

Scheufele, Rolf; Bäurle, Gregor

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Credit cycles and real activity - the Swiss case

Gregor Bäurle* and Rolf Scheufele†

13 February, 2015

Abstract

This paper analyzes credit supply and demand shocks for the Swiss economy. Using a medium scale BVAR model we are able to take into account various interactions of housing prices, credit supply and demand, interest rates and real activity measures. To identify meaningful economic shocks, we used a combination of zero and sign restrictions. Generally, the empirical analysis implies that the effects of credit supply and demand shocks on real activity are limited, only playing a substantive role in specific episodes. Furthermore, the credit supply shocks (i.e. bank lending shocks and monetary policy shocks) explain a large fraction of housing price and credit fluctuations. Indeed, they tend to be more important for housing prices than housing demand shocks. There is further evidence that shocks related to credit supply, monetary policy shocks dominate bank lending shocks. For Switzerland as a small open economy it turns out to be very crucial to take into account foreign demand which is able to explain a substantial variation in real and financial variables.

JEL classification: C11, C32, E30, E44, E51, E52

Keywords: Credit supply and demand, housing prices, SVARs, Bayesian shrinkage

*Swiss National Bank, Economic Analysis, P.O. Box, CH-8022 Zurich, Switzerland, e-mail: gregor.baeurle@snb.ch

†Swiss National Bank, Economic Analysis, P.O. Box, CH-8022 Zurich, Switzerland, e-mail: rolf.scheufele@snb.ch

1 Introduction

The recent financial crisis has brought up a renewed interest in the interactions of the financial sector and the real economy. In particular, housing and housing finance are seen as crucial factors for the origin of the crisis. Therefore, understanding the relation between housing prices, credit conditions, interest rate spreads and real activity has become one of the hot topics in today's macroeconomics. This paper looks at the Swiss experience, studying the role of credit market conditions and housing prices for real activity over the last three decades through the lenses of a structural Bayesian vector autoregressive model (BVAR).

Switzerland is a particularly interesting case in this respect as the housing market played central role for the Swiss business cycle in recent decades. In contrast to many industrialized countries that saw a long lasting period of housing price increases and then a rapid decline during the financial crisis, Switzerland can now look back to nearly 15 years of permanent house price increases and strong credit growth. Before this boom, however, Switzerland experienced a sustained slump in the housing market beginning in the early 1990s and was followed by a period of abnormally low GDP growth with low internal demand. This is a scenario that threatens many industrialized countries currently. Not surprisingly, the 1990s slump was preceded by a period of overly strong housing price and credit growth in the 1980s, accompanied by high growth of overall economic activity.

There are a number of anecdotal explanations for these fluctuations. First, the expansionary conduct of monetary policy in the 1980s followed by a substantial tightening starting at the end of 1988 is often described to be a main determinant of the boom and the subsequent slump in the Swiss housing market (see e.g. Meyer (1998), Müller (2012)). A second, complementary view is that changes in lending standards in the 1980s also related to over-optimistic expectations by households and in particular by banks - contributed to an unsustainable increase in credit. When the market turned, this led to stress in the banking sector that amplified the negative dynamics of housing prices in the 1990s (Thalmann (2010), Meyer (1998)). Other factors put forward in descriptions of the Swiss housing and business cycle include demand fluctuations - mainly through income changes and changes in population growth - and the sluggish adjustment of the housing

supply to demand for housing Meyer (1998).

However, there is so far no study that systematically assess the importance of these difference factors using econometric methods. We attempt to fill this gap by disentangling within our BVAR framework four different sources of economic fluctuations - monetary policy shocks, credit supply shocks (other than monetary policy) and housing demand shocks and assessing their relative importance for housing prices and real activity.

From a methodical point of view, the analysis is challenging for two reasons. First, we have cope with the *large dimension of the parameter space* in our model. Second, the *identification of economically interpretable shocks is complicated by the fact that many different factors interact* in our model.

As to the first challenge, we use Bayesian shrinkage techniques making the estimation of a large number of parameters tractable. Specifically, we combine a Minnesota prior implementing the idea that a priori, the series follow a simple statistical model (see e.g. follow Doan et al. (1984), Litterman (1986), Banbura et al. (2010) and Giannone et al. (2014)) with information from training observations to form an informative prior for our parameter space. The weights of the different sources of prior information is taken as an unknown parameter and determined within our numerical posterior analysis. The implementation follows Giannone et al. (2014), who use the same idea to determine the weights of different components of a Minnesota prior. Using this Bayesian shrinkage technique, we are able to expand the data set to include several interest rate measures as well as subcomponents of GDP (e.g. construction investment) in addition to the more standard macroeconomic variables such as consumer prices, monetary aggregates, credit and stock prices. Since Switzerland is a small open economy, we also take into account exchange rate developments and an export weighted measure of foreign GDP.¹

The second challenge, the identification of shocks, is done by using the method proposed by Arias et al. (2014) to implement zero- as well as sign restrictions to restrict the response of observed variables to the shocks. The zero restrictions are established to distinguish three different sets of shocks, a block of foreign shocks influencing all variables on impact, a block of domestic macroeconomic shocks not influencing foreign variables on impact

¹At the same time, we abstract from the international transmission of credit market shocks and concentrate on domestic shocks in this respect

but all domestic variables in the model and a block of financial shocks only influencing fast moving, financial variables. The sign restrictions are implemented to disentangle the shocks within these blocks. They are chosen carefully, such that they match the responses we would expect according to theoretical considerations. Thereby, two assumptions are key. The first is that the spread between mortgage interest rates and the policy interest rate decreases on impact as a consequence of a restrictive monetary policy shock, but increases following an exogenous tightening of credit supply. This disentangles monetary policy shocks from other lending shocks. The second key assumption is that contractionary monetary policy and credit supply shocks lead to lower housing prices but increasing mortgage interest rates, while negative housing demand shocks lower housing prices and interest rates. This disentangles credit supply shocks, i.e. monetary policy and lending shocks, from credit demand shocks.

Our work relates to a quite new but rapidly growing body of theoretical and empirical work on the relationship between the financial sector and the macroeconomy. Prior to the financial crisis, many theoretical as well as empirical macroeconomic models have typically ignored a direct impact of credit aggregates, interest rates spreads and housing on real economic activity (e.g. Christiano et al. 2005, Smets and Wouters 2007). The few prominent exceptions in the theoretical literature stressed the role of the financial system as an accelerator of shocks (e.g. Kiyotaki and Moore (1997) and Bernanke et al. (1999) or underscore the importance of housing for the business cycle (Goodhart and Hofmann (2008), Iacoviello (2010) and Iacoviello and Neri (2010)). After the emergence of the global financial crisis a new consensus has been established that financial shocks should be regarded as an important source of fluctuations besides standard macroeconomic (supply and demand) and monetary policy shocks. Therefore many studies have included certain financial aspects into DSGE policy models and investigated the role of financial frictions empirically. Examples of theoretical work on the role of credit include Atta-Mensah and Dib (2008) and Christiano et al. (2009).²

In the empirical literature, interesting contributions on the role of credit supply shocks come from Busch et al. (2010), Eickmeier and Ng (2011), Helbling et al. (2011), Meeks

²Beck et al. (2014) provide an excellent overview of recent advances to incorporate financial frictions into DSGE models.

(2012), Fornari and Stracca (2012) and Peersman and Wagner (2014). An key issue is the role and the relative importance of credit supply shocks and standard monetary policy shocks as identified by Musso et al. (2011) for the US and the EU. Studies that take into account specific issues of housing are Jarocinski and Smets (2008), Goodhart and Hofmann (2008), Musso et al. (2011), as well as Hirata et al. (2012).

From our analysis, three main results emerge. A first and very robust finding is that the effect of credit supply and demand shocks on real activity are limited, only playing a substantive role in specific episodes. In particular, once we set those shocks in relation to foreign demand shocks, we can infer that they do not contribute much to GDP growth on average.

Second, our set of credit supply shocks (i.e. bank lending shocks and monetary policy shocks) explain a large fraction of housing price and credit fluctuations. Indeed, they tend to be more important for housing prices than housing demand shocks. Third, we obtain tentative evidence that among the shocks related to credit supply, monetary policy shocks dominate bank lending shocks.

The paper is structured as follows. We first describe our data set and illustrate stylized facts on the Swiss business cycle. We then present the empirical methodology and analyze the properties of our prior distribution. Finally, the results are shown and conclusions provided.

2 Data

Table 1 describes the data and its sources. We estimate the model on a quarterly frequency, i.e. we aggregate monthly data and interpolate annual data using related indicators before estimating the model. All variables but the interest rates are transformed with the natural logarithm. We take into account data from 1981 and use a VAR with lag length of 4.

TABLE 1 — DESCRIPTION OF VARIABLES USED

Series	Frequency (original)	Description
Real variables		
GDP	quarterly	Seco estimates, real
Working hours	quarterly	internal estimates based on SFSO employment figures
Foreign Population	Annual	interpolated SFSO estimates
Interest rates		
Short-term interest rate	Monthly	3-Months Libor, linked to 'Frankensatz' 3 Months in Q1 1998
Mortgage rate	quarterly	2-years, linked 1996 (Cantonal Banks) and 2007 (VZ Banks)
Long-term interest rate	Monthly	10-Y Eidgenossen, linked series from MI
Foreign long-term interest rate	working days	10-Y German gov. bonds
Assets		
Credit volume	Annual/monthly	Credit to households and firms, monthly only from 1988
Prices		
Housing prices	quarterly	Offer prices
Consumer prices excl. rents	monthly	
Consumer prices rents component	quarterly	
Foreign variables and exchange rates		
Exchange rate	quarterly	nominal, export-weighted
Foreign demand	quarterly	real, export weighted

3 Structural BVAR

We assume that data is generated by a vector autoregressive process:

$$y_t = B_0 + B_1 y_{t-1} + \dots + B_p y_{t-p} + Q \varepsilon_t \quad (1)$$

$$\varepsilon_t \sim N(0, I_n) \quad , \quad (2)$$

where y_t is a $n_t \times 1$ vector of endogenous variables and ε_t is an $n_t \times 1$ vector of exogenous shocks. $B_0, \dots, B_p$ and Q are matrices containing the unknown parameters. The likelihood of the model is invariant to orthonormal transformations of Q , the contemporaneous impact of shocks on observed variables. We therefore parameterise the likelihood function in terms of $\Sigma = Q'Q$ and estimate this reduced form model. Only in a second step do we identify Q based on further restrictions derived from economic theory.

3.1 Prior and posterior reduced form

We rewrite the system for each sample as follows, (following e.g Giannone et al. (2014)). First, define the matrices $y = [y_{p+1}, \dots, y_T]'$, $Y = \text{vec}(y)$, $x_t = [1, y'_{t-1}, \dots, y'_{t-p}]'$, $x = [x_{p+1}, \dots, x_T]'$, $X = I_{n_t} \otimes x$, and $e = \text{vec}([\varepsilon_{p+1}, \dots, \varepsilon_T]')$. Then, write the system as

$$Y = X\beta + e \quad (3)$$

$$e \sim N(0, \Sigma_i \otimes I_{T-p}) \quad , \quad (4)$$

where $\beta = \text{vec}(B)$ with $B = [B_0, \dots, B_p]'$. Hence, the system can be written as a linear regression model and standard Bayesian methods for such models can be applied. The number of regressors is $k = np + 1$ in each sample and the number of observations are denoted by T .

We follow the bulk of the literature by selecting a natural conjugate prior distribution for the model parameters, setting

$$\Sigma \sim IW(\underline{\Psi}, \underline{d}) \quad (5)$$

$$\beta | \Sigma_i \sim N(\underline{\beta}, \Sigma \otimes \underline{\Omega}) \quad . \quad (6)$$

The posterior distribution can be shown to be

$$\Sigma|y, X \sim IW(\underline{\Psi} + \hat{\varepsilon}'\hat{\varepsilon} + (\hat{B} - \underline{\hat{\beta}})' \underline{\Omega}^{-1} (\hat{B} - \underline{\hat{\beta}}), T - k + \underline{d}) \quad (7)$$

$$\beta|\Sigma, y, X \sim N(\hat{\beta}, \Sigma \otimes (x'x + \underline{\Omega}^{-1})^{-1}) \quad , \quad (8)$$

with $\hat{B} = (x'x + \underline{\Omega}^{-1})^{-1}(x'y + \underline{\Omega}^{-1}\underline{\beta})$, $\hat{\beta} = \text{vec}(\hat{B})$, $\hat{\varepsilon} = y - x\hat{B}$ and $\underline{\hat{\beta}}$ being a $k \times n$ matrix obtained from reshaping $\underline{\beta}$ suitably.

3.2 Parameterising the prior distribution

A standard idea for the parametrization of the prior distribution is to implement an uncertain a priori belief that the data is generated by a simple statistical model, such as a univariate random walk. An alternative idea is to use a so-called training sample to determine the prior parameters. Our strategy is to use a combination of these ideas and to treat the respective tightness of the two parts as hyperparameter to be determined in a formal posterior analysis.

We implement this idea by adding to sets of 'dummy observations' to the actual sample. The first set $(\sqrt{\gamma}y^{Minn}, \sqrt{\gamma}X^{Minn})$ implements the Minnesota prior. The second set $(\sqrt{\lambda}y^{Train}, \sqrt{\lambda}X^{Train})$ stems from the idea that data prior to the actual sample contains some information on the true process, but for various reasons, we believe this information to be less accurate than the observations in the actual sample. The observations are multiplied by factors λ and γ , respectively, parameterizing the tightness of the prior. If we multiply the likelihood of these observations with the initial improper prior $p(\Phi, \Sigma) \propto |\Sigma|^{-(n+1)/2}$, we obtain the prior distribution implied by adding the observations to the data set:

$$\underline{\beta} = (\gamma X'_{Minn} X_{Minn} + \lambda X'_{Train} X_{Train})^{-1} (\gamma X'_{Minn} y_{Minn} + \lambda X'_{Train} y_{Train}) \quad (9)$$

$$\underline{\Omega} = (\gamma X'_{Minn} X_{Minn} + \lambda X'_{Train} X_{Train})^{-1} \quad (10)$$

$$\underline{\Psi} = \gamma (Y_{Minn} - X_{Minn} \underline{\beta})' (Y_{Minn} - X_{Minn} \underline{\beta}) + \lambda (Y_{Train} - X_{Train} \underline{\beta})' (Y_{Train} - X_{Train} \underline{\beta}) \quad (11)$$

$$\underline{d} = T_{Minn} + T_{Train} \quad (12)$$

$$(13)$$

We determine the prior weights λ and γ by conducting a formal posterior analysis. Specifically, we add a gamma prior for these parameters and simulate from its posterior distribution by introducing a Random-Walk Metropolis-Hastings step into the otherwise standard posterior sampling procedure for the VAR coefficients (see e.g. Giannone et al. 2014, for an application of the same idea to a Bayesian VAR with different sets of dummy observations). Thus, we produce draws from the posterior distribution using the following algorithm. Starting with initial parameters $\beta_{i,0}$, $\Sigma_{i,0}$, $\lambda_{i,0}$ and $\gamma_{i,0}$, we iterate $j = 1, \dots, J$ times over the following steps:

Step 1: Draw $\beta_{i,j}$ from (7) and $\Sigma_{i,j}$ from (8).

Step 2: Draw a candidate value λ^* from

$$\begin{pmatrix} \lambda^* \\ \gamma^* \end{pmatrix} = \begin{pmatrix} \lambda_{j-1} \\ \gamma_{j-1} \end{pmatrix} + \zeta$$

with $\zeta \sim N(0, V)$, V being the scaled inverse hessian of the posterior density evaluated at the posterior mode of $p(\lambda, \gamma|y, X) \propto p(\lambda, \gamma)p(y|\lambda, \gamma)$.³ Accept the candidate values with probability

$$\alpha = \min \left\{ 1, \frac{p(\lambda^*, \gamma^*|y, X)}{p(\lambda_{j-1}, \gamma_{j-1})} \right\}$$

The scale of V is set such that the acceptance rate is between 0.2 and 0.3.

Step 3: For each draw j and regime i , produce J draws of $Q_{i,j}$ using the method described in ? and retain only the parameter draws for which the implied impulse response functions satisfy certain restrictions.

3.3 Identification of shocks

³The marginal likelihood $p(y|\lambda)$ can be derived analytically, see e.g. Giannone et al. (2014).

TABLE 2 — IDENTIFIED SHOCKS

	Monetary policy	Bank lending	Housing preference	Population	Foreign	Other shocks
Foreign block						
Foreign GDP	0	0	0	0	+	0
Foreign interest rates	0	0	0	0		0
Non-financial block (slow moving)						
Population	0	0	0	+		
GDP	0			+		
Construction	0	0	+	+		
Working hours	0	0	0			
CPI ohne rents	0	0	0			
CPI rents	0	0				
Financial block (fast moving)						
Short rate	-	0	0			
Long rate						
Exchange rate	+					
Mortgage rate						
Housing prices			+			
Credit	+	+	+			
Combinations						
Mortgage rate - Long rate		-	+			
Price - rents			+			
GDP - working hours				-		
Credit - GDP		+				

The isolation of different types of financial shocks is challenging. In this study we try to disentangle credit supply, housing demand and monetary policy shocks. Note that even the differentiation of a monetary policy shock and a pure credit supply shock may pose problems in practise (Milcheva 2013).

To distinguish between two types of shocks which originate from different sources but have similar effect, we need to impose a valid and economic meaningful identification scheme. Therefore we make use of traditional zero restrictions as well as sign restrictions, but not only for single variables but also on variable combinations (e.g. interest rate spreads and ratios). For the implementation we apply the computational procedure of Arias et al. (2014) to obtain reliable restrictions.

To allow for a better interpretability, we differentiate between different variable blocks: a foreign block that does not react to domestic shocks, a non-financial block that includes "slow moving" variables such as GDP, employment and inflation, a financial block (e.g. interest rates, exchange rates, housing prices) as well as shocks that are expressed in combinations of variables shocks (i.e. in terms of ratios). For the slow moving block a number of zero restrictions is employed. This is mainly in the tradition of identifying monetary policy shocks where it is assumed that GDP and inflation do not instantaneously react, but with some time lag (e.g. Christiano et al. 1999). For the financial block or "fast moving block" only a small number of zero restrictions are employed. Those are solely used to separate bank lending and housing preference shocks from monetary policy shocks. E.g. a bank lending shock is assumed to have no effect on short term interest rates on impact.

Bank lending shocks

Our definition of a bank lending shock (credit supply shock) captures movements in credit that are both unrelated to monetary policy (and therefore orthogonal to short term interest rates) and leads to a decline in the mortgage risk premium (defined as difference between mortgage rates and long-term bond yields). Additionally, this shock is set to move the credit-to-gdp upward. The restrictions are similar to Eickmeier and Ng (2011). The assumed decline in the mortgage risk premium is intended to separate credit supply from credit demand factors (where the mortgage premium is assumed to widen). The increase

in credit to GDP is important to separate it from real shocks (aggregate demand) which may also have an impact on credit.

In practise, positive credit supply shocks can be summarized as those shocks that are independent of monetary policy but do lead to additional credit activity. Therefore those shocks include financial innovations (e.g. through securitization), increase in risk-appetite of banks, changes capital requirements for financial intermediaries or liquidity provided by the central bank.

Monetary policy shocks

A conventional monetary policy shock is defined as moving short-term rates down and credit up. Furthermore, since Switzerland is a small open economy and heavily depend on foreign demand, it is assumed that a monetary policy shocks leads to a depreciation. The reaction of credit explicitly assumes a credit channel of monetary policy. Note that we additionally employ a set of zero restrictions typically used in identification of monetary shocks. In our case this implies that all real variables as well as inflation do not contemporaneously react to monetary policy shocks.

Housing demand shocks

In identifying a housing demand shock, we basically follow Jarocinski and Smets (2008) and Musso et al. (2011). However, we try to decompose the housing demand shock in two types of separate shocks: a housing preference shock and a population shock. The first shock is in the spirit of Iacoviello and Neri (2010) which is an increase in the households willingness to spend for housing. The assumed restrictions imply a positive reaction of housing prices and construction investment (this corresponds to Jarocinski and Smets 2008, Musso et al. 2011).

The second shock is a pure quantity effect. As additional drivers of housing prices and credit can be seen in the expansion of population. In particular migration can have a non-negligible impact on housing market developments since new residence do require additional living room and do increase housing demand. Therefore, it is desirable to distinguish a housing preference shock caused by additional population – mostly a quantity effect – and a demand shock which is a pure housing preference shock. The population

shock is defined as moving the number of foreign population and GDP up, while leading to lower productivity. Biany and Gete (2014) follow a similar approach to disentangle population shocks from other sources of housing demand (although population does not appear as a separate variable).

Foreign shocks

In order to improve the interpretability of your results, we also try to identify additional shocks. First, a foreign demand shock is identified. Due to high external dependence (export to GDP ratio) it is expected that this shock is a main driver of Swiss GDP and may be also responsible for movement in other variables. In particular the transmission onto domestic variables may be interest. Shock identification for is achieved by a combination of zero and sign restrictions. Shock to all remaining variables are assumed to have no impact on foreign demand (this mirrors the fact that Switzerland is a small open economy). Furthermore this shock lifts up foreign GDP as well as domestic GDP.

3.4 Analyzing the prior distribution

In any Bayesian analysis, it is imminent to discuss the properties of the prior distribution thoroughly. In our case, the formal presentation of the prior is complicated for several reasons. First, the fact that the weight of the different elements of the prior is unknown makes the marginal density of the parameters non-standard, even though the conditional distribution of the parameters is available in closed form. Second, the sign-restrictions have to be interpreted as part of the prior distribution (see e.g. Baumeister and Hamilton (2014)). And third, the statistic of interest are non-linear functions, i.e. variance decompositions and impulse response functions, which are a non-linear transformation of the parameters. We mitigate this complication by numerically drawing from the prior distribution including the sign-restrictions and graphically analyzing its properties. Figure 1 shows the 50% and 80% highest posterior density (HPD) intervals of the impulse response function implied by the full set of prior information. The response of the policy interest rate is normalized to a decrease by one percentage point. We see that the prior is informative on the short-term reaction of credit to the monetary policy shock, but very uninformative with respect to the reaction of housing prices.

FIGURE 1 — IRFs ACCORDING TO PRIOR BELIEF TRAINING SAMPLE

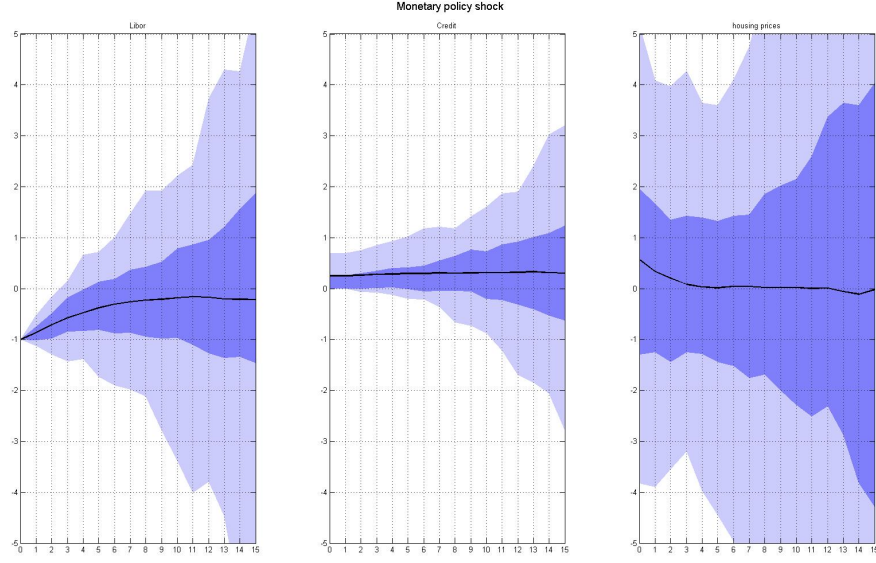
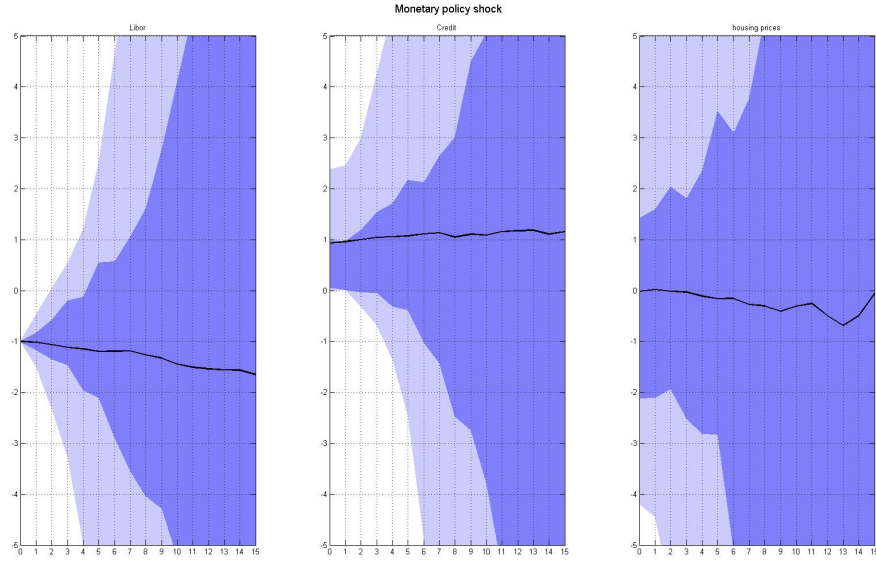


FIGURE 2 — IRFs ACCORDING TO PRIOR BELIEF MINNESOTA

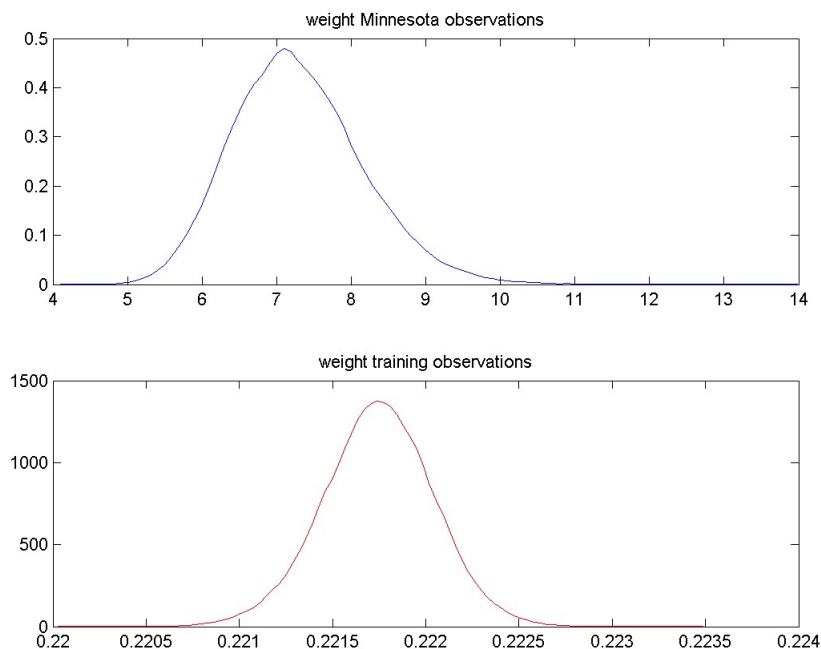


The fact the prior is informative with respect to the reaction of credit may be a result of two channels. First, it could be that the sign-restriction for the credit variable is very informative. Second, it is possible that already the training observations are informative. Figure 2 shows the implied prior by setting the weight of the training sample to zero. The weight of the Minnesota prior is drawn from its prior distribution. From this analysis, we can deduce that both channels are at work. The HPD intervals for the reaction of

credit are much wider than based on the full prior information, suggesting that training sample is informative. However, the intervals for the reaction of housing prices are still substantially wider, also if only the 'unrestricted' part of the distribution is considered. As the Minnesota prior per se treats credit and housing prices symmetrically, this indicates that also the sign-restrictions lead to tighter intervals.

4 Estimation results

FIGURE 3 — POSTERIOR DISTRIBUTION OF HYPERPARAMETERS



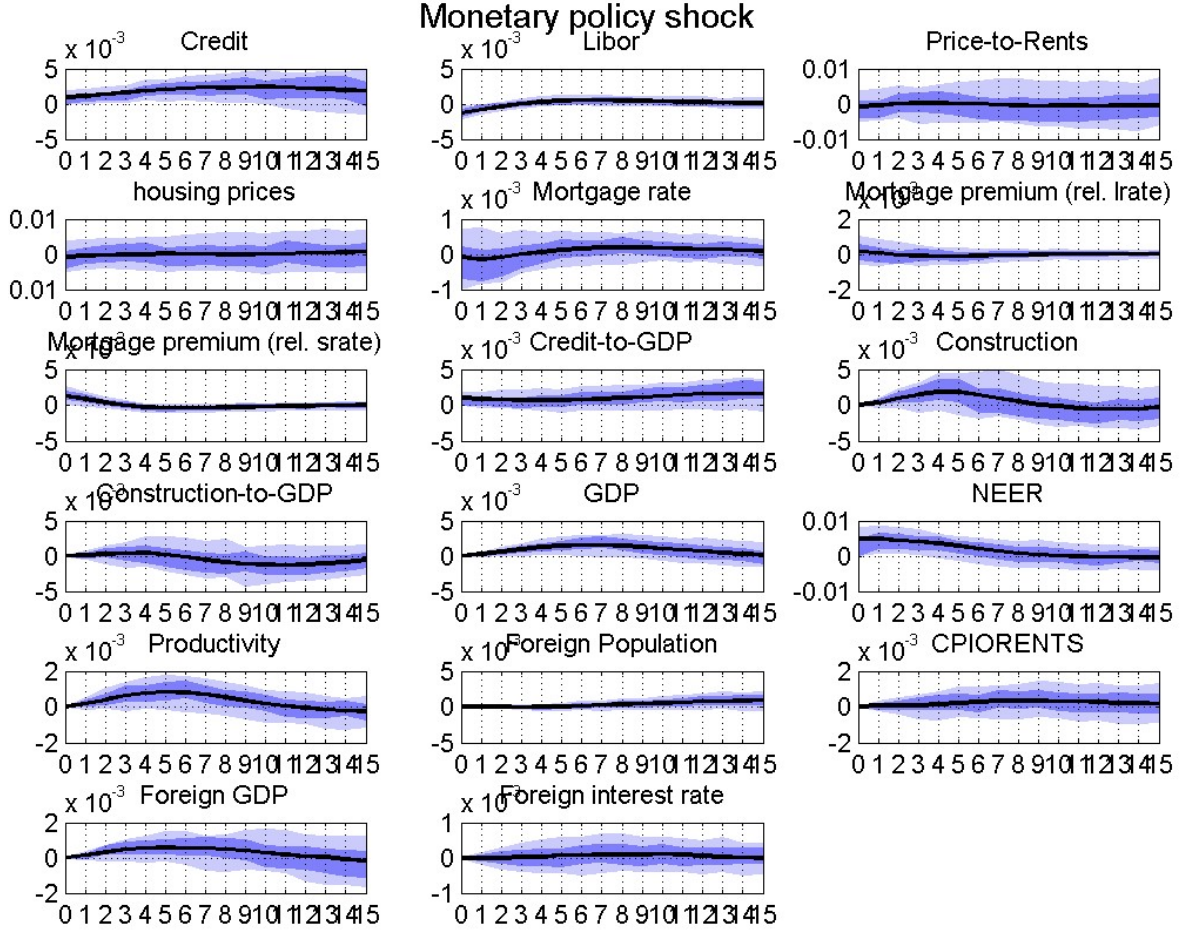
4.1 Prior weights

Our BVAR is estimated over the sample 1981q1-2013q4, while the first period 1981-1986 serves as our training sample. We opt for the training sample approach because some data are not consistently measured throughout the sample (credit, mortgage rates, housing prices) and with the training sample we can take into account the full data set, but with a lower weight. According to our estimates, the training sample enters with a weight of about 22% (see figure 3). The posterior distribution of the Minnesota prior is given in the same figure and corresponds closely to what Giannone et al. (2014) report for their

medium scale BVAR.⁴

4.2 Impulse response analysis

Response to monetary policy shocks



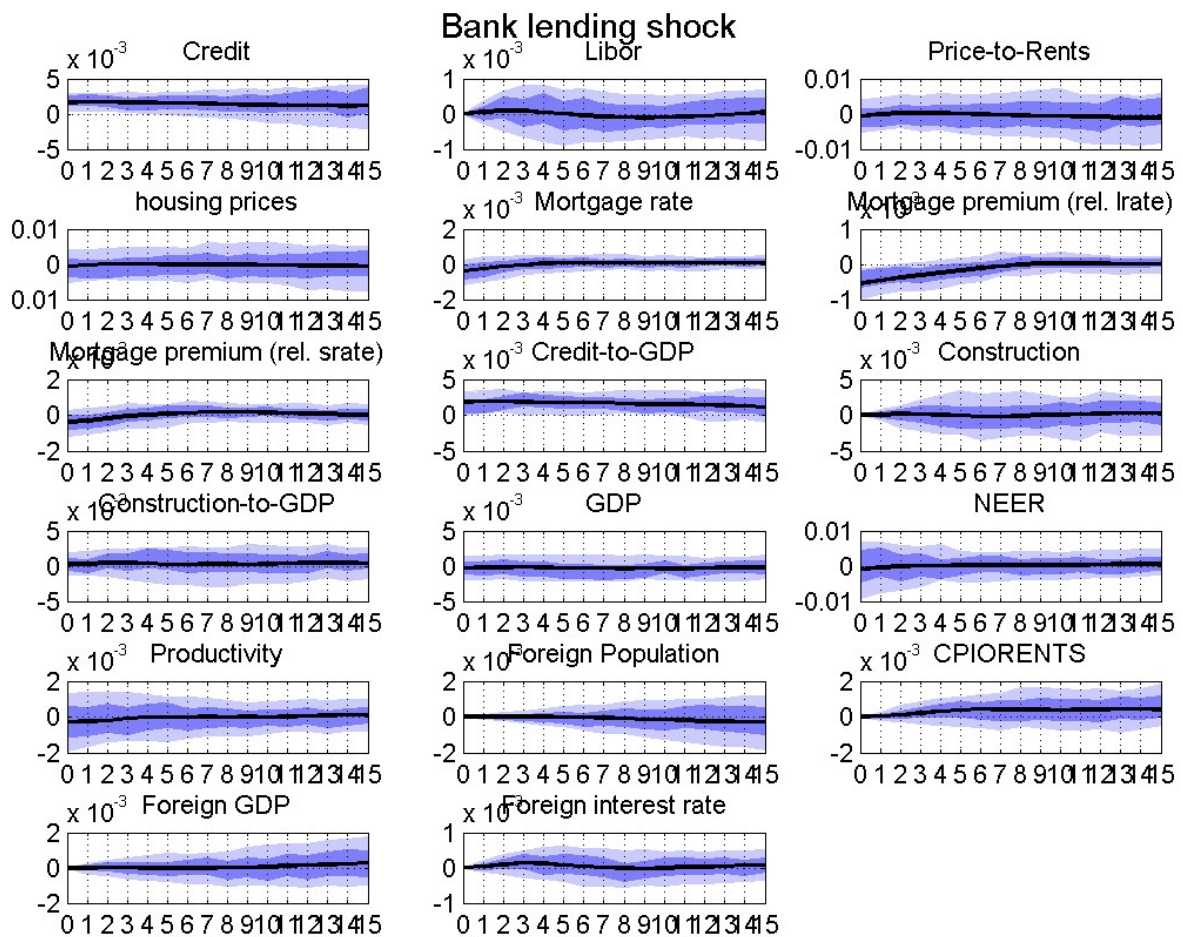
We start by looking at a conventional monetary policy shock. As specified, an expansionary monetary policy shock is set to lead to a short-term decrease in the policy rate, an increase in credit as well as to an appreciation. Given our identification strategy, we find that a monetary policy shock leads to an increase in GDP after 2 to 3 quarters while the maximum effect is reached after about 1 1/2 and 2 years. There is also evidence

⁴Note that Giannone et al. (2014) define the Minnesota prior in a slightly different way: $\mu = 1/\lambda$. This implies that our estimate of 7 corresponds to a value of 0.14. This is in between the modes of their large and medium scale BVAR model estimates.

that monetary policy has some effect on construction investment with a lag of about a year. Additionally there is a temporary positive effect on productivity. The positive effect on credit is relatively persistent (up to 3 years). The overall effect on consumer prices remains limited. There is also a positive reaction of housing prices, but the uncertainty surrounding the estimates is quite high.

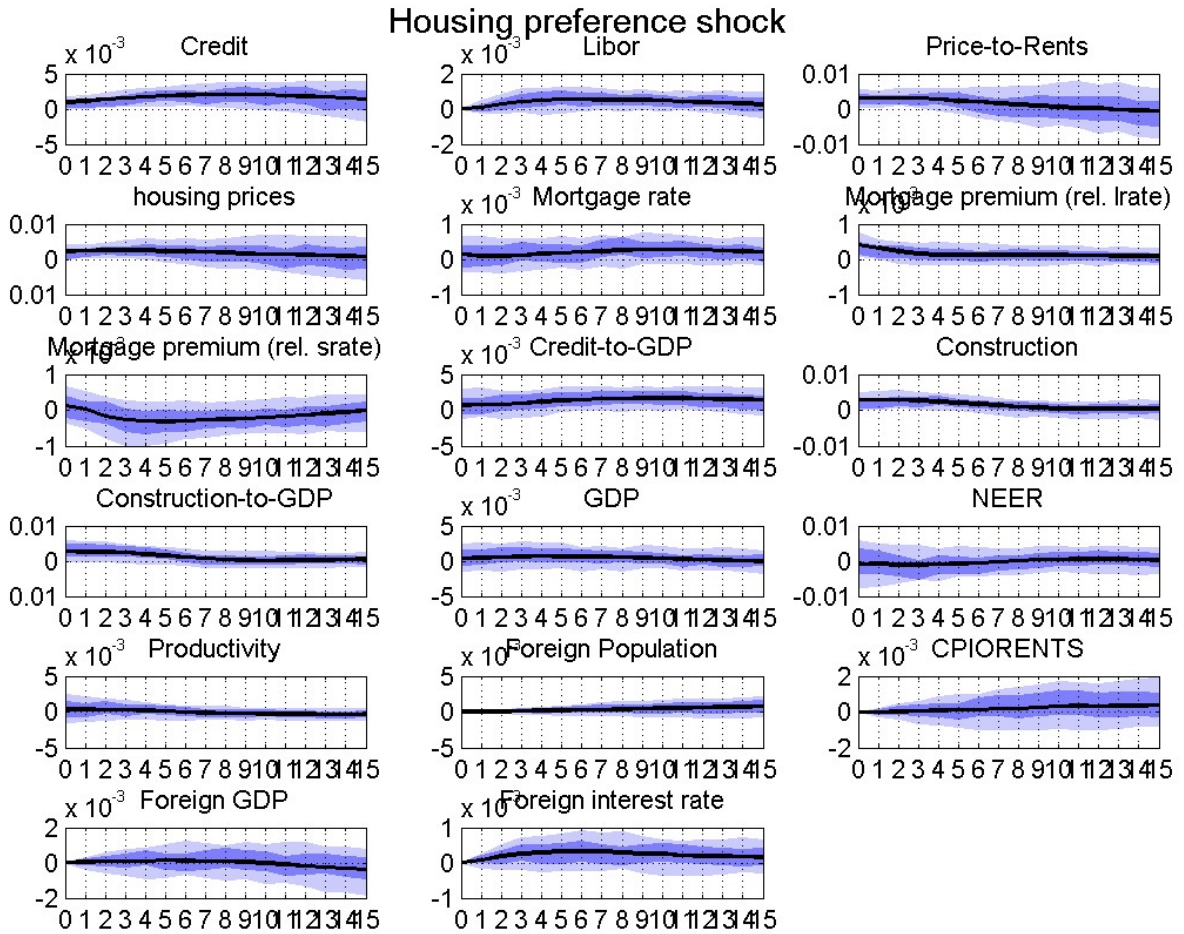
Generally, the findings imply that monetary policy has some effects on the housing market. The effect is evident in construction investment and rising housing prices. But the positive impact on GDP is also triggered by the appreciation and through net exports (not that the construction to GDP ratio remains more or less constant).

Response to credit supply shocks



The average effect of bank lending shocks for IRFs remains very limited besides the prespecified restrictions. Generally this type of shock has not a large influence on many macroeconomic variables. However, this does not mean that there may be certain episodes where these shocks matter (see the historical decompositions below). This findings imply that bank lending shocks do not seem to have contributed much to housing market developments in Switzerland which might be surprising. But note that the main identifying assumption relies on variations of the mortgage premium which does not have a large variation in our sample and therefore is not able to explain the large movements in housing prices or construction investment.

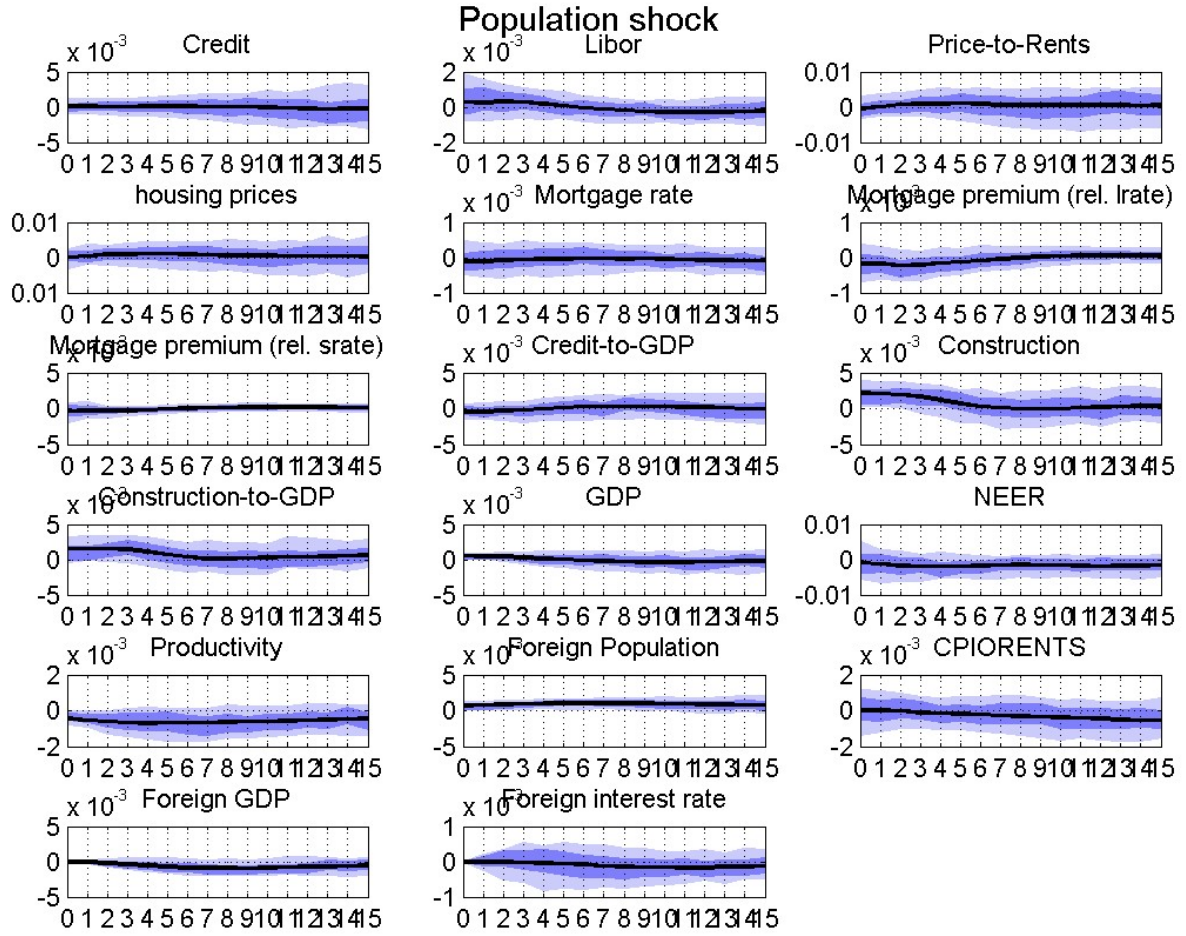
Response to housing demand shocks



The housing preference shock is set to have a positive short term impact on credit, housing prices, construction investment, mortgage spread and to the price-to-rents ratio. The impact on GDP remains limited - this is not surprising since households need to save more to invest in housing (which *ceteris paribus* has a negative impact on GDP). However, the IRFs imply that the construction-to-GDP ratio increases which is consistent with a housing boom. Furthermore, the credit-to-GDP ratio is affected positively after 2 years.

The overall impact on GDP is neutral which suggests that consumption is affected negatively through a higher savings rate (and therefore compensates for higher construction investment), which is consistent with a housing preference shock in DSGE models (Iacoviello and Neri 2010). This also may reflect that there is no strong wealth effect through higher housing prices in Switzerland.

Additionally, we find that monetary policy seems to react to housing demand shocks by increasing interest rates. This might explain the only temporary effects on housing prices, construction investment and price-to-rents ratios.



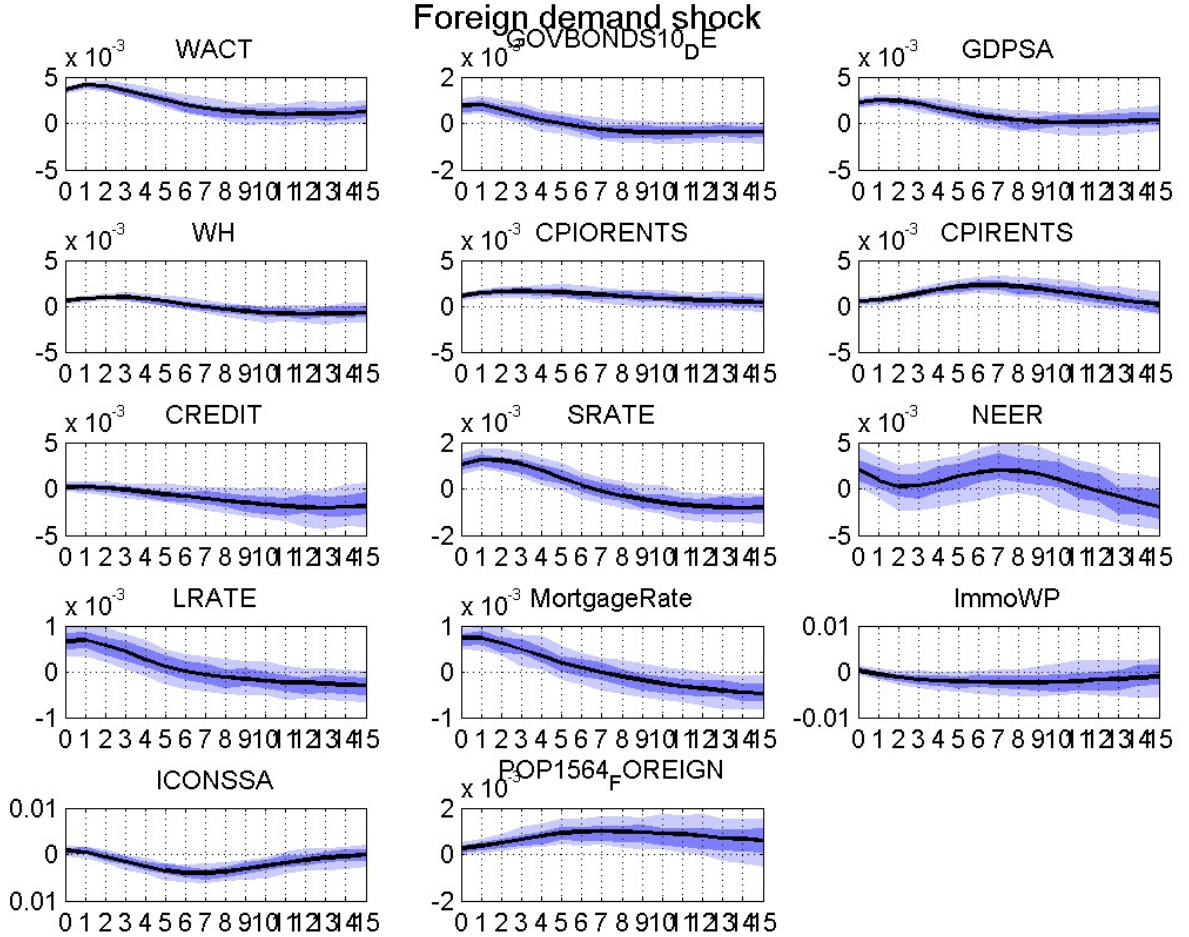
Population shocks have generally a very low impact on many macroeconomic variables. In particular, in terms of housing prices and credit, those shocks do not turn out to be significant. Note that this does not mean that population growth is irrelevant, but that shocks to the normal development do not have a big impact. The only exception is employment, where a positive employment response can be observed. This indicates that employment might have been subject to supply constraints which was partly solved by higher immigration.

Response to foreign demand shocks

The foreign demand shock turns out to have a large and significant impact on many variables of the system. It moves up GDP, interest rates, employment and inflation. Interestingly it has a negative impact on credit, construction investment and housing

prices. This implies that the response of monetary policy to a foreign demand shock more than offsets potential positive income effects (which could boost housing demand). Additionally, we find that a foreign demand shock increase the demand for workers and therefore leads to a rise in foreign population after some quarters. This implies that the number of foreign population does respond to demand conditions in Switzerland.

Interestingly, an export boom seems to have a negative impact on the housing market (on both housing prices and construction investment). This can be rationalized by a monetary policy response which also drag down credit supply. Generally, the significant impact of foreign demand is underscore the high dependence of the Swiss economy to foreign economic conditions.



4.3 Shock contributions

Given our identification scheme we can now look at the relative importance of shocks for different horizons by means of forecast error variance decompositions. Additionally, the contribution of different shocks to our variable set over the business cycle is investigated by historical decomposition. This gives an indication which types of shocks matter in different episodes. Some of the shocks may only marginally matter for some variables in most of the cases, but may contribute a substantial amount in certain rare events.

We therefore investigate the relative importance of shocks for credit, housing prices, GDP and employment. Since we look at a medium scale VAR with 14 variables it is important to note that there will be a large fraction of unexplained variances (since about 2/3 of shocks are not explicitly identified).

For credit shock we find that bank lending shocks contribute the most in the short term. More than 25% of variation in credit volumes is explained by this shock. After about a year, housing preference shocks as well as monetary policy shocks do also matter to a substantial degree and the relative importance of bank lending shocks declines. Foreign demand and population shocks do not matter much for credit.

By investigating the shocks for credit over time we find the following. During the start of the 1990s when Switzerland experienced a large housing upturn, we see that most shocks contribute positively to the credit development. Housing preference shocks seem to have contributed importantly during that time. But not only in the upturn, but also in the followed downturn housing preference shocks are an important source for credit developments. In the mid 2005s, where credit growth was relatively sluggish, restrictive monetary policy and negative bank lending shocks contribute to this development. The latest development of strong credit growth is mostly determined by monetary policy shocks and bank lending shocks.

For the explanation of housing prices, we find that bank lending shocks explain the most on impact (nearly 20%). But also monetary policy and housing preference shocks explain a fraction up to more than 10%. Again, population shocks and foreign demand do not contribute much.

For the explanation of housing prices over time it is always a combination of shocks

FIGURE 4 — FORECAST VARIANCE DECOMPOSITION FOR CREDIT

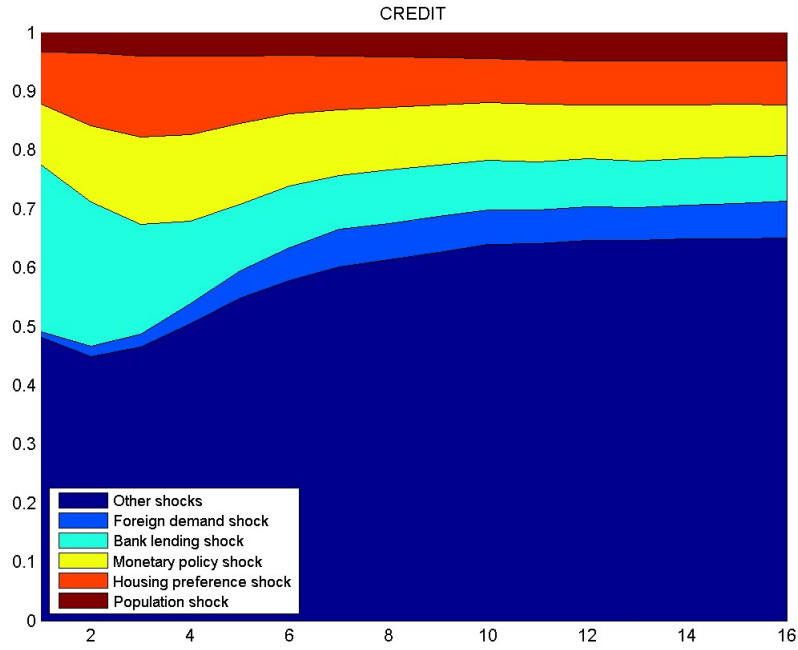
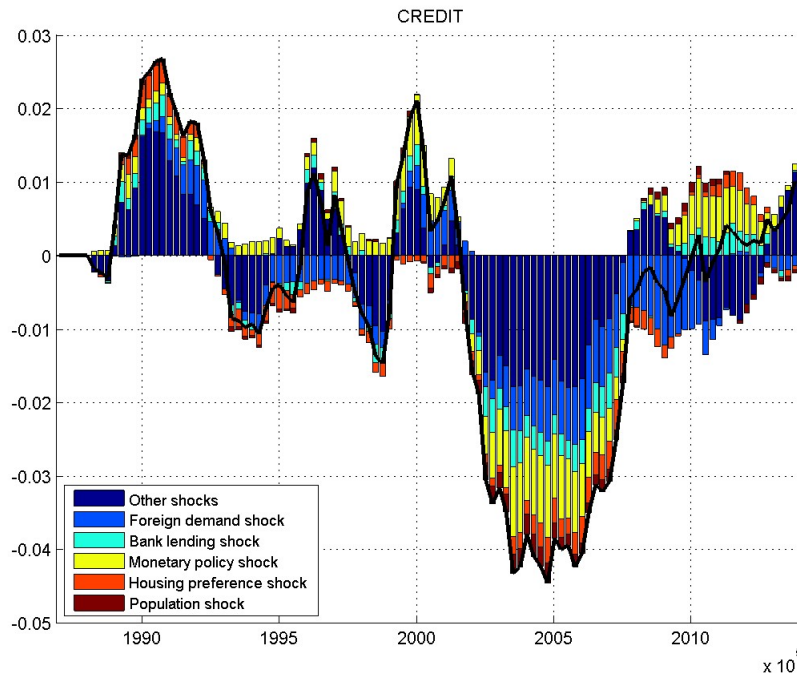


FIGURE 5 — HISTORICAL DECOMPOSITION FOR CREDIT



which seems to matter. Housing preference shocks (positive and negative) seem to be an important factor in the early 1990s. Thereafter, negative bank lending, monetary policy shocks and population shocks were responsible for the weak development around 2000. In

FIGURE 6 — FORECAST VARIANCE DECOMPOSITION FOR HOUSING PRICES

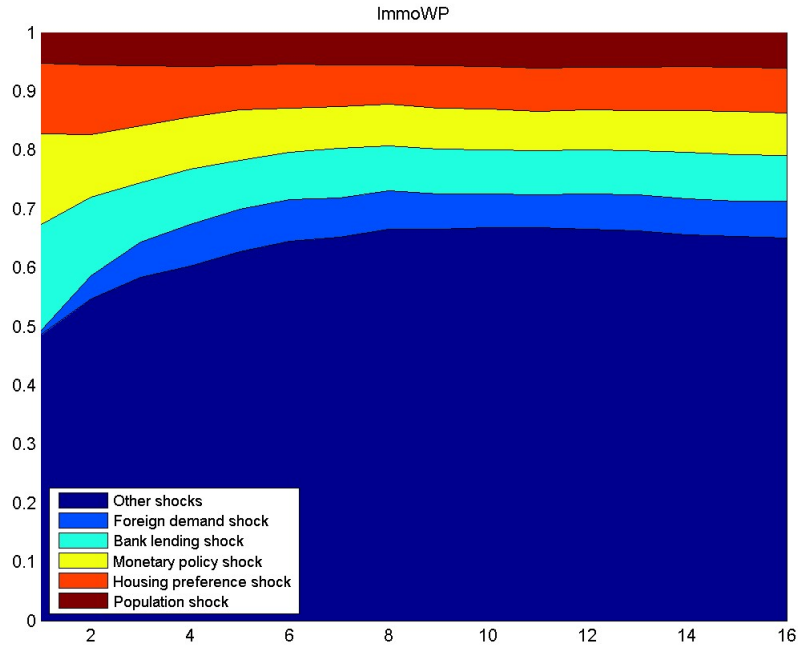
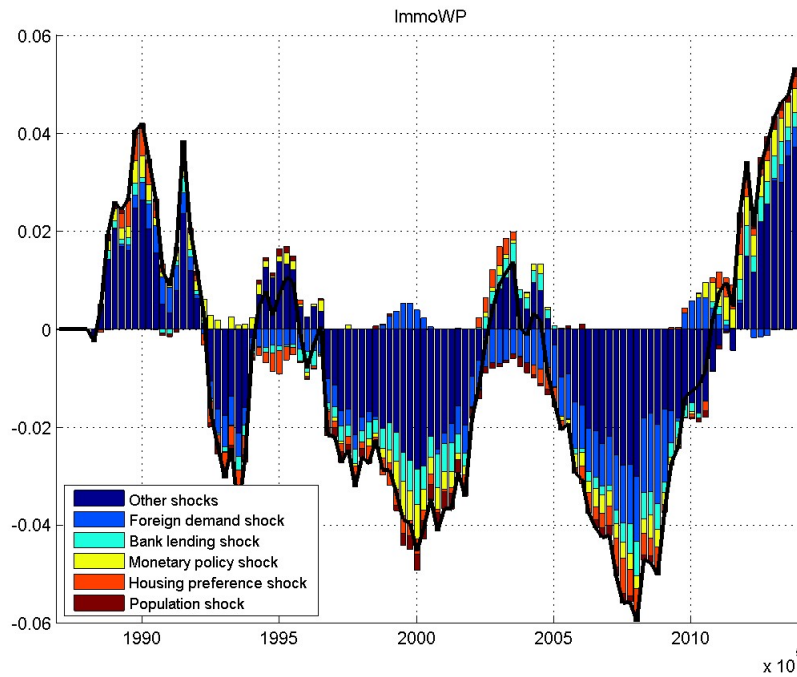


FIGURE 7 — HISTORICAL DECOMPOSITION FOR HOUSING PRICES



the mid 2000s, again housing preference shocks were important and even negative foreign demand shocks dampened the housing price developments. The most recent upturn in prices is driven by monetary policy and bank lending shocks, but also population and

housing preference shocks contribute positively.

FIGURE 8 — FORECAST VARIANCE DECOMPOSITION FOR GDP

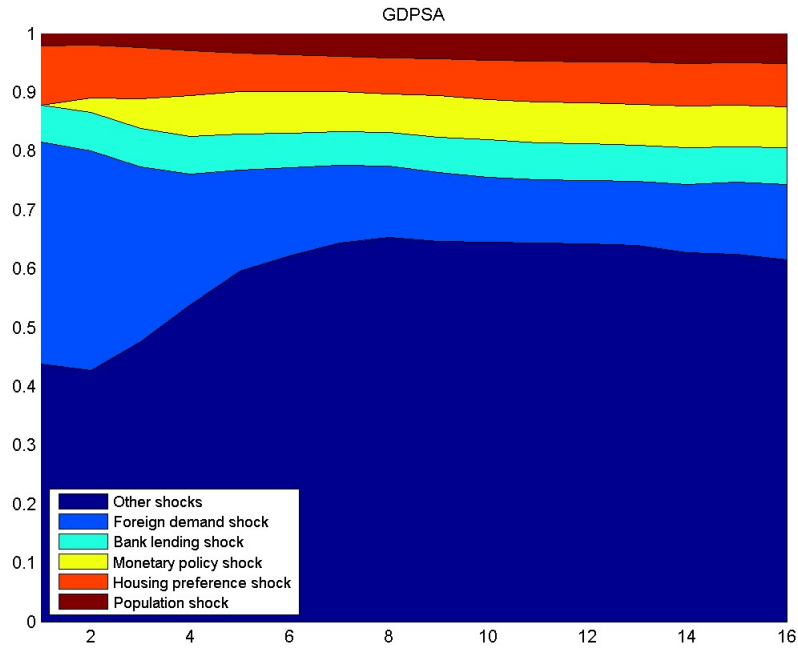
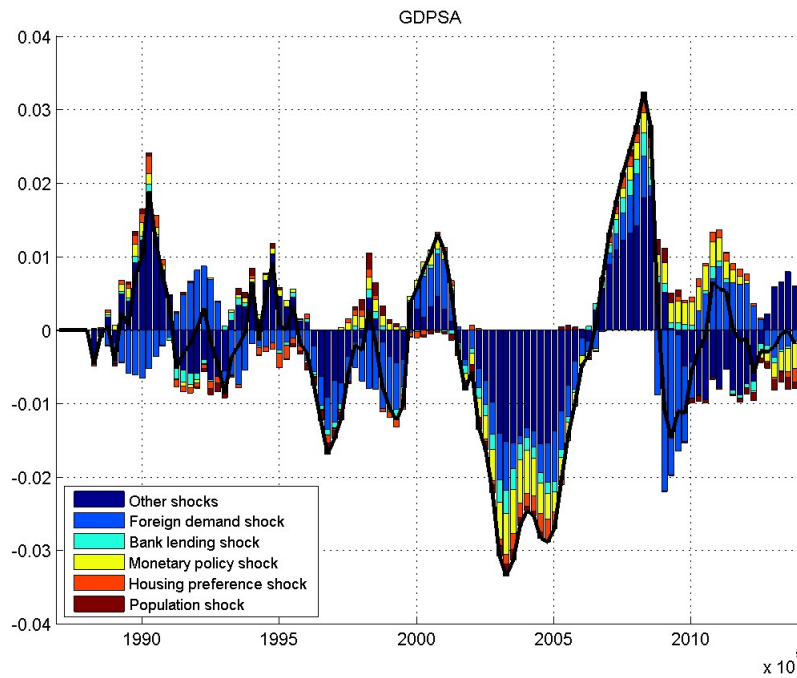


FIGURE 9 — HISTORICAL DECOMPOSITION FOR GDP



For real economic activity, namely GDP, we find that foreign demand explain a very large fraction of variation. About 35% is explained by this shock in the short-term. Even

in the long-term this shock does matter a lot. The bank lending, housing preference, monetary policy as well as population shocks do matter, but only to a small degree (together they account for about 25% of total variation in GDP).

FIGURE 10 — FORECAST VARIANCE DECOMPOSITION FOR EMPLOYMENT

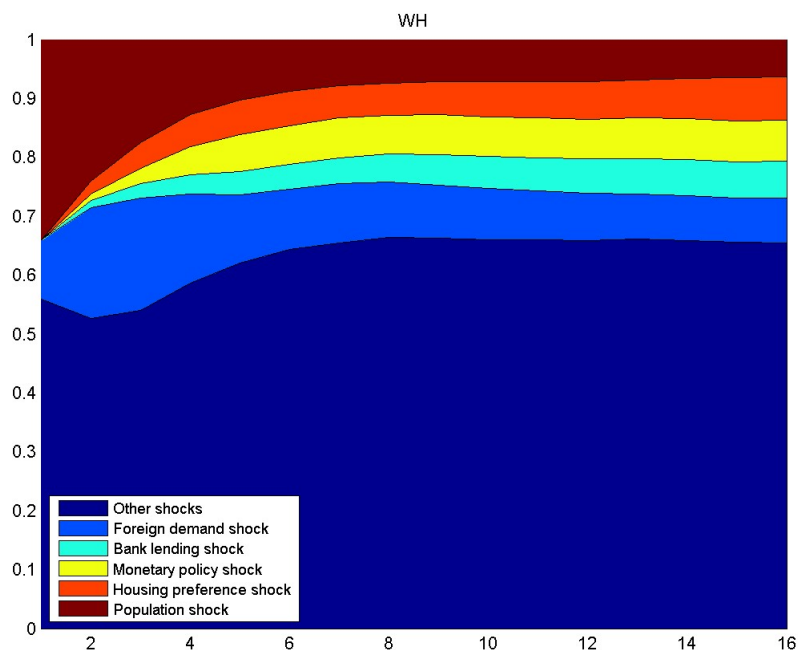
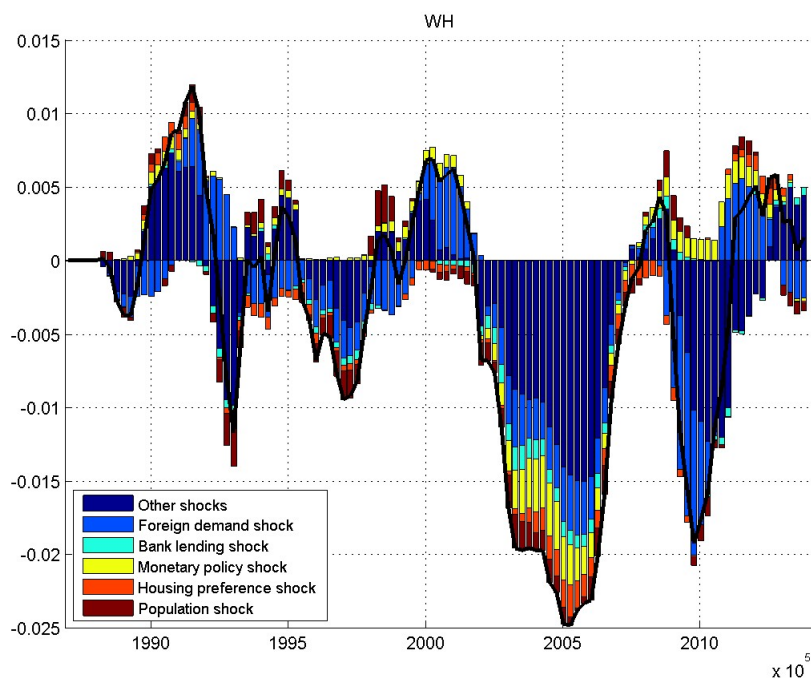


FIGURE 11 — HISTORICAL DECOMPOSITION FOR EMPLOYMENT



When we investigate the shock contributions over time, we see that bank lending shocks as well as housing demand shocks do not matter a lot. Besides foreign demand, only monetary policy do matter somehow. In particular during the financial crisis monetary policy shocks contributed positively to GDP and helped to stabilize the economy. Similar findings are found for employment.

In terms of employment, population growth shocks seem to be an extremely important factor. On impact 30% is explained by this shock. This implies that new foreigners do directly attend a job and firms seem to eliminate labour shortages (as unemployment in Switzerland is very low). After a small lag, employment does also react to foreign demand. This implies that labour demand follows aggregate demand with a small lag. Housing preference shocks are important around 2005 and 2011. This suggests that the construction sector, because of its high labour intensity, has some impact on aggregate employment dynamics. But generally, foreign demand is a major driver of employment.

Generally, we find that the average effect of credit shocks on real activity is limited and relatively small compared to other findings (e.g. for the US). However, there are certain episodes where those shocks do matter. In particular, housing preference and monetary policy shocks did have a measurable impact on GDP within the last 15 years. Moreover, housing prices are affected by combination of credit shocks. The most recent housing price boom can be traced back to bank lending and monetary policy shocks.

5 Conclusions

This paper analysed credit supply and demand shocks for the Swiss economy. Using a medium scale BVAR model, we were able to take into account various interactions of housing prices, credit, interest rates and real activity measures. To identify meaningful economic shocks, we used a combination of zero and sign restrictions.

Generally, the empirical analysis implies that the effect of credit supply and demand shocks on real activity are limited, only playing a substantive role in specific episodes. Furthermore, the credit supply shocks (i.e. bank lending shocks and monetary policy shocks) explain a large fraction of housing price and credit fluctuations. Indeed, they tend to be more important for housing prices than housing demand shocks. There is further

evidence that shocks related to credit supply, monetary policy shocks dominate bank lending shocks. It turns out to be very important to take into account foreign demand which is able to explain a substantial variation in real variables.

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TABLE 3 — OVERVIEW SHOCK DEFINITIONS

	credit supply / lending shock	monetary policy shock	housing demand	productivity	demand	population	housing preference
	+	+	+	+	+	+	+
	-	-	-	-	-	-	-
	0	0	0	0	0	0	0
Credit	1,3,6,7,10, 12	1,9		7			
GDP	1,3,8,9	1,4,8,11		7,12		12	
Prices		1,4, 7,11	9,10,13		4		12
Lending rate (or Mortgage rate)			8,9,10,13		4		
Short-term interest rate	1,9				4		14
Corporate bond rate	3	1,8,9	10		4		
Default rate	6	1,4,7,8,9,10,11					
Credit - GDP	3						
Corporate bond - Government bond	3						
Corporate bond - Short term interest	3						
non-default component of bond spread	2						
Financial - non financial stock prices		4			4		
Private investment		4					
Housing investment							
Housing investment - GDP			13			14	12
CA - GDP							
Credit mix	8	8					
Credit spread	6,7						
Productivity	6		11	12		12	
Reserves		7					
Exchange rate (appreciation)	8	8,11		12			
House prices	8, 12		13			12,14	
Credit - Monetary base	9	8					

Notes: 1: Busch et al. (2010), 2: Meeks (2012), 3: Eickmeier and Ng (2011), 4: Fornari and Stracca (2012), 5: Abildgren (2012), 6: Helbling et al. (2011), 7: Hirata et al. (2012), 8: Halvorsen and Jacobsen (2014), 9: Peersman (2011), 10: Peersman and Wagner (2014), 11: Tamsi and Vilgi (2011), 12: Biany and Gete (2014), 13: Jarocinski and Smets (2008), 14: Iacoviello and Neri (2010)