Bank loan supply shocks and alternative financing of non-financial corporations in the Euro area*

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January 2018, Preliminary and incomplete

Abstract

We analyze the macroeconomic effects of exogenous contractions in bank lending to non-financial corporations in the Euro Area, Germany, France, Italy and Spain using a Bayesian vector autoregressive model with endogenous hyperparameter selection and identification via sign restrictions. We focus on the behaviour of firms' external financing sources alternative to bank loans, such financing via equity and debt securities and lending from non-banks. For the Euro Area our results show that alternative financing sources display a negative delayed response after an exogenous expansion in bank lending. However, quantitatively the developments in bank loans dominate the response of overall external financing since developments in alternative financing sources cannot compensate the expansion in bank lending. This result also holds at the country level. However, we show that the behaviour of alternative financing sources after a loan supply shock is quantitatively and qualitatively heterogeneous across countries. We also find the contributions of loan supply shocks for the development in alternative financing sources to be relatively small.

Keywords: loan supply, external financing, Euro Area, Bayesian VAR, sign restrictions

JEL classification: C32, E32, E51

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1 Introduction

The Euro Area economy as a whole and many of its members have experienced a sustained weakness in bank lending to firms following the financial and sovereign debt crises. An important policy question is whether this weakness in bank lending is mostly due to weak loan demand, reflecting weak business cycle conditions which persisted well into 2015 or whether it was due to a contraction in banks' loan supply, eg. due to weak capital positions, reduced risk-taking or reassessments of risks. As a result, the past years have seen a number of papers studying the effects of loan supply shocks in the Euro Area, e.g. Altavilla, Darracq-Paries, and Nicoletti (2015), Deutsche Bundesbank (2015), Gambetti and Musso (2017) and Moccero, Darracq-Paries, and Maurin (2014)as well as in individual Euro area countries eg. Bijsterbosch and Falagardia (2014) and Hristov, Hülsewig, and Wollmershäuser (2012).

These analyses, however, do not account for firms potentially having access to alternative sources of external financing that might act as substitutes for the reduced availability of bank loans after a loans supply shock. In fact, access to cheap alternative financing sources might explain weak loan demand in countries such as Germany, eg. Deutsche Bundesbank (2016).

In this paper we augment standard VAR models used in the analysis of loan supply shocks with alternative financing sources for firms taken from the flow of funds statistics. We study the effects of loan supply shocks on the standard macroeconomic variables as well as on the alternative external financing sources and on overall external financing of non-financial firms. The analysis is carried out both for the Euro Area and for the four large member countries (Germany, France, Italy and Spain). We identify loan supply shocks using standard restrictions motivated by DSGE models. Mumtaz, Pinter, and Theodoridis (2014) show that VARs with sign restrictions are able to capture credit supply shocks reasonably well in simulations. Since the inclusion of additional financing sources leads to a considerable increase in the dimension of the VAR we estimate the VAR using a Bayesian approach and employ the endogenous hyperparameter s election approach from Giannone, Lenza, and Primiceri (2015) which selects the shrinkage imposed on the VAR coefficents in a data-driven way.

Our analysis is closest to those in Gambetti and Musso (2017) and Bijsterbosch and Falagardia (2014). While both use a time-varying VAR model this appraoch requires the VAR to have a reasonably small dimension and the availablility of long data series. Since we use higher-dimensional models and our data set runs from 1999 onwards only we continue to use a fixed-parameter VAR. The second important difference in our approach is that both papers do not consider alternative financing sources. For the individual

country models our analysis differs from Bijsterbosch and Falagardia (2014) furthermore, in that we include euro area aggregates for output and price level in the country models to improve the estimation of the monetary policy reaction function and the identification of the monetary policy shock.

Aldasoro and Unger (2017) also consider the effect of loan supply shocks on alternative financing sources but look only at the composite of the three variables we are considering individually. They also do not present results for historical decompositions and for the dynamics of the overall sum of external financing including bank loans which does not allow them to estimate to what an extent substitution across financing sources is important. In contrast to them we do not consider supply shocks to bank loans and other financing to be shocks that, by construction, imply substitution among financing sources. These additional restrictions imply a much more narrow interpretation of the shocks than in the literature (see below).[1]

2 Empirical approach

2.1 Estimation approach

The dynamic interactions among the variables and the corresponding shock identification is based on an estimated time-invariant Bayesian vector autoregressive model

$$y_t = c + A_1 y_{1,t} + \cdots + A_p y_{n,t} + \epsilon_t \tag{1}$$

where y_t is a vector of n variables, c is a vector of intercepts, A_i is a $n \times n$ matrix of coefficients on lag i, p is the number of lags and ϵ_t is a vector of residuals that are normally distributed with mean zero and covariance Σ.

As the number of parameters is large relative to the sample size the choice of the hyperparameters is of crucial importance for the estimated parameters, as these govern the tightness. The model is estimated using the approach by Giannone et al. (2015). They do not fix the hyperparameters in an ad-hoc way (Sims and Zha, 1998), by estimating them using a training sample or matching the in-sample fit of the BVAR to that of a small VAR (Banbura, Giannone, and Reichlin, 2010), but treat those as random variables. The implied hierarchical structure is augmented by an a priori specification of the hyperparameter distributions using "hyperpriors".

[1] Their results are not comparable to ours because their model deviates from the literature in using levels for real GDP and prices and growth rates for financing sources which also destroys any possibility of cointegration. Furthermore their analysis relies on imposing zero and sign restrictions to identify different types of financing supply shocks which are difficult to justify theoretically.

The prior for the autoregressive coefficients A_i is of the Minnesota-type, assuming all variables as independent random walks conditional on the vector of hyperparameters γ and on the covariance matrix Σ.

$$E\left(A_{k,ij}|\Sigma,\gamma\right) = \begin{cases} 1 & \text{if } i=j \text{ and } k=1 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

The prior covariance matrix of the A_i coefficients is given by

$$cov\left(A_{k,ij}, A_{s,hm}|\Sigma,\lambda,\Psi\right) = \begin{cases} \lambda^2 \frac{1}{k^2} \frac{\Sigma_{ih}}{\Psi_{jj}} & \text{if } m=j \text{ and } s=k \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

where the hyperparameters λ and Ψ being elements of γ. The higher the lag k, the stronger the shrinkage of the dynamic coefficients towards its prior mean (2). λ controls the relative importance of the prior. The larger λ, the less important is the prior information, the smaller the shrinkage. The term $\frac{\Sigma_{ij}}{\Psi_{jj}}$ accounts for different scales of the variables.

For forecasting purposes Giannone, Lenza, Momferatou, and Onorante (2014) and others include the sum-of-coefficient prior and the initial-dummy-observation prior. Both types of priors are not included here. Empirical evidence suggests that this allows for richer dynamics in the interaction of the variables.

The prior on the covariance matrix Σ is assumed to be inverse Wishart

$$\Sigma \sim IW\left(\Psi, n+2\right). \tag{4}$$

The scale matrix Ψ is assumed to be diagonal. Its elements are treated as hyperparameters.

The estimation is based on a Markov-Chain-Monte-Carlo (MCMC) algorithm that is the combination of a Gibbs sampler and a Metropolis Hastings step. As in standard BVAR models, the Gibbs sampler generates draws for the dynamic coefficients and the elements of the covariance matrix based on a specific set of hyperparameters. The additional Metropolis-Hastings step is used for generating draws of the hyperparameters. It accounts for the uncertainty on these hyperparameters. The algorithm starts at the mode of the posterior of the hyperparameters. As the closed form of the density of the data conditional on the hyperparameters is known, the mode can be determined by numerical optimization.

The prior for λ is specified as Gamma distribution with mode equal to 0.2. The prior on the scale matrix Ψ is an Inverse-Gamma distribution with scale and shape equal to 0.02^2.

2.2 Data

We use quarterly data for the Euro area, Germany, France, Italy and Spain. Our baseline model includes real GDP, the GDP deflator, real MFI loans to non-financial corporations[2], the EONIA rate as proxy for the monetary policy rate, the interest rate on bank loans to non-financial corporations (newly issued loans), the five-year government bond yield and three variables from the flow of funds: external financing of non-financial corporations via equity and shares, debt securities, and loans where we subtract bank loans from the latter series leaving only loans from non-bank sources. Bank loans and the flow of funds data are notional stocks and are deflated using the GDP deflator.[3] Since the flow of funds data are not seasonally adjusted and display a marked seasonal pattern we seasonally adjust the deflated series using the X12 procedure in EViews.

The BVAR model is estimated in log-levels for all variables except for the interest rates and interest rate spreads which are taken as decimal numbers.[4]

2.3 Identification

Shock identification is achieved through sign restrictions using the algorithm of Arias, Rubio-Ramírez, and Waggoner (2014). We identify four structural shocks, an aggregate demand shock, an aggregate supply shock (inflation shock), a monetary policy shock and a loan supply shock (Table 1). While we are mainly interested in the effects of the loan supply shock we will also present results on the effects of the other shocks on firms' external financing.[5] Identification of the the aggregate demand, aggregate supply and monetary policy shock is standard and the sign restrictions are presented in Table 1. A loan supply shock is identified as an exogenous increase in real bank lending that leads to an increase in real output, a decline in the interest rate on bank loans and an increase in the monetary policy rate.[6] Thus, the loan supply shock represents a range of underlying structural disturbances that work through banks' loan supply, eg. exogenous changes in bank capital or net worth, changes in banks' risk-assessment of borrowers, regulatory changes (changes to capital requirements or loan-to-value ratios) etc. This

[2]MFIs are monetary financial institutions and include the commercial banking sector, building societies, money market funds and the central bank.

[3]Notional stocks are constructing based on growth rates derived from the transactions based changes in the series, ie. they do not include changes due to revaluations, reclassifications etc. For details, see European Central Bank (2012).

[4]Specifically, the variables are transformed into 4×log-levels to make them conformable with the annualized interest rates, since the prior-selection approach is not scale invariant, see Giannone et al. (2015) for details.

[5]We also use the results concerning the other shocks to gauge the quality of the model, ie. to check whether the model produces theoretically plausible impulse responses.

[6]Mumtaz et al. (2014) provide a general discussion of the performance of sign restrictions in identifying credit supply shocks.

interpretation also covers more general financial markets shocks which also affect banks' lending behaviour and are consistent with the results of various DSGE models with an banking sector.[7] We leave the impulse responses of firms' alternative financing sources unrestricted, thus allowing for the possibility of a negative effect (ie. substitution between bank loans and other financing) as well as for a positive effect which would be in line with the more broad interpretation of the loan supply shock as a financial shock which also works through banks' loan supply. This interpretation is consistent with most of the literature and allows us to compare the results from our extended model setup to the already established evidence.

The identifying restrictions on the loan supply shock are similar to those in Gambetti and Musso (2017) and Bijsterbosch and Falagardia (2014). However, we do not impose the restriction that the loan supply shock causes a positive correlation between bank loans and the price level on impact, since this is not a robust implication across the DSGE literature on bank lending shocks (see, eg. Gambetti and Musso (2017), Table II) and there is some evidence that restrictive financial shocks might lead to an initial increase in the price level, (Gilchrist, Schoenle, Sim, and Zakrajsek, 2015; Abbate, Eickmeier, and Prieto, 2016, e.g.). In order to disentangle the loan supply shocks from the aggregate supply shock without the restriction on the price level response we impose the assumption that an expansionary loan supply shock causes the central bank to increase its policy rate as it expects a future increase in the price level (see Deutsche Bundesbank (2015)).

The sign restrictions are imposed on impact. Part of the literature combines sign restrictions on the effects of loan supply shocks with zero restrictions on output and prices (e.g. Peersman, 2011; Hristov et al., 2012). While this might be defensible on a monthly frequency, results from both estimated DSGE models (e.g. Gertler and Karadi, 2011; Gerali et al., 2010) as well as from empirical studies on the effects of financial shocks (e.g. Abbate et al., 2016) provide strong evidence for financial shocks affecting the real economy within the quarter and thus make zero restrictions difficult to defend. We also do not identify a loan demand shock since this is already contained in the aggregate demand shock.[8]

We complete the analysis for the euro area by analyses of the effects of loan supply shocks in the four large Euro area countries (Germany, France, Italy and Spain). Since the European Central Bank decides about monetary policy based on developments in the aggregate euro area economy there is the danger that the monetary policy reaction

[7] For examples, see Gerali, Neri, Sessa, and Signoretti (2010); Gertler and Karadi (2011) or the summary in Gambetti and Musso (2017), Table II.

[8] Since the budget constraint and the optimization problem of firms imply that a demand-driven increase in financing will reflect to some extent in an increase in inputs to production or in investment, imposing zero restrictions on output and the price level in order to disentangle aggregate demand from financing demand shocks would be be inconsistent with micro-foundations.

Variable	$RGDP$	$GDPDEF$	$LOANS$	$MPRATE$	$LRATE$
AD shock	+	+			
AS shock	-	+		+	
MP shock	-	-		+	
LS shock	+		+	+	-

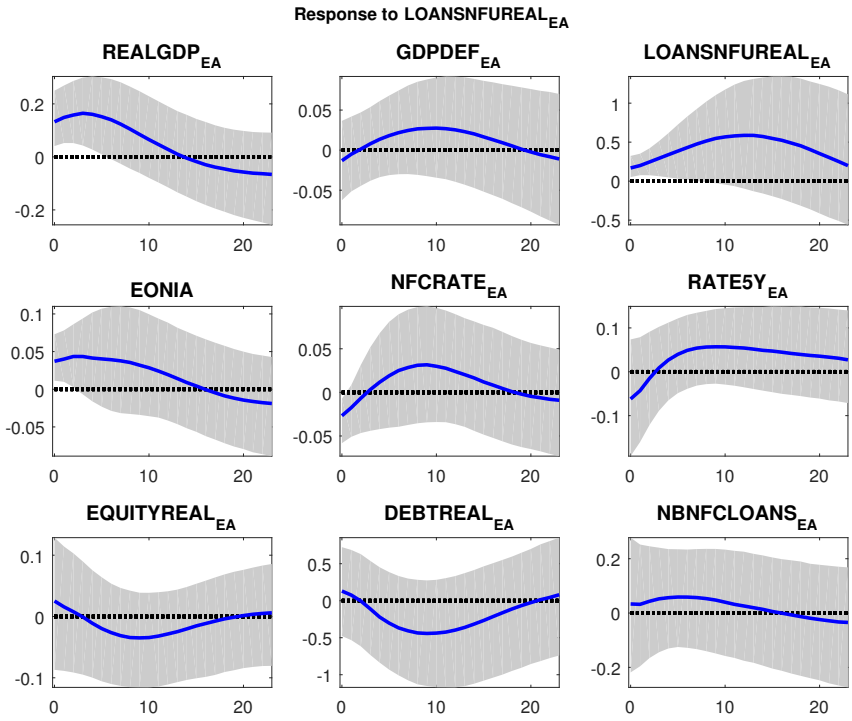
Table 1: Sign restrictions - Euro area model

Variable	$RGDP$	$GDPDEF$	$LOANS$	$MPRATE$	$LRATE$	$RGDP_{EA}$	$GDPDEF_{EA}$
AD shock	+	+					
AS shock	-	+		+			
MP shock				+		-	-
LS shock	+		+	+	-		

Table 2: Sign restrictions - country model

function and thus the dynamics of the policy rate will be incorrectly estimated if the correlation between the euro area aggregates and the national variables is w imperfect. To account for this, we include euro area aggregates of real GDP and the GDP deflator in the model and identify the monetary policy shock through sign restrictions on these euro area aggregates and not on the country-specific variables. Identifying restrictions for the other three shocks are placed on the country-specific variables. Thus, aggregate demand, supply and loan supply shocks potentially capture both country-specific and euro area common shocks. Here an issue arises with the identification of the loan supply shock through the assumption of a restrictive monetary policy reaction, ie. the assumption that the ECB responds to a possibly country-specific expansionary bank lending shock by raising the policy rate. This assumption would be difficult to maintain if we were considering small euro area countries. However, since the four countries in question carry considerable weights in the euro area aggregates even a country-specific loan supply shock will, all other things equal, affect the euro area averages and thus trigger a policy response. The identification scheme is summarized in Table 2.

Figure 1: Impulse responses to loan supply shock (median and 17- and 83% percentiles)



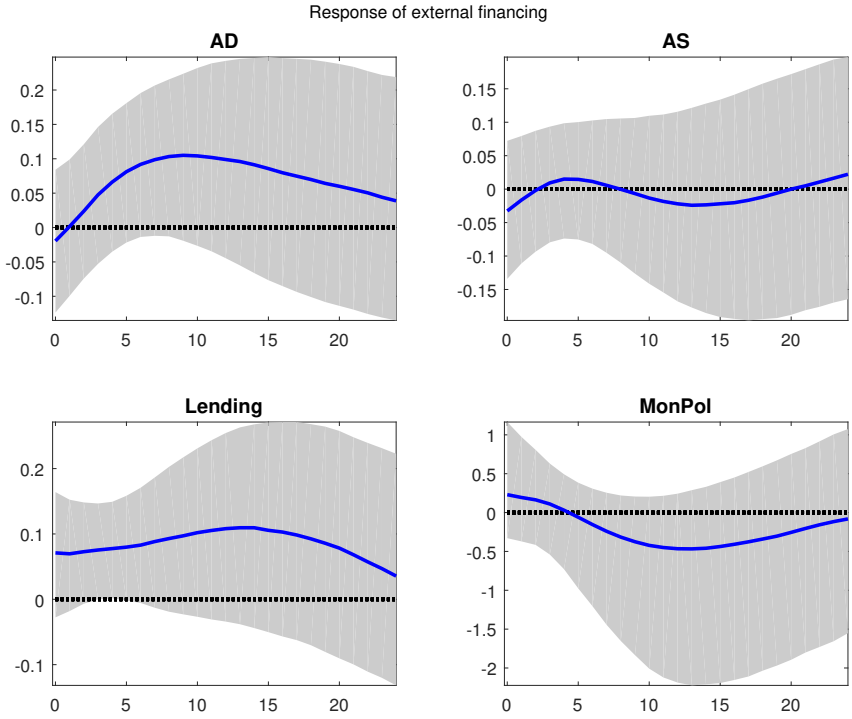
3 Results

3.1 Euro area

Figure 1 displays the impulse responses of the variables to an expansionary one-standard deviation loan supply shock in percentage deviations from baseline. The graphs show the median (in blue) of the posterior distribution of the impulse response functions together with the interval between the 17%- and 83%-percentiles. In interpreting the results we base our assessment on whether the bulk of the posterior distribution is located above or below zero.

The shock causes a temporary increase in output and with some delay in the price level. Note that the median initial price level response is negative which indicates that imposing a positive correlation between the loan supply shock and the price level on impact represents a strong prior assumption. The central bank responds with a persistent increase in the policy rate. Considering the increase in the price level - which was not imposed through sign restrictions - the assumption of an increase in the policy rate in the identification scheme seems reasonable if the central bank decides about policy in a forward-looking way. The bank lending rate drops initially by assumption but then increases somewhat above baseline, possibly due to the monetary tightening and the

Figure 2: Impulse responses of external financing to identified shocks



increase in economic activity.[9]

Concerning the alternative financing sources neither equity financing, nor debt securities nor non-bank lending seems to react to the increase in bank lending immediately. However, after about one year financing through equity and debt securities decline and reach a trough after about ten quarters. In contrast, non-bank lending remains broadly unchanged.[10]

Given the medium-term developments in two of the three alternative financing sources that are opposite to the developments in bank loans it is of interest how the sum of external financing, ie. the sum of bank lending, equity financing, debt securities and non-bank lending changes after the loan supply shock.

Figure 2 shows the impulse response of the sum of external financing to the four identified shocks.[11] The result clearly shows that a positive loan supply shock results

[9]This interpretation is supported by the impulse responses to an expansionary aggregate demand shock in the appendix. These show an increase in bank lending and in the bank lending rate which is likely to reflect an increase in firms' demand for bank loans.

[10]The posterior distribution of the impact response of financing via equity and debt securities exhibits substantial mass above zero, in fact, the median responses are positive on impact. This supports the interpretation of a loan supply shock in a broad sense as discussed in Section 2 as also encompassing more general financial market shocks that impact bank lending. Imposing a negative impact response on the two variables, thus, is likely to impose a very narrow interpretation on a loan supply shock.

[11]The impulse response distribution is obtained by computing a weighted average of the individual variables' impulse responses for each draw of the model with weights equal to the average share of the variables in overall external financing over the estimation period (approx. 24% for bank loans, 51% for

in an increase in overall external financing that persists for about four years. Broadly speaking, the expansion in bank lending dominates the contraction in the two other external financing sources. Thus, a contractionary (negative) shock to bank lending would result in an overall reduction of external financing since the contraction in bank lending would not be compensated by the expansion in equity financing and financing through debt securities.

Concerning the effects of the other identified shocks on external financing we find the a positive aggregate demand shock to have no contemporaneous impact but a delayed positive effect on external financing of non-financial firms. Figure 3 shows that this results from the expansion in bank and non-bank lending to firms while market-based financing shows a tendency to a negative response in the short-term. The aggregate supply (inflation) shock does not result in relevant movements in overall external financing but behind the unremarkable aggregate response are a tendency for bank lending to decline which is compensated by upward reactions in equity and bond financing after about four to six quarters (Figure 4). A restrictive monetary policy shock (increase in the policy rate) results in a short-term increase in overall external financing but after about one year the effect of the policy rate hike on firms' external financing turns negative. The short-run increase is due to the initially positive response of equity financing (Figure 5). While bank lending remains unresponsive immediately after the shock it declines with a delay and this decline is not compensated for by the expansion in equity and debt securities-based financing. One possible explanation for the increase in these two financing components might a substitution of firms with access to financial markets from bank loans to market-based financing with banks' loan supply contracting and lending rates increasing.

Figure 6 presents the median and percentiles of the posterior distribution of the identified shocks. The estimates suggest pronounced negative loan supply shocks in 2012 and 2013. The sequence of a positive shock in 2008Q1 followed by negative shocks corresponds to the results in Gambetti and Musso (2017) and the estimated shocks for the preceding period look similar to their estimates, as well. Figure 7, and Figure 8 show the historical decomposition of output, prices, bank lending and the flow of funds series. Specifically, the stacked coloured bars show the median contribution of each of the four identified shocks to the series' deviation from the unconditional forecast while the black line indicates the median deviation of the actual series from the unconditional forecast across all draws from the posterior distribution. The yellow bars represent the effects of the unidentified shocks as well as the approximation error resulting from the sum of the median contribution not necessarily being equal to the median of the sum of the contributions. Given that the

equity, 5% for debt securities and 21% for non-bank lending). Since the weighted average is a function of the model parameters from the MCMC simulations the resulting distribution is a valid approximation to the posterior distribution of the response of overall external financing.

Figure 3: Impulse responses to aggregate demand shock (median and 17- and 83% percentiles)

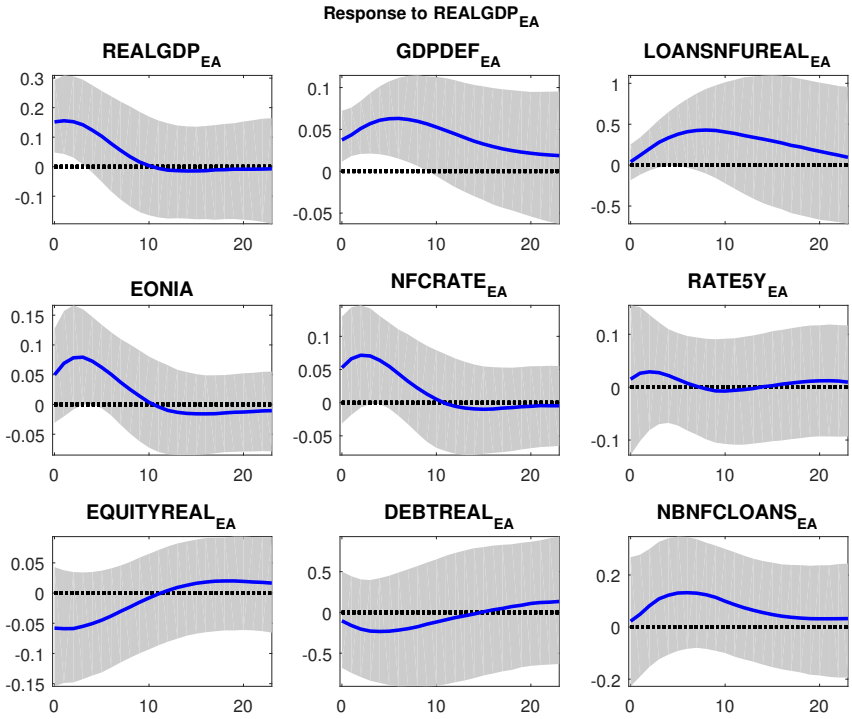


Figure 4: Impulse responses to aggregate supply shock (median and 17- and 83% percentiles)

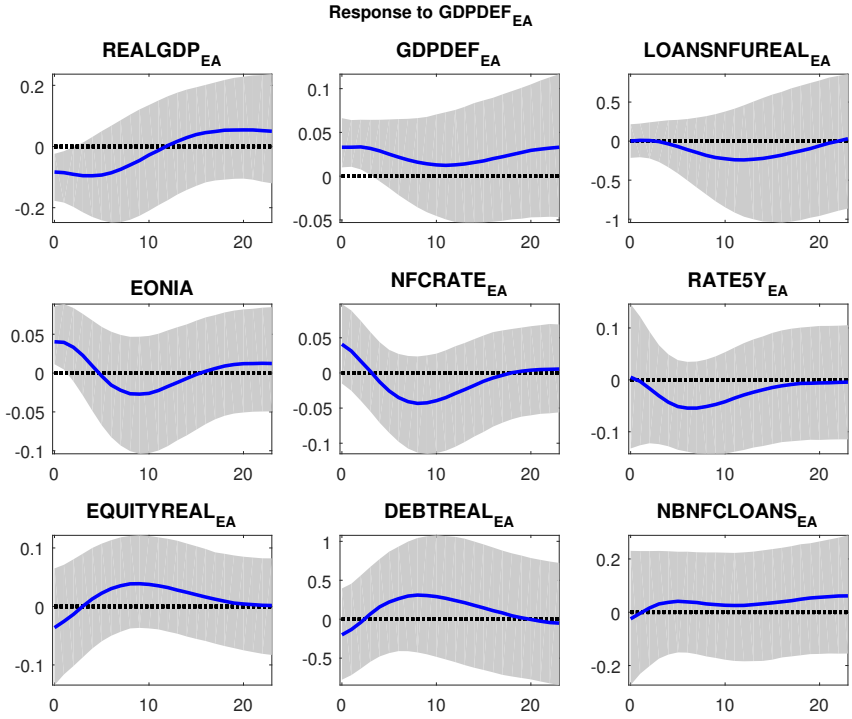
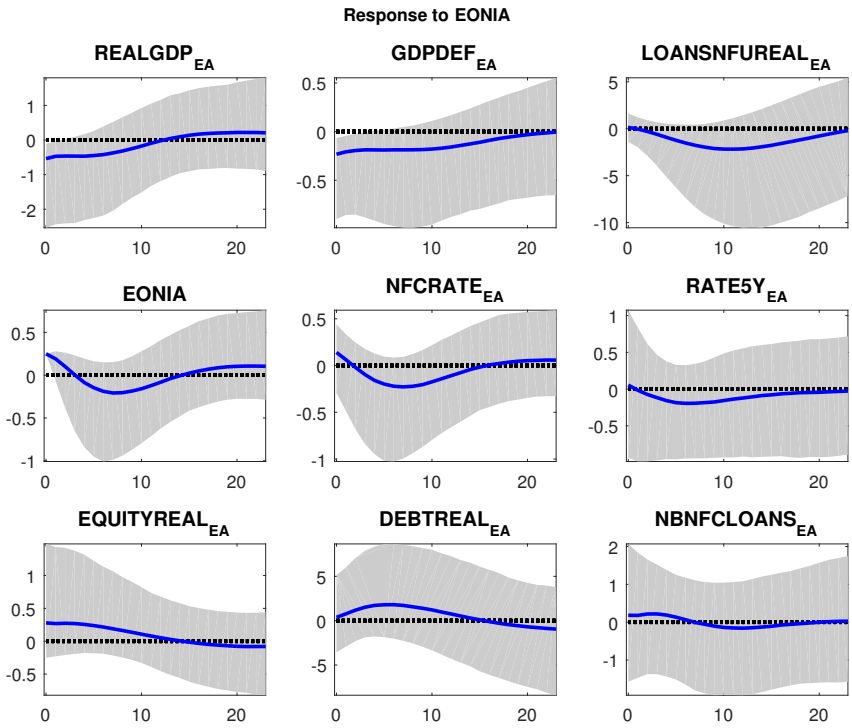


Figure 5: Impulse responses to 25bp monetary policy shock (median and 17- and 83% percentiles)



model contains five unidentified structural shocks the identified shocks generally account for less than half of the deviations from the unconditional forecasts. The effects of past positive loan supply shocks contributed to bank lending well up to 2012 when the effects of the negative shocks became dominant and continue to exert a negative influence on bank lending up to the end of the estimation period. Loan supply shocks have also been important in explaining the weaker than expected price level developments while their effect on real output growth has largely disappeared from 2015 onwards. Our estimates show little relevance of loan supply shocks on non-bank lending while they contributed to the rise in firms' financing through debt securities issuance above the unconditional forecast from about 2014 onwards and to the higher than expected growth in equity financing after 2015.

As a robustness test we extend the model to include the stock price index deflated by the GDP deflator, the CISS as an indicator of financial stress Hollo, Kremer, and Lo Duca (2012) and the corporate bond spread relative to Germany Gilchrist and Mojon (2014) which has also been shown to be a good indicator for financial shocks and is also a proxy for changes financing costs through issuance of debt securities relative to the risk-free rate. In the identification of all the shocks we leave these three variables unrestricted. The results in Figure 9 are very similar to those from the baseline model which carries over to the impulse responses of overall external financing (not shown). The estimated

Figure 6: Identified shocks (median and 17- and 83% percentiles of posterior distribution)

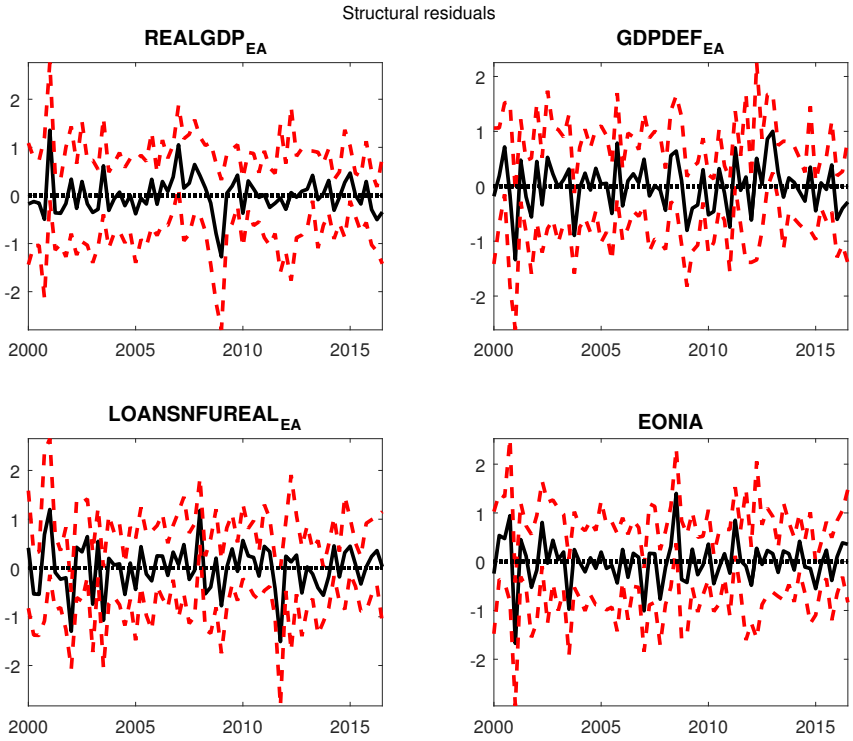


Figure 7: Historical decomposition -median contribution of identified shocks

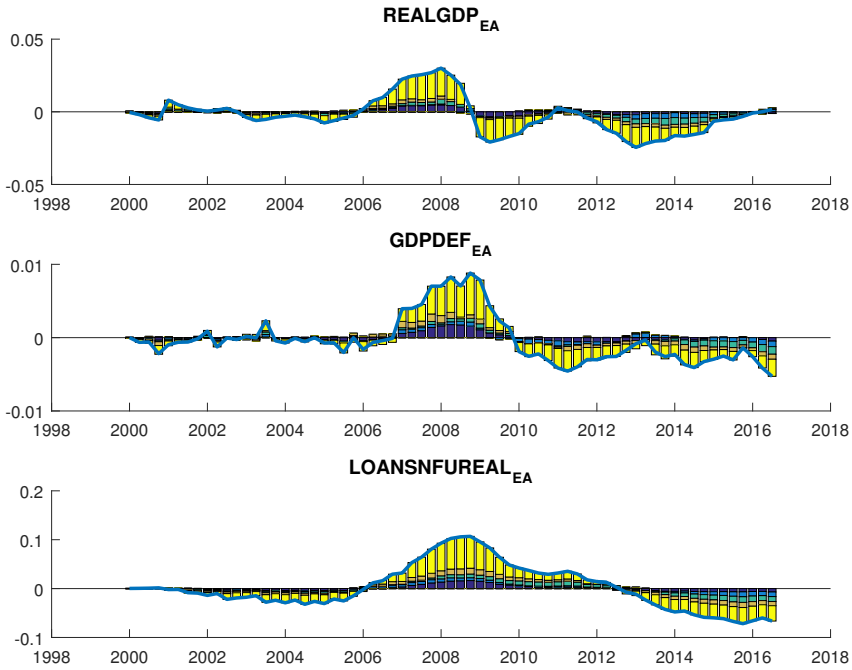
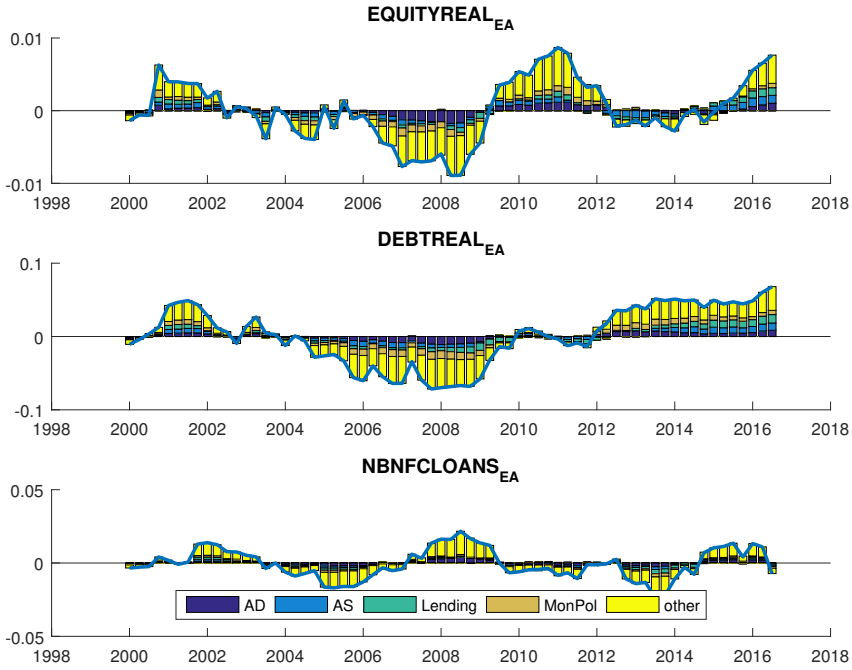


Figure 8: Historical decomposition -median contribution of identified shocks (contd.)



posterior distribution of the loan supply shock turns out to be very similar, as well. The impulse response distributions of the three additional variables are very wide on impact and do not suggest a marked reaction of these variables to loan supply shocks.

3.2 Germany

Figure 10 shows the effects of loan supply shock in Germany which identified according to the identification scheme in Table 2. Thus, this loan supply shock is likely to contain elements of both idiosyncratic loan supply shocks in Germany and loan supply shocks in Germany which are common to the Euro area. The responses of most of the variables are generally less persistent than in the Euro Area model and instead of hump-shaped patterns display montonous convergence to baseline. Three differences stand out: (1) the interest rate on bank loans drops more persistently in Germany than in the Euro area, (2) this also applies to the government bond yield, and (3) equity financing and financing through debt securities displays a positive correlation on impact with bank lending and then returns to baseline with a speed similar to that for bank loans. In contrast to the results for the Euro Area there is no evidence of a medium-term decline in financing from these sources following a expansionary loan supply shock, ie. there is no evidence for substitution among these sources of financing. This also reflects in the response of the sum of external financing (Figure 11) which increases on impact and returns back to baseline after a few quarters. For the other identified shocks the posterior distributions do

Figure 9: Impulse responses to loan supply shock - extended model (median and 17- and 83% percentiles)

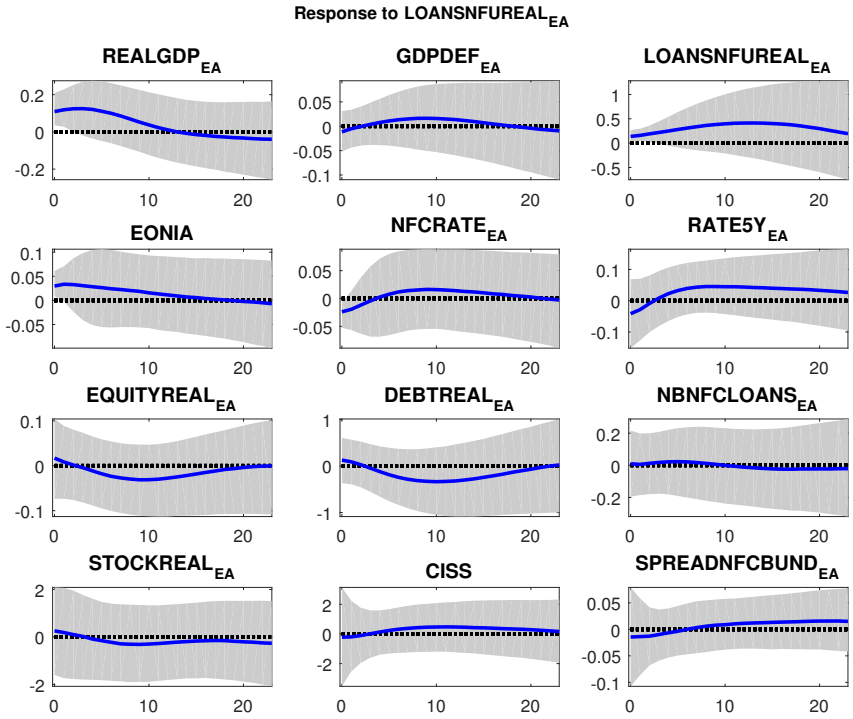


Figure 10: Impulse responses to loan supply shock - Germany (median and 17- and 83% percentiles)

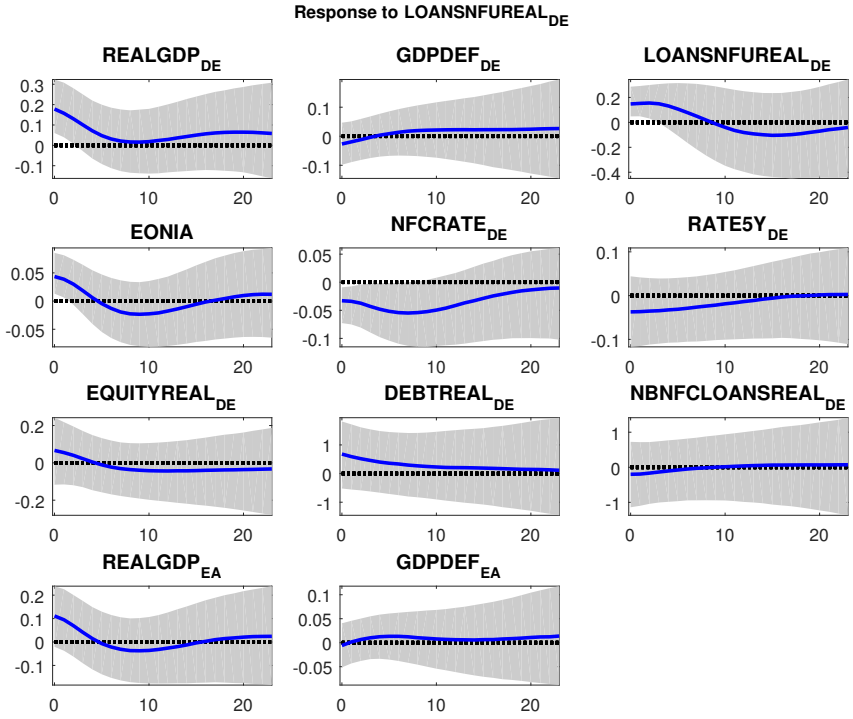
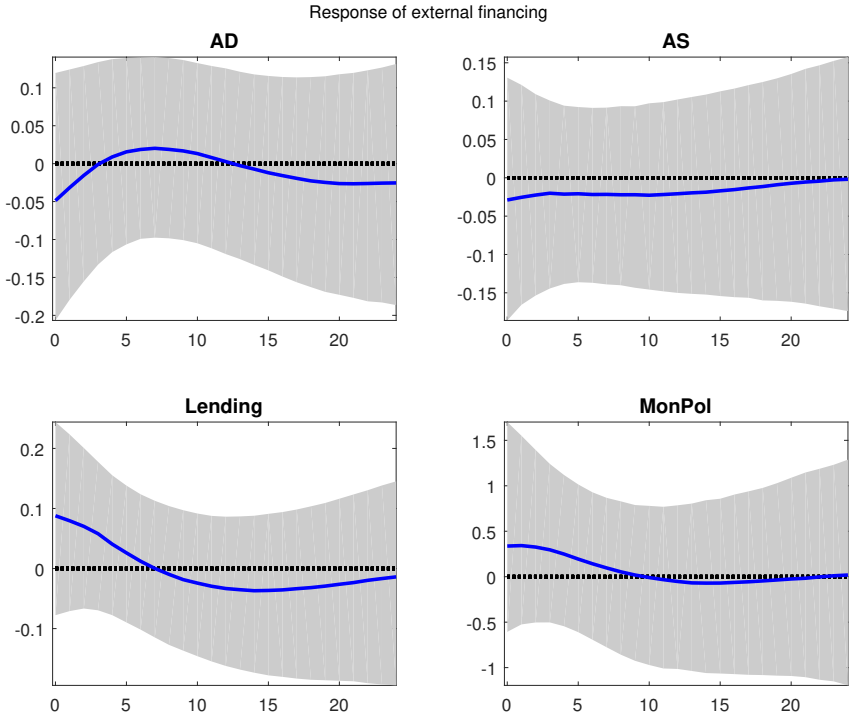


Figure 11: Impulse responses of external financing to identified shocks - Germany



not indicate a clear direction in their effects on external financing of German non-financial firms, except for a short-term positive effect to a contractionary monetary policy shock which is linked to a temporary increase in equity financing (not shown). Concerning the aggregate demand and supply shocks only bank lending responds in a statistically relevant way to the aggregate demand shock with a delayed and temporary positive response. The estimates of the other financing sources show the effects centered around zero with wide distributions indicating high estimation uncertainty.

The posterior distribution of the identified loan supply shock in Figure 12 suggests less relevance for the loan supply shock for Germany than for the Euro area during the financial and sovereign debt crises with only one negative loan supply shock standing out in 2009. Consistent with these results loan supply shocks turn out to be relatively unimportant for developments in Germany (Figure 13 and Figure 14).

Figure 12: Identified shocks - Germany (median and 17- and 83% percentiles of posterior distribution)

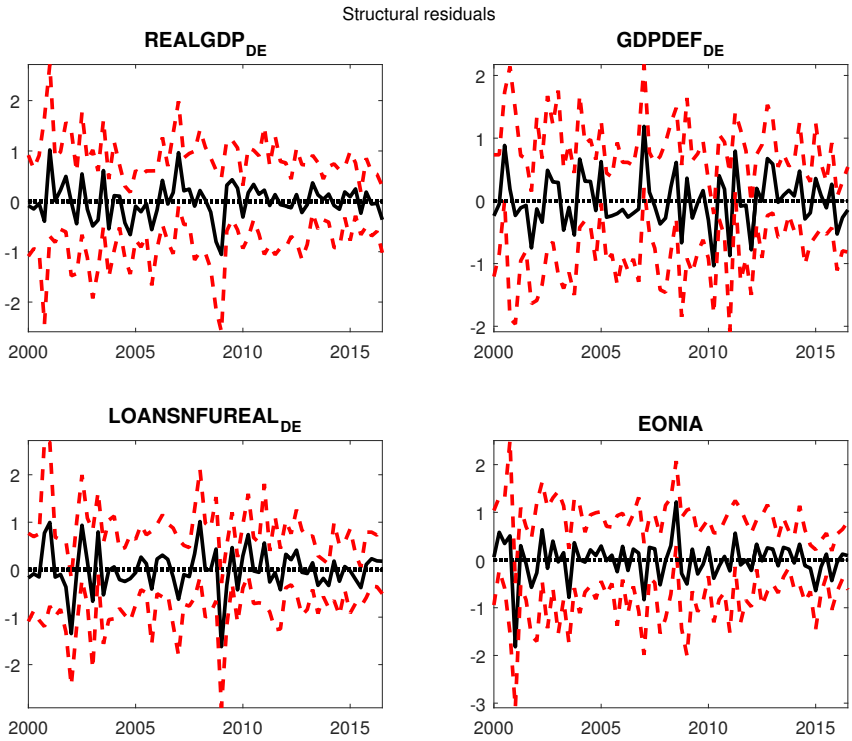


Figure 13: Historical decomposition - median contribution of identified shocks, Germany

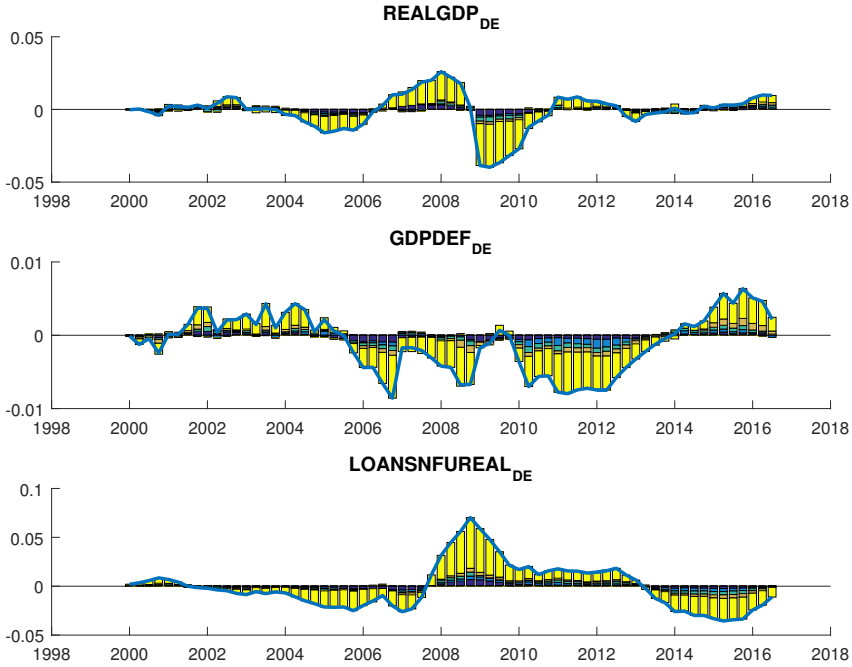
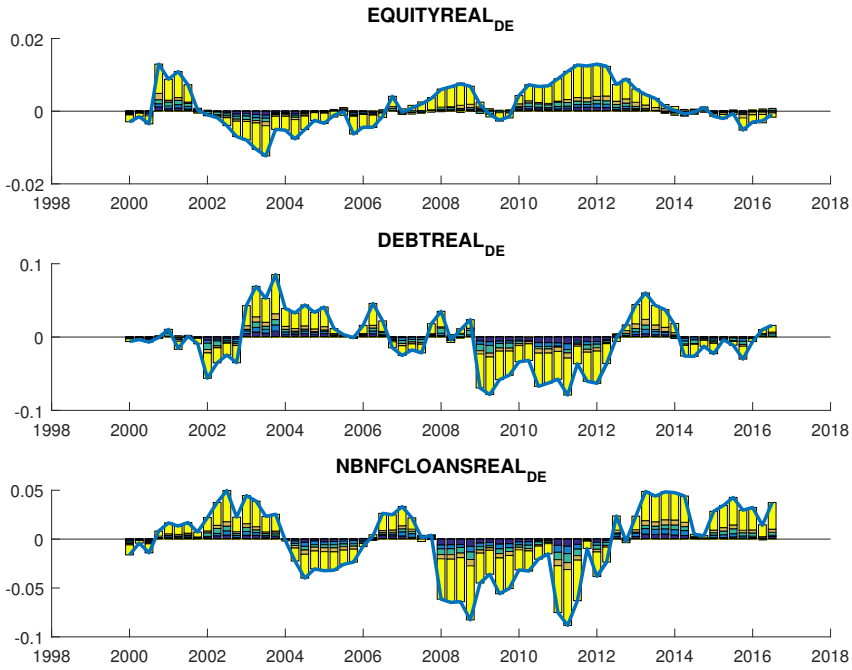


Figure 14: Historical decomposition - median contribution of identified shocks, Germany (contd.)



3.3 France

For France most of the variables respond to the identified loan supply shock in a similar way as in the Euro Area as a whole (Figure 15). On difference is that the government bond yield does not exhibit a marked temporary decline as in the Euro Area but, similar to the German yield shows only a short downward response on impact. The estimates for the alternative financing sources suggest some differences between France and the Euro Area aggregates. First, equity financing in France does not show the marked decline with a trough after about two years. Second, the similar decline in financing via debt securities registered for the Euro Area is also not present in France. In fact, after about two years the results indicate debt securities rising slightly in France. Third, the response of non-bank lending, except for the first two-quarters, shows a similar pattern as bank lending. The latter two finding contrast also with the estimated responses for Germany where we found a short-term increase in debt securites but no response in non-bank lending. The impulse-response distribution for the sum of external financing for non-financial firms in France, however, is broadly similar to the one estimated for the Euro Area which conceals the differences found for the individual components. The dynamics in external financing in France after aggregate demand and monetary policy shocks are closer to those estimated for Germany than to the Euro Area aggregate estimates (Figure 16).

The historical decompositions for output and loan growth are qualitatively similar to

Figure 15: Impulse responses to loan supply shock - France (median and 17- and 83% percentiles)

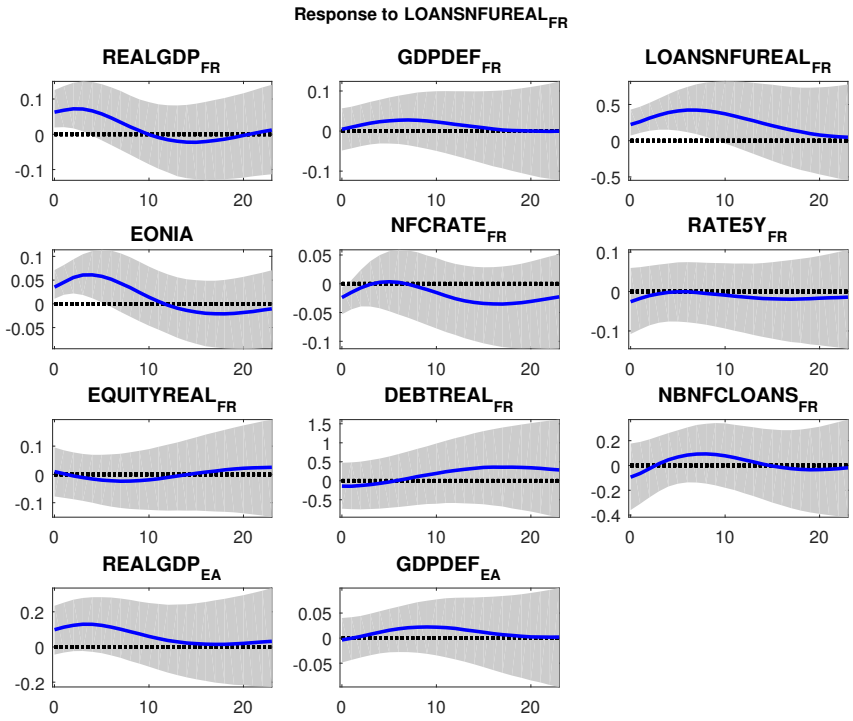


Figure 16: Impulse responses of external financing to identified shocks - France

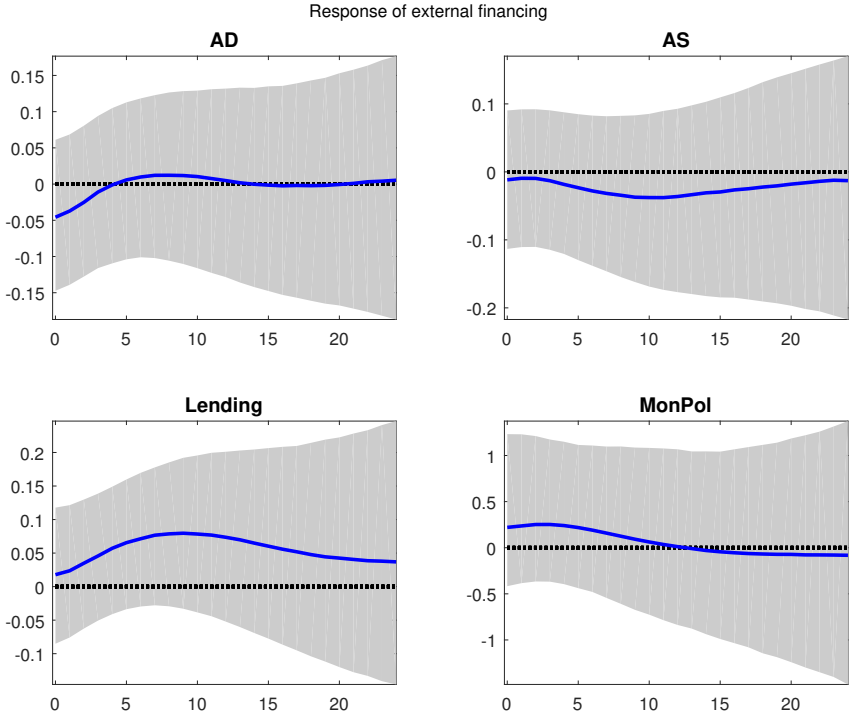
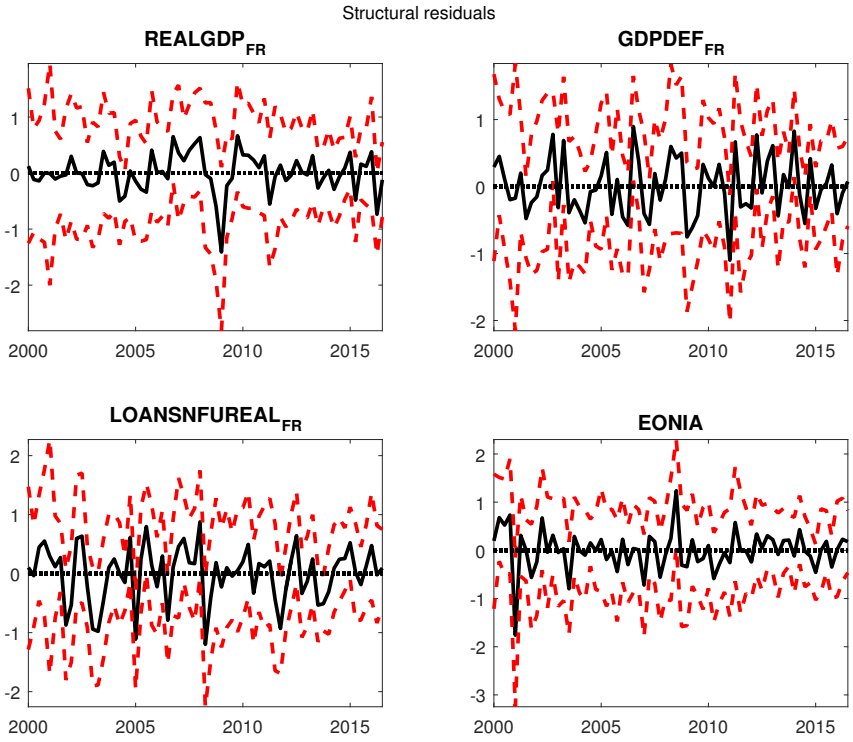


Figure 17: Identified shocks - France (median and 17- and 83% percentiles of posterior distribution)



the ones for the Euro Area as a whole but indicate much smaller relative contributions of loan supply shocks, similar to the importance of this shock in Germany. This also applies to the decompositon of equity and debt securities financing and non-bank lending (Figure 18 and Figure 19).

Figure 18: Historical decomposition - median contribution of identified shocks, France

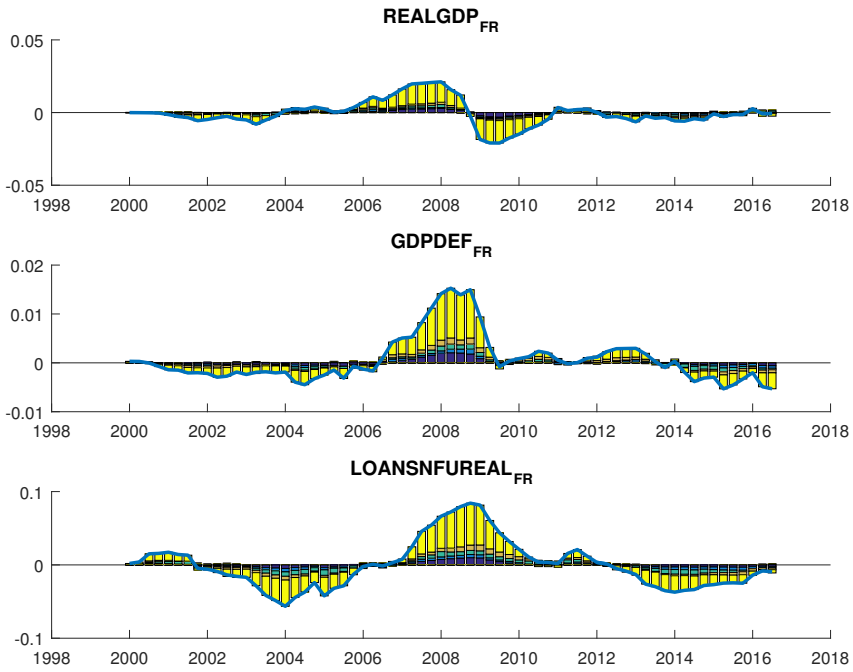


Figure 19: Historical decomposition - median contribution of identified shocks, France (contd.)

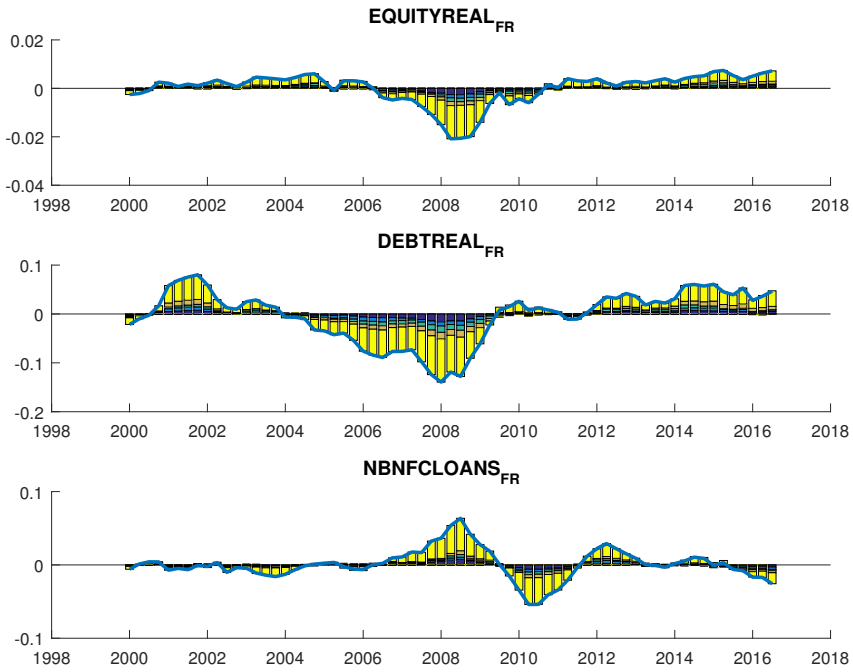
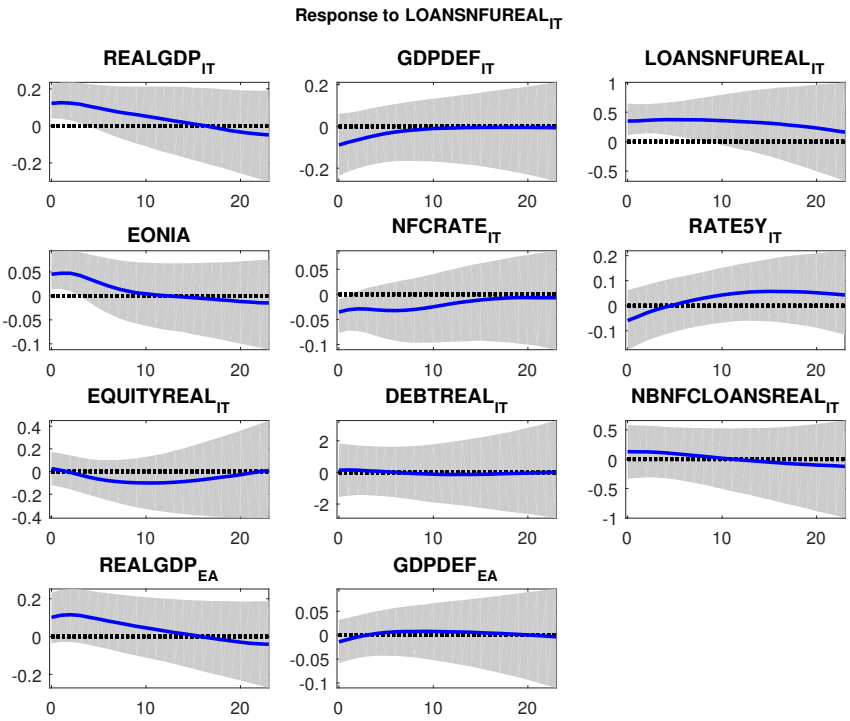


Figure 20: Impulse responses to loan supply shock - Italy (median and 17- and 83% percentiles)



3.4 Italy

The dynamics of most variables following a loan supply shocks in Italy are estimated to be similar to those in the Euro Area as a whole (Figure 25). An important difference is the clear negative contemporaneous response of the price level to an expansionary loan supply shock. The alternative financing sources also react in a similar way as in the Euro Area with equity and debt securites financing displaying a hump-shaped delayed decline. The overall external financing of non-financial firms also exhibits a dynamic similar to the Euro Area aggregates but the expansion in financing is more pronounced (Figure 26).

The historical decomposition shows the contributions of loan supply shocks on output and bank lending in Italy similar to those in the Euro area and Spain, but less than in Germany and France. These shocks have some relevance both during the mid-2000s as well as during the crisis. Considerung the alternative financing sources there is only evidence for some positive impact of loan supply shocks in Italy on equity financing in the recent period, similar to the results for the Euro area. The effect on the other financing sources is very small. (Figure 23 and Figure 24). Overall the estimates show Italy to be quite representative for the Euro Area as a whole.

Figure 21: Impulse responses of external financing to identified shocks - Italy

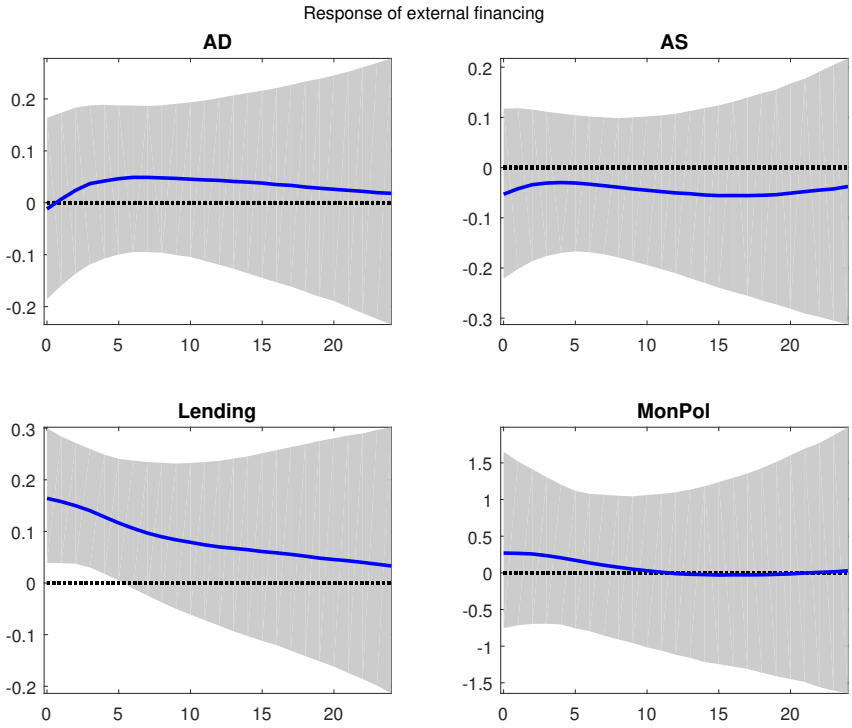


Figure 22: Identified shocks - Italy (median and 17- and 83% percentiles of posterior distribution)

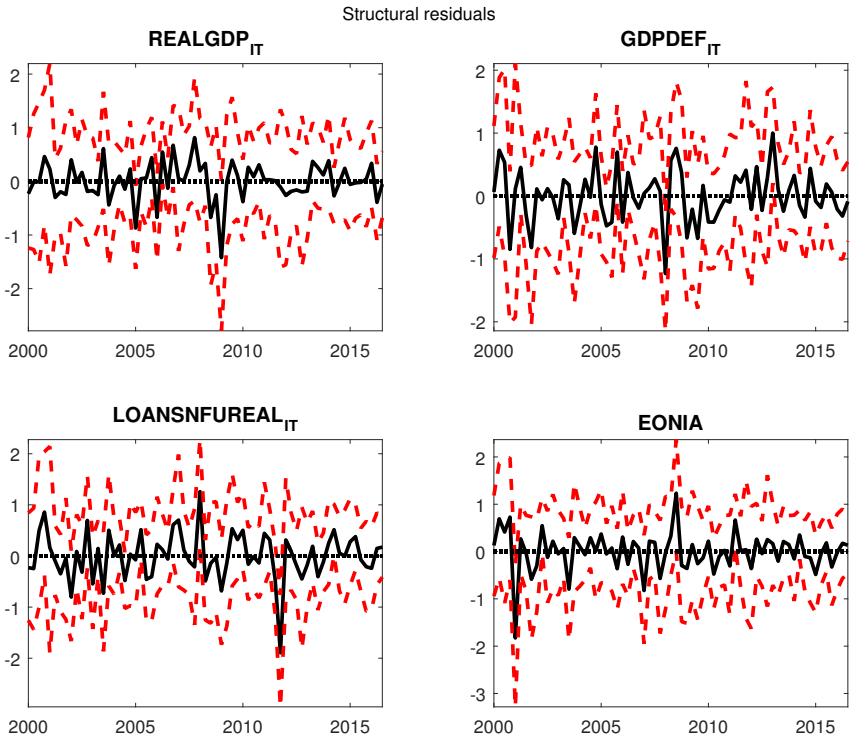


Figure 23: Historical decomposition - median contribution of identified shocks, Italy

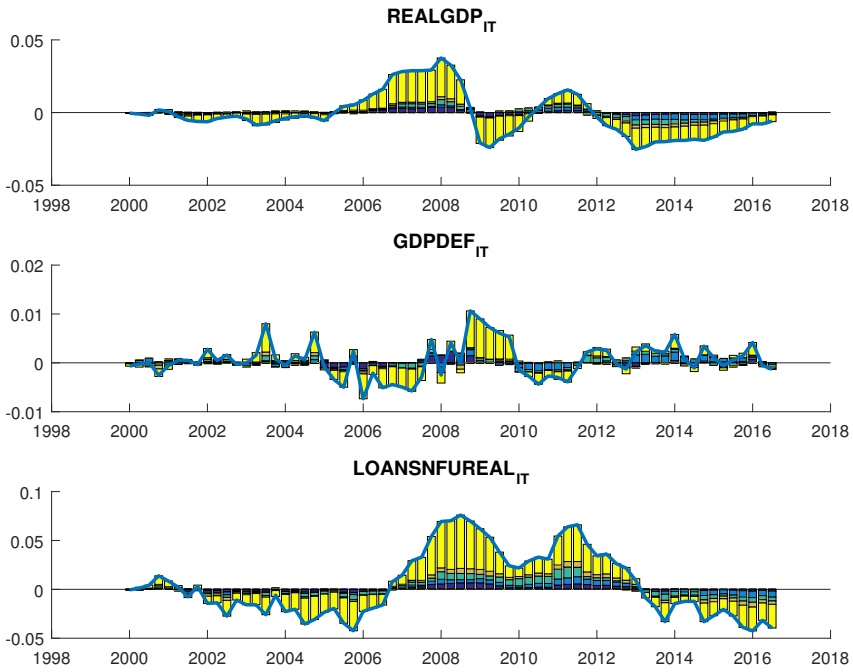


Figure 24: Historical decomposition - median contribution of identified shocks, 'Italy (contd.)

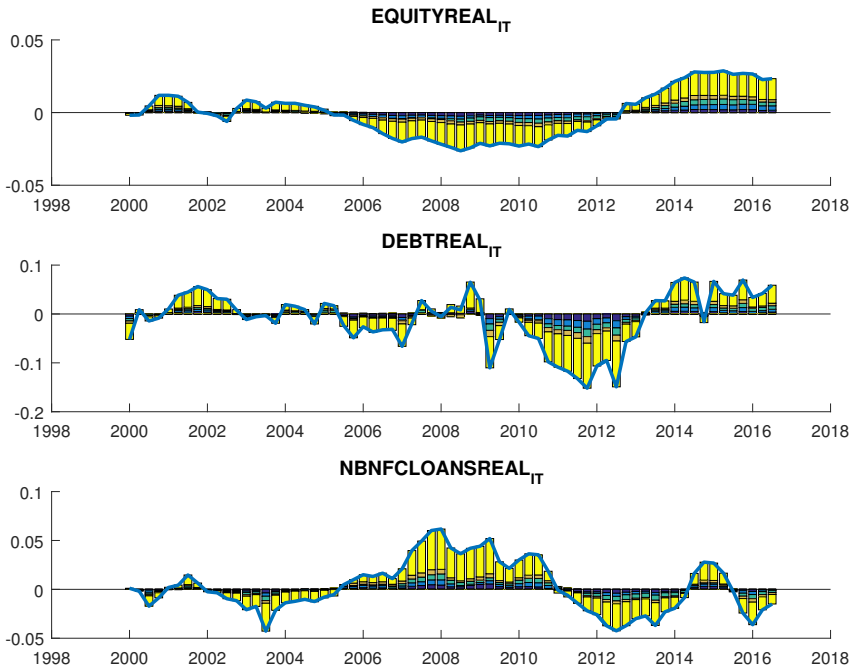
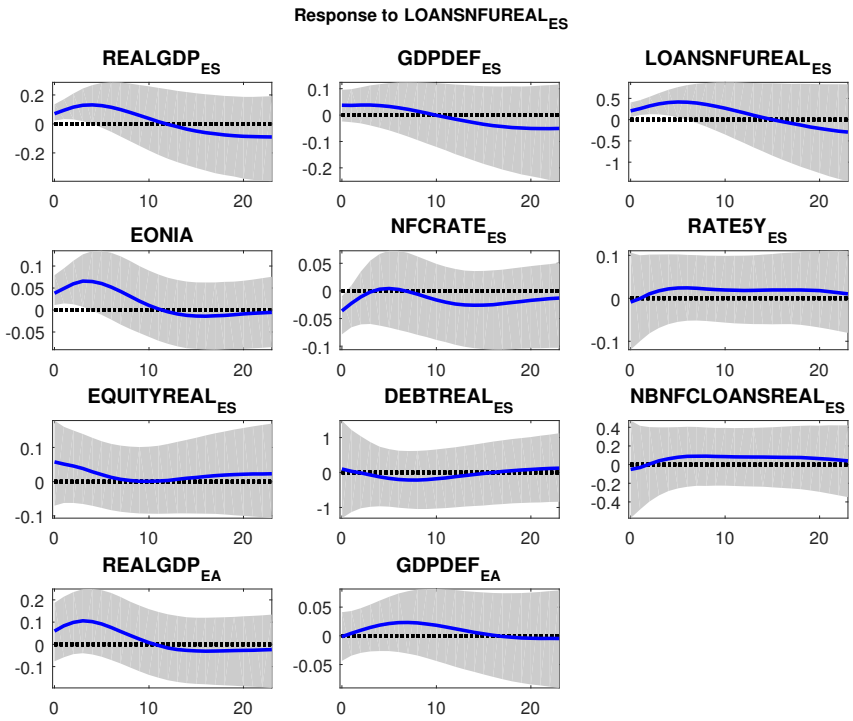


Figure 25: Impulse responses to loan supply shock - Spain (median and 17- and 83% percentiles)

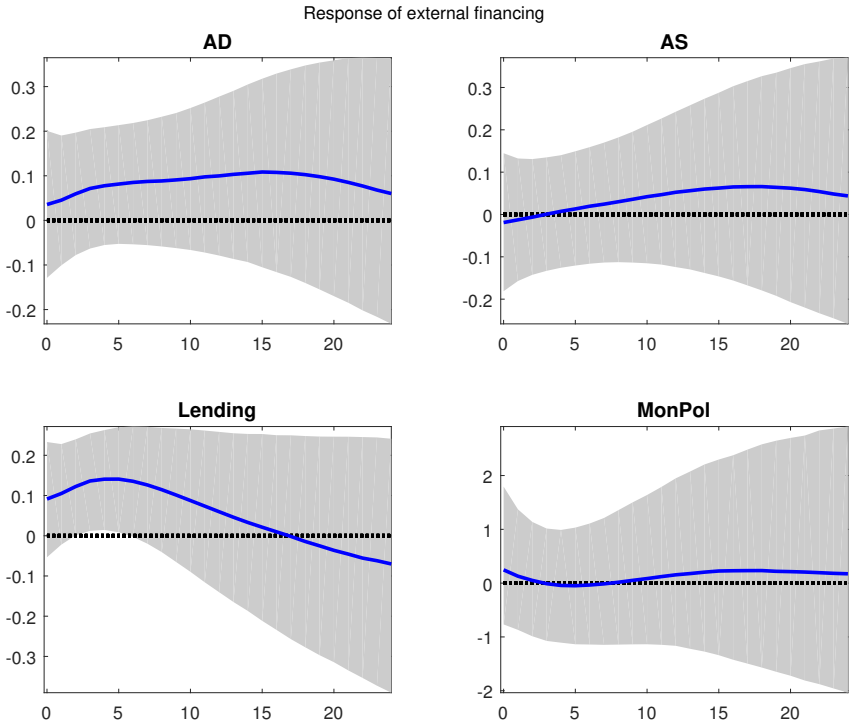


3.5 Spain

Our estimates for Spain show impulse responses to a loan supply shock similar to those of the Euro Area aggregate variables for output, bank loans and bank lending rates Figure 25. However, for Spain we there is also evidence for a contemporaneous positive effect on the price level whereas the price level in the other countries and in the Euro area did not display a market immediate reaction. The third row shows that financing via debt securities responds in a qualitatively similar way as in the Euro Area aggregate but not as in France and Germany. In contrast, the dynamics of equity financing resemble rather those in Germany than those in France or in the Euro area composites. Overall external financing of non-financial corporatations reacts qualitatively similar to the loan supply shock in Spain as it does in the Euro Area as a whole but the increase in lending is less persistent. Compared to France the increase in overall external financing is also less persistent but somewhat stronger initially (Figure 26) Overall external financing does also display a stronger positive response to the aggregate demand shock compared to France and Germany but around the same order of magnitude as in the Euro area as a whole.

Comparison of the historical decomposition of output, prices and lending in Spain to Germany and France shows higher contributions of loan supply shocks both during the credit boom in the mid-2000s as well as in the crisis period, results that are similar to those

Figure 26: Impulse responses of external financing to identified shocks - Spain



for Italy. However, the contribution to the developments in equity and debt securities based financing and in non-bank loans is relatively small. (Figure 28 and Figure 29).

Figure 27: Identified shocks - Spain (median and 17- and 83% percentiles of posterior distribution)

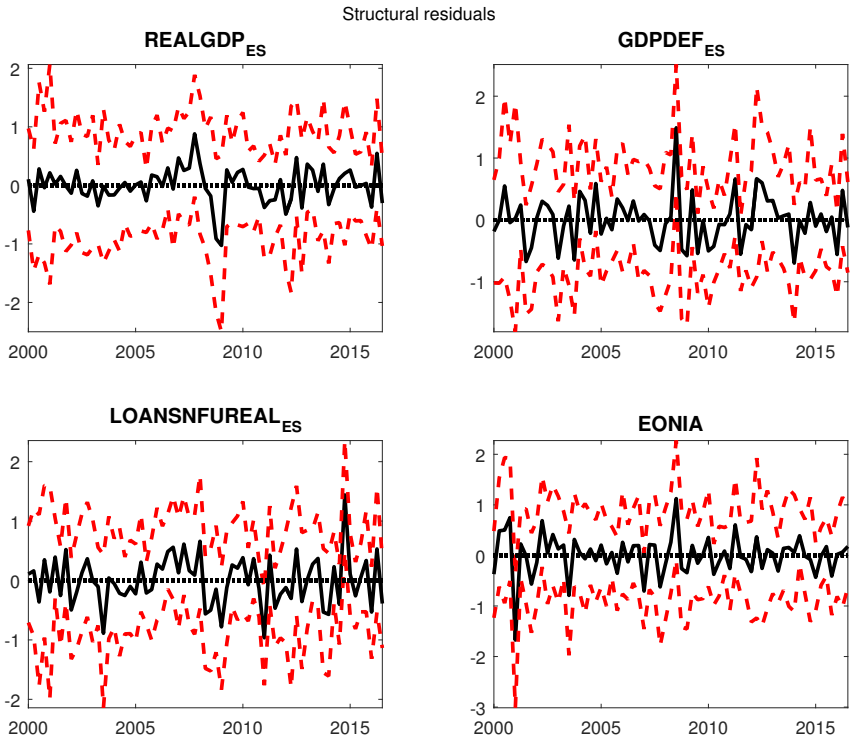


Figure 28: Historical decomposition - median contribution of identified shocks, Spain

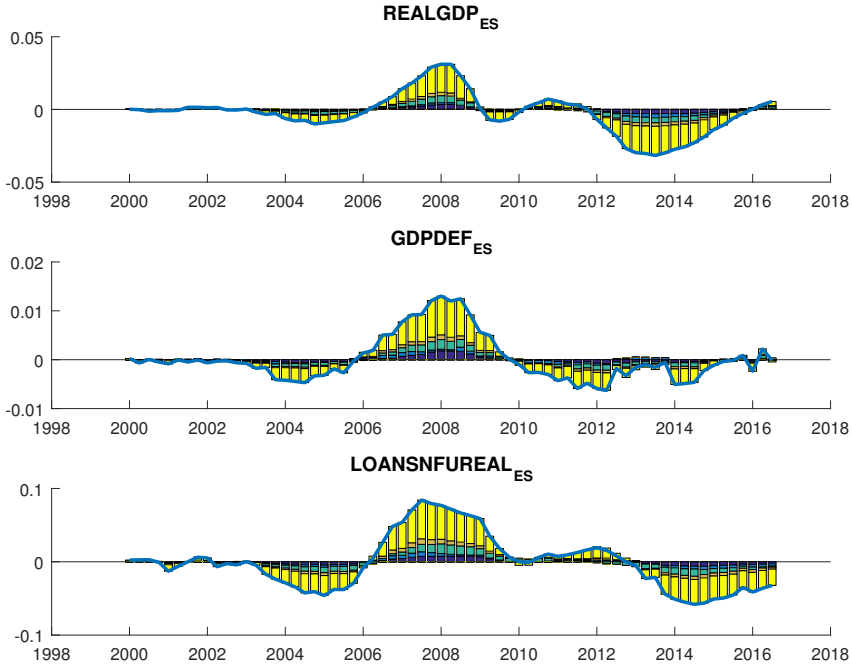
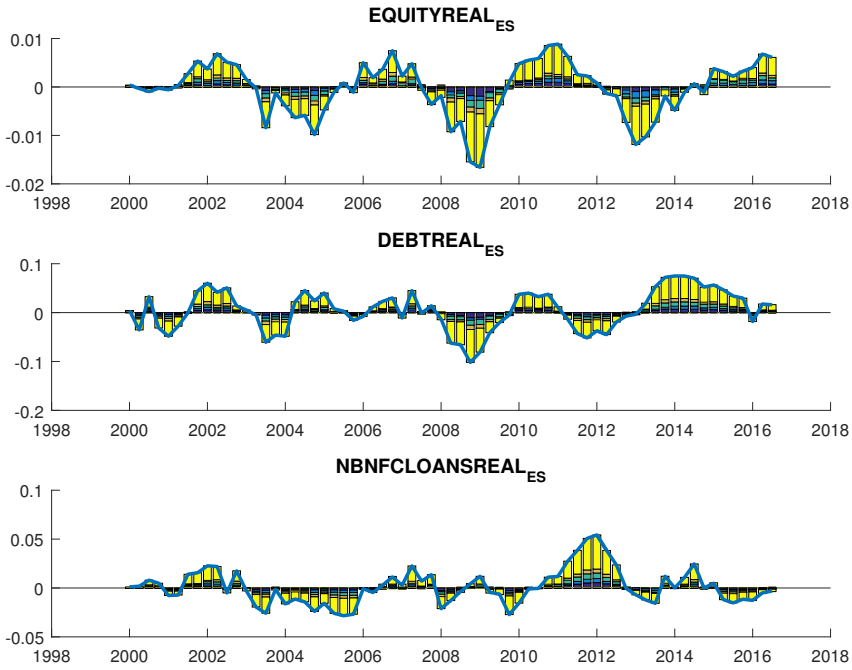


Figure 29: Historical decomposition - median contribution of identified shocks, Spain (contd.)



4 Conclusions

We analyze the macroeconomic effects of shocks to banks' lending to non-financial corporations both in the Euro Area and in Germany, France, Italy and Spain and account explicitly for possible interactions of bank lending with alternative sources of financing for firms. The general result is that the response pattern of the sum of bank loans and other external financing sources (equity issuance, debt securities issuance and non-bank lending) corresponds to the dynamics of bank loans after a loan supply shock, ie. alternative financing sources do not overcompensate the effects of the bank lending shock on bank loans. In the case of a negative, ie. contractionary loan supply shock this indicates that alternative financing sources, even if some substitution takes place and even if we ignore composition effects, ie. the fact that a substantial number of firms does not have access to these alternative financing sources, cannot fully compensate for a reduction in bank lending. Generally, the contribution of loan supply shocks to developments in alternative financing sources also turns out be rather limited.

Loan supply shocks have made an important contribution to developments in aggregate output, prices and bank lending on the Euro Area level but their importance varies strongly across countries with little relevance in France and, in particular, in Germany and more important effects in Spain. Furthermore, we also show that there is heterogeneity in the dynamics of the individual components of external financing different from

credit at the country level with some components displaying positive and other negative correlation with bank lending and this correlation is not robust across countries.

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