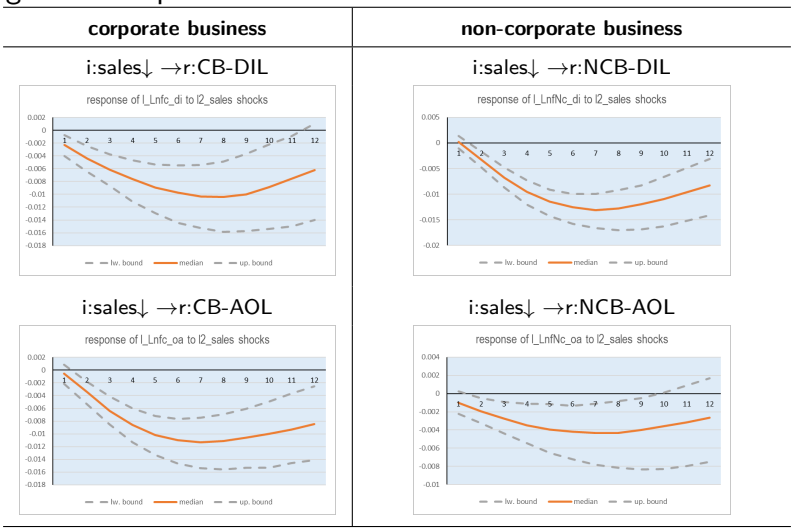
Further evidence on the peculiarity of monetary shocks is gained from the response of disaggregated loans to specific loan interest-rate shocks; these are in Figure 7. To notice that we cannot be 100% sure about the matching done between loan aggregates and the interest rates available.[15] Nevertheless, if we focus on firms and disregard mortgages, no increase occurs in case of a rate hike, so no puzzle. We will discuss further these impulse-response functions in section 4.3.

The IRFs for the effect of a GDP shock provide a first answer to the question: do loans have a significant counter-cyclical component? The conclusion from Figure 6 is that they do not have. This conclusion is reinforced by the response of disaggregated loans to a sales shock; see Figure 8. Sales are useful because they should strictly mirror revenues of non-financial businesses (both small and large). On the whole, *loans do not seem to move counter-cyclically* (**R5**).[16]

[15] To wit, the loan prime rate should be the relevant market rate for loans to corporate and non-corporate business from depository institutions and other sources, but there is no guarantee.

[16] Based on the discussion in BG1995, this could still be coherent with their explanation if firms demanded more loans only to compensate higher interest expenditures and not lower revenues from sales. However, the IRFs in Figure 7 exclude this possibility.

Figure 8: Response to an adverse sale shock: loan to businesses



Notes: HNP is for households and non-profit, CB for corporate-business, NCB for non-corporate business. TM is for mortgages, CC for consumer credit, DIL for depository institution loans, AOL for advances and other loans. *i* marks the impulse variable, *r* marks the response variable.

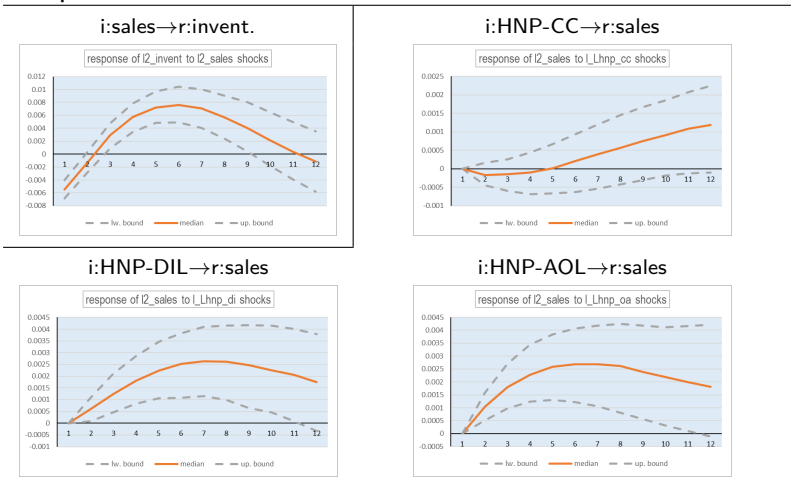
4.1.2 Sales and inventories.

The charts in the first row of Figure 5 show the response of inventories and sales to a FFR shock. As discussed in section 2, the evolution of inventories characterize BG1995 explanation of the loan puzzle. Sales respond as real-activity: a clear, strong decrease. The sales response is in line with the evolution of consumer credit. Unlike sales, inventories exhibit a first slight increase that turns into a reduction between the 3rd and 4th quarter. This picture confirms that, contemporaneously to a sales reduction, inventories first increase then decrease (Ramey & West 1999).[17]

Figure 9 shows the response of inventories to a positive sales shock. This is in line with what expected: a temporary sharp decrease which subsequently changes into an increase to follow sales. The other charts in Figure 9 report the response of sales to positive household loan shocks. The point here is to assess whether or not loans finance households' expenditures. Consumer credit does not have a statistically significant impact on sales, while sales respond strongly to DIL and AOL shocks.

[17] The relationship between inventories and credit conditions is well discussed in Kashyap et al. (1994).

Figure 9: Response to a sales and household-loan shocks: inventories and sales



Notes: HNP is for households and non-profit, CB for corporate-business, NCB for non-corporate business. TM is for mortgages, CC for consumer credit, DIL for depository institution loans, AOL for advances and other loans. *i* marks the impulse variable, *r* marks the response variable.

4.1.3 Interest rates.

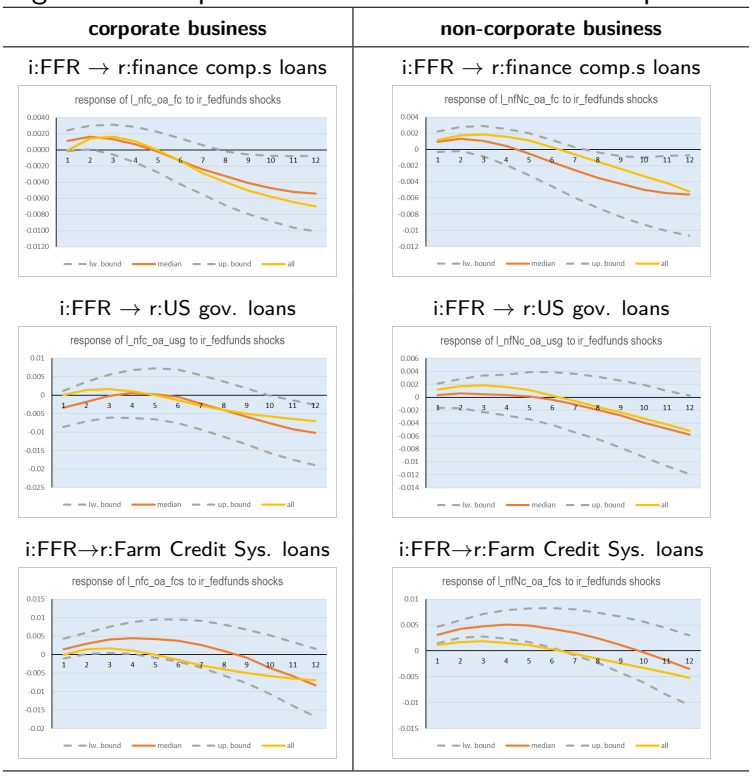
The response of interest rates is in the fourth row of graphs in Figure 5. As for that, the prime loan rate (the short-term interest rate on loans to business) stands on one side, all the other interest rates stand on the other. Indeed, the prime loan rate jumps upward in correspondence with the shock while all the other rates increase slowly and achieve a maximum around the fourth quarter. The increase of the loan prime rate is more than the double the increase of the other rates. Then, a significant divergence emerges in terms of cost (and return) between loans to business and all the other loans. This is an important point that we will discuss again in section 4.3.

4.1.4 GDP and prices.

The evolution of GDP in response to a monetary policy shock is as expected: it decreases strongly. That is in line with the evolution of sales, which reflect consumption, the largest GDP component.

Even though counter-intuitive, the response of prices is in line with the well-known price puzzle (Estrella 2015). We include in the estimation the world index of commodity prices in the hope to solve it but it emerges anyway. Nonetheless, compared to a VAR without it, the commodity price index makes the CPI increase smaller.

Figure 10: Responses to a FFR shock: AOL components



Note: The orange line is the IRF under consideration, the yellowish line is for the AOL aggregate, it is reported for comparison. *i* marks the impulse variable, *r* marks the response variable.

4.2 Inside *advances and other loans.*

An interesting feature of the "advances and other loans" aggregate is that it is made mainly of loans from non-depository institutions, but also of concessional loans (such as those granted by the government and by cooperative banks).[18] Using its components shows whether the response of lenders very different from banks is comparable to banks', and may help to understand the reason behind a specific response given the lender characteristics. To wit, finance companies are subject to a different regulatory regime for which their need to reshuffle the portfolio is less tight, then, if risk is the main reason why lenders reshuffle their portfolio following a monetary tightening, we should observe a milder response by finance companies. The list of AOL components for each of the three borrower groups is in Table 6 in the appendix.[19] In Figure 10 we plot the IRFs from our benchmark VAR in which we have replaced the AOL aggregate with some if its components; the VAR remains a 20-variable system.

[18] Just the residual part "Rest of the World" might include loans from foreign depository institutions.

[19] As for AOL to corporate business, in the period under consideration around 60% is made of loans from finance companies, 18% of loans from the rest of the world, 8% of banker's acceptances, 4% of US government loans and another 4% of syndicated loans, etc.

If we consider just finance-companies, we observe a clearer increase at step 1 (time of the shock) for loans to corporate business, while no much changes for loans to non-corporate business. The response of AOL restricted to finance-company loans gets more similar to banks', but it is smaller anyway (0.002 for finance companies against 0.005 for banks at the peak). Then, from a supply-perspective, *finance companies behave as banks in response to a monetary tightening* (**R6**): they extend credit. Nonetheless, their response is milder and this might depend on the fact they are more relaxed about risk re-balancing following a monetary hike.[20]

Loans granted by government agencies do not exhibit a significant response. This could be because government agencies do not change their supply policy in response to an unexpected FFR increase.

The last insight comes from loans supplied by the Farm Credit System, a system of cooperative banks serving the entire US agricultural sector. Interestingly, loans from the system increase in case of a FFR hike, more clearly to non-corporate business. According to Monke (2016), such loans (thanks to tax benefits) are cheaper than those granted by commercial banks. Then, a portion of the observed increase could be demand-driven and caused by substitution away from the relatively more expensive banks' loans.

4.3 From the IRFs to an explanation of the loan puzzle

The IRFs discussed in the previous sub-sections provide information to evaluate the two alternative explanations of the loan puzzle.

The first point to stress is that the loan puzzle emerges only in case of a FFR shock. If the loan increase observed in case of a FFR shock (the puzzle) were explained by a counter-cyclical push linked to the need to counterbalance decreasing revenues, this should be also in case of a real-activity shock. Similarly, if the same loan increase were explained by a counter-cyclical push linked to the need to counterbalance increasing interest expenditures, this should be observed also in case of a loan interest-rate shock. Neither are observed.[21] Furthermore, also an adverse sales shock does not cause a loan

[20] According to DSY2007, banks reshuffle their portfolio away from households and more towards firms for risk management.

[21] It does not emerge either in case of an adverse real-activity shock, which is supposed to cause a similar revenue decrease, or in case of a loan interest-rate shock that is supposed to cause a similar interest expenditure increase (i.e. the prime loan rate; see Figure 7 above). Truly, the FFR shock is somehow unique because it is the only one having an adverse impact both on real activity and on loan rates at the same time, while the other two shocks previously mentioned affect only one of the two cash-flow components. The real-activity shock impacts revenues but decreases loan-rates,

increase (Figure 8). Even though we cannot exclude that some loans might increase also because of higher demand, perhaps due to substitution away from lenders that respond more deeply to the monetary tightening (see Farm Credit System loans), on the whole **a significant counter-cyclical push to loan demand in case of a FFR shock does not find support in our data.**

BG1995 affirm that firms demand more loans to maintain production constant at a time of decreasing sales, then inventories should increase before a permanent production adjustment is realized. Loans are imagined to be used to finance inventories and, in DSY2007's perspective, inventories should therefore cause higher loan demand. Even though the evolution of inventories is in line with the explanation by BG1995, that does not provide a real support to its validity. Indeed, inventories are observed to evolve in a similar way whenever sales decrease and not just when that decrease is induced by a FFR hike; see the effect of a sales shock on inventories in Figure 9. Furthermore, the problem with the sequence of events in BG1995 is that loans do not increase in case of an adverse sales shock (Figure 8), then **it is hard to believe that the inventories increase is financed with more loans** requested to counterbalance a lower cash-flow (alias, lower sales).

The evolution of the interest rates found is very much comparable to what is in DSY2007. The prime loan rate responds quickly at the deepest to a monetary tightening, while all the other rates first start at a lower level, achieve a maximum and then revert towards zero. The response of the prime loan rate is two times higher at the peak. From a demand perspective, this should discourage more firms than households. On the contrary, from a supply perspective, short-term loans become more remunerative relatively to the others; particularly if lenders can finance themselves at a cost that increases comparatively less. On the grounds of the interest rate divergence observed, **a recomposition of loans in favor of corporations seems a possible outcome.** Of course, lenders (banks in particular) cannot just look at the return of loans but need to care about the risk that those loans bring. In this regard, Ciccarelli et al. (2015) confirm that the balance-sheet effects on borrowers are more adverse on households, who therefore worsen their credit worthiness compared to firms; along this line, the same balance-sheet effects should be stronger on small firms than large firms (BG1995).[22] Our results confirm this possible hierarchy of adverse balance-sheet effects across groups, since we observe

while the loan-rate shock should increase only interest expenditures and leave firms' revenues mostly unchanged.

[22] DSY2007 explain in details why an evolution of private interest rates very similar to what we get may take banks to lend more to firms than households. Such explanation hinges on risk management and capital-adequacy ratios.

loans to decrease more to households, then on small firms and last on large firms.

As matter of fact, borrowers face loan interest rates for the loans they demand, the federal funds rate regards directly intermediaries and only indirectly final borrowers to the extent that it is transmitted to market rates. Then, if we compare the response of loans to loan interest rates (i) with their response to the feds fund rate (ii) and a divergence emerges, as it is for bank loans to corporations, such a difference should depend on lenders because: a) they are impacted directly by the FFR while borrowers are not, b) an increase of loan interest rates, which are directly relevant to borrowers, seems to reduce loans to the private sectors as expected (IRF "i: Loan Prime rate -> r: CB-DIL and r: NCB-DIL" in Figure 7 against the response of CB-DIL in Figure 5).[23] This argument too supports a loan supply recomposition as an explanation of the puzzle.

Drawing the conclusions of what said so far, we believe that the analysis does not return evidence in support of a demand-based explanation of the loan puzzle, while it leaves room to the the supply-side explanation discussed.

5 Conclusions

In this research we have studied how loans to different groups of borrowers respond to a federal-funds rate shock, this should mirror a monetary-policy change. Our objective was to investigate more in details the differential response of loans to corporations with respect to loans to households spotted in some previous contributions. Two alternative explanations of the puzzling response of corporation loans, Bernanke & Gertler (1995) and Den Haan et al. (2007), have been discussed and we have sought evidence in support of either in our data. Our analysis confirms that the loan puzzle emerges just in case of a monetary downturn and not in case of any other event that can affect firms' cash flow in a similar way. This signals a peculiarity of monetary shocks that somehow point in favor of supply-based explanations. Our analysis therefore suggests that a loan supply recomposition is more likely to explain the loan puzzle than counter-cyclical components of the loan demand.

With respect to the literature, our analysis adds more information to this branch of research. *First*

[23] One could say that a weakness of this conclusion is that only the FFR hike causes an economic downturn while loan interest-rate hikes do not, firms could therefore demand more loans just in case of FFR shock and this is why we observe the loan puzzle only in case of a FFR shock. However, as said before, such counter-cyclical motivation behind the loan demand does not emerge.

of all, we show that loans to small firms increase as well but less than what observed with large firms. Small firms stay in between large firms and households, but the loans they get do not decrease as imagined by Gertler and Gilchrist (1993*a*, 1993*b*, 1994). Following Ciccarelli et al. (2015) as well as Bernanke (2007), if the response observed in the US market depends truly on balance-sheet effects, then our analysis confirms their hierarchy as defined by BG1995. *Secondly*, considering advances and other loans allows to come to the conclusion that finance companies behave very much as banks. A further interesting insight from the components of advances and other loans is the response of Farm Credit System loans, which are observed to increase both for corporate and non-corporate business. Such loans might increase also because of higher demand, which reflects substitution away from the comparatively more expensive bank loans after a monetary tightening. *As last*, we add that there is some limited evidence that not just industrial and commercial loans to firms increase, but also other kind of loans, such as mortgages.

References

Albertazzi, U., Barbiero, F., Marques-Ibanez, D., Popov, A. A., DAcri, C. R. & Vlassopoulos, T. (2020), Monetary policy and bank stability: the analytical toolbox reviewed, Working Paper Series 2377, European Central Bank. 3, 4

Angeloni, I., Faia, E. & Lo Duca, M. (2015), 'Monetary policy and risk taking', *Journal of Economic Dynamics and Control* **52**, 285–307. 16

Bańbura, M., Giannone, D. & Reichlin, L. (2010), 'Large bayesian vector auto regressions', *Journal of Applied Econometrics* **25**(1), 71–92. 8, 14, 15

Bernanke, B. (2007), 'The financial accelerator and the credit channel'. At the The Credit Channel of Monetary Policy in the Twenty-first Century Conference, Federal Reserve Bank of Atlanta, Atlanta, Georgia. 3, 8, 27

Bernanke, B. S. & Gertler, M. (1995), 'Inside the black box: The credit channel of monetary policy transmission', *The Journal of Economic Perspectives* **9**(4), 27–48. 1, 3, 5, 26

Busch, U., Scharnagl, M. & Scheithauer, J. (2010), Loan supply in germany during the financial crisis, Discussion Paper 05/2010, Deutsche Bundesbank. 2

Cafiso, G. (2019), 'Gdp growth through private debt: the effect of monetary shocks', *CESifo Economic Studies* **65**(2), 236–253. 2

Christiano, L. J., Eichenbaum, M. & Evans, C. L. (1999), 'Monetary policy shocks: What have we learned and to what end?', *Handbook of macroeconomics* **1**, 65–148. 16

Ciccarelli, M., Maddaloni, A. & Peydró, J.-L. (2015), 'Trusting the bankers: A new look at the credit channel of monetary policy', *Review of Economic Dynamics* **18**(4), 979–1002. 3, 8, 14, 27

den Haan, W. (2011), 'Why do we need a financial sector?', VoxEU. 3

Den Haan, W. J., Sumner, S. W. & Yamashiro, G. M. (2007), 'Bank loan portfolios and the monetary transmission mechanism', *Journal of Monetary Economics* **54**(3), 904–924. 1, 2, 3, 7, 26

Dieppe, A., Legrand, R. & van Roye, B. (2018), *The Bayesian Estimation, Analysis and Regression (BEAR) Toolbox - Technical Guide*, European Central Bank. 14

ECB (2011), *The monetary policy of the ECB*, 3rd edn, European Central Bank. 1, 3

Estrella, A. (2015), 'The price puzzle and var identification', *Macroeconomic Dynamics* **19**(8), 1880–1887. 22

Gambetti, L. & Musso, A. (2017), 'Loan supply shocks and the business cycle', *Journal of Applied Econometrics* **32**(4), 764–782. 9, 14

Gertler, M. & Gilchrist, S. (1993*a*), 'The cyclical behavior of short-term business lending: Implications for financial propagation mechanisms', *European Economic Review* **37**(2), 623 – 631. 1, 2, 3, 5, 6, 27

Gertler, M. & Gilchrist, S. (1993*b*), 'The role of credit market imperfections in the monetary transmission mechanism: arguments and evidence', *The Scandinavian Journal of Economics* pp. 43–64. 1, 2, 3, 5, 6, 27

Gertler, M. & Gilchrist, S. (1994), 'Monetary policy, business cycles, and the behavior of small manufacturing firms.', *Quarterly Journal of Economics* **109**(2). 1, 2, 3, 5, 6, 17, 27

Giannone, D., Lenza, M. & Primiceri, G. E. (2015), 'Prior selection for vector autoregressions', *Review of Economics and Statistics* **97**(2), 436–451. 14

Giannone, D., Lenza, M. & Reichlin, L. (2012), Money, credit, monetary policy and the business cycle in the euro area, Discussion Paper DP8944, CEPR. 2

Giannone, D., Lenza, M. & Reichlin, L. (2019), Money, credit, monetary policy and the business cycle in the euro area: what has changed since the crisis?, Working Paper Series 2226, ECB. 6, 10, 14

Guerrieri, V. & Lorenzoni, G. (2017), 'Credit crises, precautionary savings, and the liquidity trap', *The Quarterly Journal of Economics* **132**(3), 1427–1467. 1

Hristov, N., Hülsewig, O. & Wollmershäuser, T. (2012), 'Loan supply shocks during the financial crisis: Evidence for the euro area', *Journal of International Money and Finance* **31**(3), 569–592. 14

Jiménez, G., Ongena, S., Peydró, J.-L. & Saurina, J. (2014), 'Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking?', *Econometrica* **82**(2), 463–505. 5

Kaplan, G., Moll, B. & Violante, G. L. (2018), 'Monetary policy according to hank', *American Economic Review* **108**(3), 697–743. 1

Kashyap, A. K., Lamont, O. A. & Stein, J. C. (1994), 'Credit conditions and the cyclical behavior of inventories', *The Quarterly Journal of Economics* **109**(3), 565–592. 21

Kashyap, A. K. & Stein, J. C. (2000), 'What do a million observations on banks say about the transmission of monetary policy?', *American Economic Review* **90**(3), 407–428. 3

Kilian, L. & Lewis, L. T. (2011), 'Does the Fed respond to oil price shocks?', *The Economic Journal* **121**(555), 1047–1072. 16

Monke, J. (2016), Farm credit system, CRS Report RS21278, Congressional Research Service. 24

Ramey, V. A. & West, K. D. (1999), 'Inventories', *Handbook of macroeconomics* **1**, 863–923. 10, 21

Stock, J. H. & Watson, M. W. (2001), 'Vector Autoregressions', *The Journal of Economic Perspectives* **15(4)**, 101–115. 8

Appendix.

Table 4: Total mortgages: components by borrower

FRB code	component
	Households and nonprofit organizations
FL153165105	Households and nonprofit organizations; home mortgages; liability
FL163165505	Nonprofit organizations; commercial mortgages; liability
	corporate business
FL103165105	NF corporate business; home mortgages; liability
FL103165405	NF corporate business; multifamily residential mortgages; liability
FL103165505	NF corporate business; commercial mortgages; liability
FL183165605	Corporate farm business; farm mortgages; liability
	Non-corporate business
FL233165605	Non-corporate farm business; farm mortgages; liability
FL113165003	NF non-corporate business; total mortgages, excluding non-corporate farms; liability

Table 5: Depository-institution loans: components by borrower

FRB code	component
	households and nonprofit organizations
FL763068213	U.S.-chartered DIs; other bank loans to households and nonprofit organizations; asset
FL753068213	Foreign banking offices in the U.S.; other bank loans to households and nonprofit organizations; asset
FL713068303	Monetary authority; DI loans n.e.c. to households (Term Asset-Backed Securities Loan Facility); asset
	corporate business
FL763068105	U.S.-chartered DIs; DI loans n.e.c. to NF business; asset
FL753068110	Foreign banking offices in the U.S.; commercial and industrial loans and leases to U.S. addressees; asset
FL753069603	Foreign banking offices in the U.S.; bankers' acceptances; asset
FL743068005	Banks in U.S.-affiliated areas; DI loans n.e.c.; asset
FL473068005	Credit unions; DI loans n.e.c.; asset
FL113168005	NF non-corporate business; DI loans n.e.c.; liability
	non-corporate business
FL233168005	Non-corporate farm business; DI loans n.e.c.; liability
FL113168003	NF non-corporate business; DI loans n.e.c., excluding non-corporate farms; liability

Note: DI stands for depository institution.

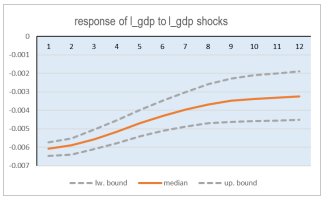
Table 6: Advances and other loans: components by borrower

FRB code	component	weight
	households and nonprofit organization	
FL 15 31692 03	Households and nonprofit organizations; U.S. government loans; liability	11%
FL 15 31694 05	Households and nonprofit organizations; policy loans; liability	47%
FL 15 31693 05	Households and nonprofit organizations; Sallie Mae loans; liability	0%
FL 66 30670 03	Security brokers and dealers; margin accounts at brokers and dealers; asset	42%
	corporate business	
FL 10 31692 05	corporate business; U.S. government loans, including loans to automakers; liability	4%
FL 10 31695 35	corporate business; finance companies loans; liability	60%
FL 10 31697 05	corp. bus.; customers' liability on acceptances outstanding to commercial banking; liability	8%
FL 26 30695 00	Rest of the world; U.S. NF business loans; asset	17%
FL 10 31698 03	corporate business; syndicated loans; liability	4%
FL 18 31693 05	Corporate farm business; Farm Credit System loans; liability	1%
FL 73 30690 13	Holding companies; other loans and advances due from U.S. addressees; asset	3%
	non-corporate business	
FL 11 31692 05	non-corporate business; U.S. government loans; liability	46%
FL 11 31695 35	non-corporate business; finance companies loans; liability	23%
FL 11 31693 05	non-corporate business; Farm Credit System loans; liability	31%

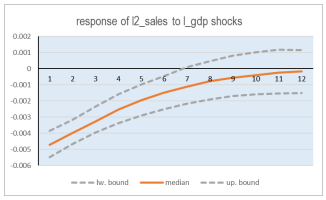
Notes: Weights are over the total for the period 1971q1-2007q4.

Figure 11: Response to an adverse real-activity shock: all variables

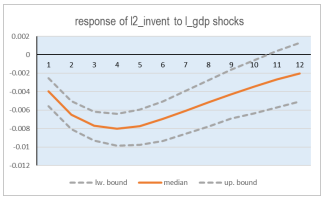
i: GDP → r: GDP



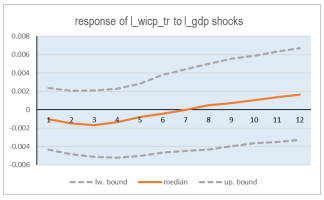
i: GDP → r: sales



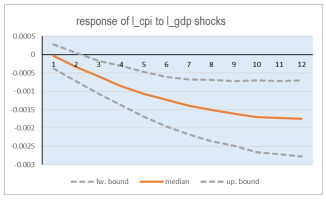
i: GDP → r: inventories



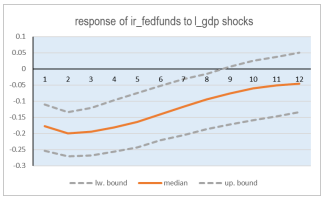
i:GDP → r:WI commodity prices



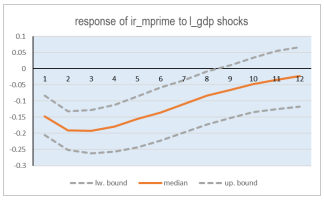
i:GDP → r:consumer price index



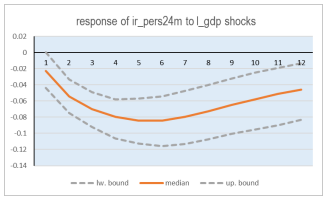
i:GDP → r: Federal Funds Rate



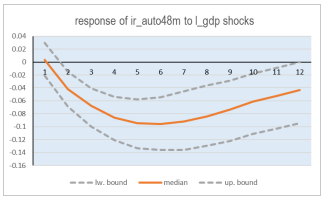
i: GDP → r: loan prime rate



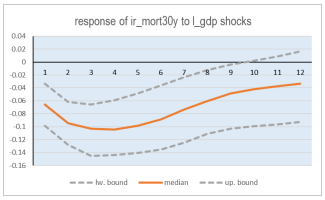
i: GDP → r: 24m loans i.rate



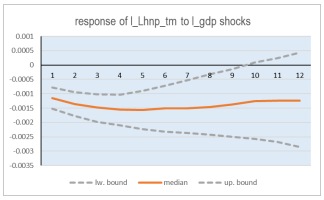
i: GDP → r: 48m loans i.rate



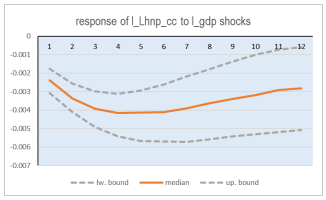
i: GDP → r: 30y mortg. i.rate



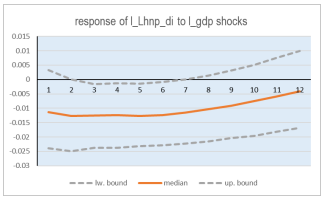
i: GDP → r: HNP-mortgages



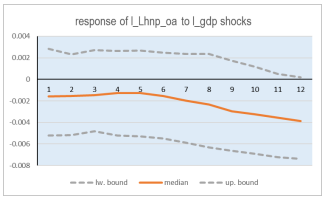
i: GDP → r: HNP-CC



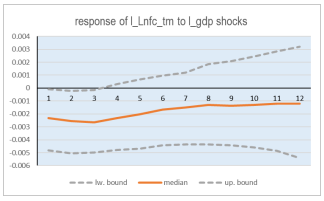
i: GDP → r: HNP-DIL



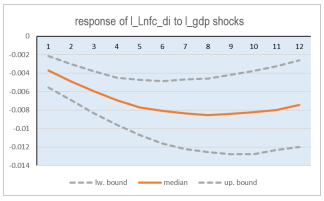
i: GDP → r: HNP-AOL



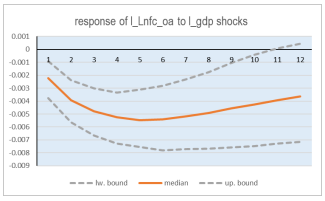
i: GDP → r: CB-mortgages



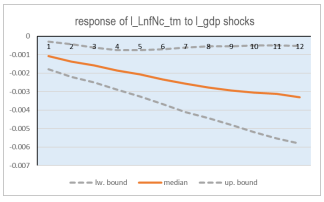
i: GDP → r: CB-DIL



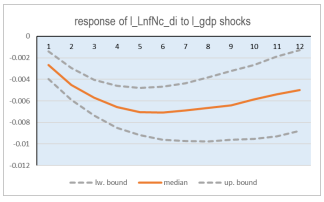
i: GDP → r: CB-AOL



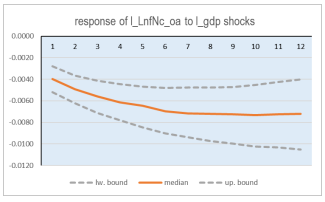
i: GDP → r: NCB-mortgages



i: GDP → r: NCB-DIL



i: GDP → r: NCB-AOL



Notes: HNP is for households and non-profit, CB for corporate-business, NCB for non-corporate business. TM is for mortgages, CC for consumer credit, DIL for depository institution loans, AOL for advances and other loans. *i* marks the impulse variable, *r* marks the response variable.