A Primer on Slovene House Prices Forecast

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Abstract

This paper presents a basic econometric model for house prices forecasting in Slovenia. The model is based on Bayesian Vector Autoregression model (BVAR), which is a common econometric tool used in the forecasting processes. The key findings of the paper are that the house prices in Slovenia are driven by the following 6 variables: volume of housing investment, personal disposable income, unemployment rate, construction costs, economic growth, measured with a real gross domestic product, and real housing interest rate. The applied econometric framework predicts that the declining trends in Slovene housing market will probably come to a standstill. As the solid economic growth in Slovenia continues, presented econometric model predicts a positive but only gradual growth of house prices over the projection horizon. In addition, forecasting housing prices can become a necessary tool for a prudent implementation of macroprudential regulation. Further development of econometric tools for predicting developments in Slovene housing market is necessary irrespective to the limitations posed by relatively short Slovene house-price time-series data.

JEL Classification Numbers: C53, E27, E22

Keywords: house prices forecast, Bayesian VAR

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1 Introduction

Housing market plays an important role in every economy. It is a source of wealth for households, but can also be a source of vulnerabilities for the economy. For example, as real estates are very often used as collateral for bank loans, any change in the real estate prices will affect the wealth of economic agents and thus theirs creditworthiness (Bernanke and Gertler, 1989). In the boom phase this could lead to misallocation of resources with strong negative effects on the economy during the unwinding process. Therefore, it is crucial to closely monitor house prices developments. House price forecast is an essential tool in this framework. The measurement methodologies of house price development vary between and even within countries. From the economic policy perspective this is not desirable as it impedes international comparisons, which makes very difficult to consequently implement appropriate micro- and/or macroprudential tools to manage any potential misalignments in house prices.

On the back of the construction of the robust house price index methodology another important issue arises. As stock prices fluctuate much more than fundamentally justified, the same conclusion can be drawn for house price fluctuations. Both, house price growth in the Euro Area and Slovenia, showed considerable volatility during the observed period (Hott, 2009). The growth of real estate prices in Slovenia was rising steadily during the period, and was falling precipitously from 2008Q3 onward. However, given the rapid rise in house prices in the pre-crisis period, this fall in prices is not completely inline with the developments in the other Euro Area countries, which had a same-order magnitude housing bubble as Slovenia.

Understanding and successful forecasting of house prices represent an important macro-prudential tool to prevent future misalignments in house prices and to recognize the build-ups of housing bubbles. In this respect further prudential measures and instruments could be developed with the intention of strengthening the resilience of the financial sector against the house-price shocks and bubbles.

The remainder of this paper is organized as follows. In section 2, we present a short literature review, and in section following that we present data and measurement issues being used and examined. In section 4 the model is considered, while in section 5 we present the results. Section 6 concludes.

2 Literature review

In search of explanatory variables we review the literature on house price forecasting and modelling. The variables used in the cited literature will then be tested in our model for house prices. In this paragraph we list the papers and their corresponding variables used in forecasting house prices. We start seminal papers and only cite new papers when they propose a new explanatory variable, not already mentioned by previously cited papers. The real estate sector is a significant factor of wealth and a driver of the economy, and the development of house prices is considered to be very important, especially in times of economic turbulences. The latest financial crisis is perfect example how can exaggerated dynamics in house prices affect an economy. Movements in housing wealth are associated with movements in consumption in the same direction (Iacoviello, 2011) and shocks in the housing sector can have a significant effect on consumption and consequently on economic activity as a whole (Goodhart and Hofmann, 2008). This is especially evident in countries that have large and efficient mortgage markets (Catte, Girouard, Price and André, 2004). Ludwig and Sløk (2004), and Caroll, Otsuka, Slačálek (2006) additionally showed that the long-run consumption is more responsive to permanent changes in housing wealth[1] in countries with market-based financial system as opposed to countries with bank-based financial system. Even more, real-estate prices affect credit worthiness of firms and households, which can have a negative effect on banks' balance sheets when the prices drop (Bernanke and Gertler, 1989). All in all, the development of house prices can significantly determine the economic business cycle (Leamer, 2007).

Yet the measurement methodologies of house-price development vary between and even within countries. From the economic policy perspective this is not desirable in order to make solid international comparisons. In this respect, Silver (2012) had shown that the measurement methodologies do matter in trying to construct a robust house price index. To bridge this gap the European Commission (2013) developed a handbook, which aims to facilitate the setting-up of real estate price indices and improve the existing house-price development methodologies and secure greater level of harmonisation if necessary.

Regarding the data, Slovenia has very short time series on house prices. These limitations could be tackled by using regional data. For example, Kajuth, Knetsch and Pinkwart (2013) estimated house prices in Germany by using a regional dataset for 402 administrative districts. These regional differences help to explain the variation across local housing markets. Brunauer, Feilmayr and Wagner (2012) calculated an aggregated house price index by breaking down regions and types of property and using an estimation based

[1]However, Cirman (2007) had shown that in the case of Slovenia changes in housing wealth are somewhat cushioned by the tied financial transfers from parents to their children in order to help them resolve their housing needs. Additionally, this is also supported by a strong preference of homeownership in Slovenia due to the lack of proper rental alternatives (Cirman, 2004).

on semi-parametric models that take nonlinearity and spatial heterogeneity into account. Further on, Hill and Scholz (2014) incorporated geospatial data and use a hedonic approach with splines in order to set up an aggregated house price index.

Another important issue, when forecasting house prices, is the identification of fundamentals. Gattini and Hiebert (2010) found out that the behaviour of euro area house prices over the last decades is characterised by a stable long-term relationship with the respect to demand and supply fundamentals, including real housing investment, real income per capita and the real interest rates; but the relationship is sometimes accompanied by episodes of over- or undershooting the fundamental house prices. Nobili and Zollino (2012) showed that also building costs and population growth affect the house price dynamics. Robstad (2014) constructed a baseline structural Bayesian VAR (BVAR) model for Norway based on real house prices, GDP, inflation, real exchange rate, interest rate and real household credit. In addition, for robustness checking of the baseline BVAR model, Robstad constructed several other alternative models with different additional economic variables, such as consumption growth and foreign interest rates.

However, Hott (2009) argues that, as stock prices fluctuate much more than fundamentally justified[2], the same conclusion can be drawn for house price fluctuations, and was also documented by Agnello and Schuknecht (2009) and Muellbauer (2012). By including proxies for constant user costs, herding behaviour and speculative bubble in the analysis, Hott (2009) tries to show that, in contrary to the widespread opinion that a real estate is a very safe asset, there are substantial over- and under-valuations in the real estate markets from time to time. André (2010) added that innovations on mortgage markets[3], taxation[4] and deregulation[5], house price expectations and other local (country) specifics helped fuelling the housing bubble and consequently overshooting the fundamental house prices. Schneider (2013) and Lenarčič and Damjanović (2015) try to construct an aggregated indicator intended to provide a broad guide to extent of over- and under-valuation of house prices on the basis of sub-indicators, such as real residential property prices, price-to-rent ratio, housing investment-to-GDP ratio, interest rate risk, inverted loan-bearing capacity, and several others. All of these fundamentals and non-fundamentals

[2]Shiller (1981), LeRoy and Porter (1981).

[3]Such as extensions on loan terms, increased share of adjustable-rate mortgages, higher loan-to-value ratios, deferred amortisation loans, housing equity withdrawal, subprime loans and securitisation.

[4]According to van den Noord (2005) tax relieves and subsidies of home ownership affect the developments in the housing sector.

[5]The effect of real-estate prices on credit growth is stronger in countries with more deregulated mortgage markets (Tsatsaronis and Zhu, 2004).

were supported also by the growth of "cheap money" depending on institutional features, particularly in the beginning of the 2000s (Girouard, Kennedy, van den Noord and André, 2006; Muellbauer and Murphy, 2008; ECB, 2009; Kholodilin, Menz and Siliverstovs, 2010).

Identifying key fundamental drivers of house price determination and constructing robust house price indices would provide an important platform in preventing future housing bubbles before their burst and consequently preventing the devastating effects on the domestic and the world economy. There are several methods used to detect bubbles in the housing sector. Papers, such as McMillen (2008), Zietz, Zietz and Sirmans (2008), Gerdesmeier, Lenarčič and Roffia (2012), applied the quantile regression method[6] to detect house bubbles. On the other side, Dreger and Kholodilin (2013) followed Mendoza and Terrones (2008) in the bubble identification methodology with estimation of deviations and constructed country-specific chronologies of house price bubbles. Applying signalling approach, logit and probit models, their aim was to set up an early warning system of housing bubbles. They have shown that their methods provide sufficient prediction accuracy, which makes it useful in forecasting the future speculative bubbles in housing markets.

3 Data, construction of the house price index and its measurement issues

We first describe how our dependent (target) variable was constructed and then proceed with a description of our core explanatory variables. Despite the European Commission's Handbook (2013) regarding the house price index methodologies and European Commission's Eurostat database, which already includes internationally comparable time-series house price data, we are facing many difficulties in constructing an appropriate long-term aggregate Slovene house price time-series index. Official time-series house price index data from the Statistical Office of the Republic of Slovenia (SORS)[7] is available only from 2007Q1 onward. In the period from 2003Q1 till 2006Q4 SORS also published house price data; however SORS used a slightly different methodology than currently in practice[8]. Looking further back, from 2000Q1 onward data from

[6] The quantile regression method was firstly introduced by Machado and Sousa (2006), but used the method in order to identify asset price bubbles.

[7] Same data is also available at the European Commission's Eurostat database.

[8] The units of observation in the house index are comprised of transaction prices of existing and newly built residential units. Around 30% of transactions are newly built residential units, while the other 70% are existing residential units. Currently SORS collects data from the Surveying and Mapping Authority under the Ministry of the Environment and Spatial Planning of the Republic of Slovenia. Residential data collected is first refined by omitting all non-market transactions. Later on, SORS uses a hedonic multiple regression analysis in

the SLONEP portal[9] is available. With this in mind we have to assume that the trends and developments in the house price time-series are more or less on the same order of magnitude. Moreover, due to data availability limitations an additional reason to use SLONEP house price data is that it is the only house price source from 2000Q1 onwards (i.e. it also includes the pre-crisis and pre-bubble period). The time-series is therefore constructed by applying growth rates of average advertised prices in Ljubljana from the SLONEP portal from 2000Q1 to official series from SORS's aggregate house price index for apartments (from 2003Q1 onward using the older methodology and from 2007Q1 onward the currently official methodology).

We now describe our set of explanatory variables. An issue arises when we try to construct the real housing interest rate series, which is an important fundamental driver of house price developments. Slovene monetary policy experienced different exchange-rate regime periods, including the transition period with high, persistent inflation in the 1990s, managed floating exchange rate regime in the early 2000s, the fixed exchange rate after joining the ERMII system, and finally the period adopting the euro in 2007. Despite different policy regimes the housing interest rate is co-moving with the loans interest rates in the banking sector in Slovenia, which were following the general fall in interest rates across euro area[10].

Apart from the real-interest rate, the relevant variables which are regarded as the main drivers of the house-price dynamics are also the personal disposable income, GDP, construction costs, housing investments and the unemployment rate. Most of the above mentioned explanatory variables are a typical choice in the housing forecasting literature, however in different combinations (Gattini and Hiebert, 2010; Drought and McDonald, 2011; Deryugina and Ponomarenko, 2014; Plakandaras et al., 2014; Robstad, 2014). All variables enter the model in real terms, and are seasonally adjusted and expressed in log-levels (except for the housing interest rate and the unemployment rate, which are presented in percentages). Further descriptive statistics of the variables considered in the model are presented in Table 1 in Appendix A in more detail.

Figure 1 shows the evolution of house prices and the main driver variables. The long-term increase in the real GDP and decrease in the real housing in-

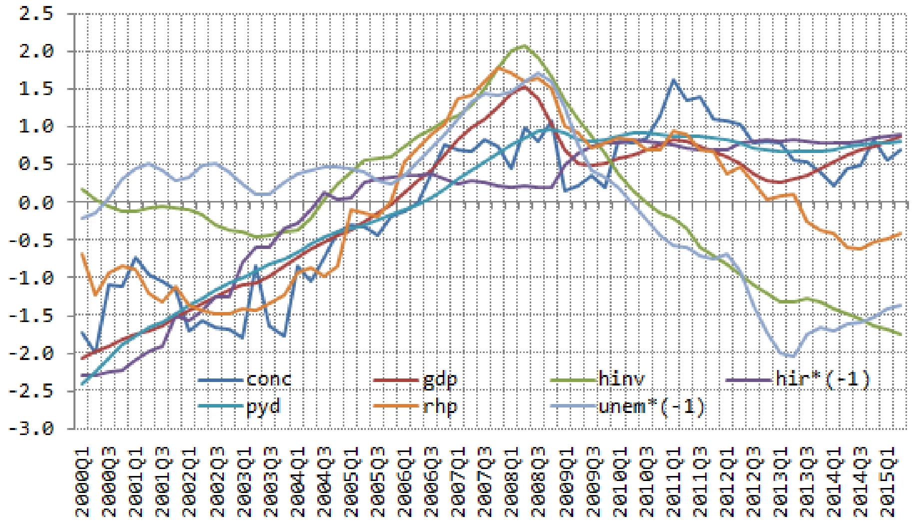
order to construct the housing index. Between 2003 and 2007 SORS used different methodology and collected data from the Tax Administration under the Ministry of Finance of the Republic of Slovenia. More on methodology is available at http://www.stat.si/doc/metod_pojasnila/04-004-MP.pdf.

[9]Available at http://www.slonep.net/.

[10]The correlation of the housing interest rate in Slovenia and the average of euro area housing interest rates stands at 0.95, while the correlation between the housing interest rate in Slovenia and the monthly average eonia rate stands at 0.97.

terest rates had driven the households' purchasing power together with the construction costs and the housing investments.

Figure 1: Normalized data entering the model



Source: own calculations, and Statistical Office of the Republic of Slovenia (SORS).
*Note: *gdp* stands for real GDP, *conc* for real construction costs, *hinv* for real housing investment, *pyd* for real personal disposal income, *rhp* for real house prices, *unem* for unemployment and *hir* for real housing interest rate.

Since the real house price index exhibits a unit root, in theory the first differences should be used to impose the stationarity of the series. On the other side, differencing the series means loosing valuable information. Diebold and Kilian (2000) had shown that if the unit root test parameter, a, is slightly less than 1 and the number of observations is relatively high, the forecast performance of models in levels could be more accurate than models using differences. Even more, since all the variables are integrated of order 1 and are cointegrated around a common trend (see Appendix A Table 2) we use the log-level variables in the model.

4 Bayesian model

This section provides the econometric methodology. BVAR is an econometric tool used in the forecasting process. BVAR methodology imposes prior restrictions over the VAR model parameters' distribution. The model parameters are obtained by mixing the prior distribution with information in the data. Because our data sample is short a classic VAR would suffer from low degrees of freedom. Due to low degrees of freedom we would be forced to estimate a VAR with insufficient lag length. Insufficient lag length could result in biased forecasts. Thus we estimate a Bayesian VAR. Bayesian VAR enables us to to bring additional information in the model in the form of priors that are well founded in theory. This additional information then enables us to consider models with longer lags, something we could not do if we used a classic VAR.

The basic structural BVAR form is given by the equation:

$$Y_t = \alpha_1 Y_{t-1} + ... + \alpha_p Y_{t-p} + \beta_1 X_{1,t} + ... + \beta_j X_{j,t} + \epsilon_t \tag{1}$$

where Y_t is a vector of regressors, α's are vectors of coefficients of the respected lagged regressors, where p is the number of lags. The constant and other deterministic exogenous variables are denoted with $X_{1,t}, ..., X_{j,t}$, β's are the coefficients of the respected exogenous variables, where j is the number of the exogenous variables. ϵ_t is the error term.

In contrast to VAR models the BVAR methodology enables us to include a larger number of variables in the time-series analysis. The possible limitation of the number of time observations of separate variables in the model affect only the setting up the tightness of the priors used in the BVAR methodology. Based on these characteristics we can more accurately try to explain the developments in the housing sector by fundamental economic variables. Bayesian methods were popularized in recent years in the literature reflecting the advances in the econometric and computational tools necessary to carry out estimation processes and at the same the usage of prior information provides a consistent way for forecasting exercises, despite that the choice of prior information could be subjective. This methodology is reflected in the growing literature in the field of the real estate forecasting. Jarociński and Smets (2008) and Plakandaras et al. (2014), for example, forecast US house prices using the BVAR methodology by including 9 fundamental economic variables[11]. Furthermore, Drought and McDonald (2011) took a step further and forecast house prices in a large scale BVAR model setting including variables for foreign economies[12] on New Zealand data, while Robstad (2014) constructed a similar structural BVAR for the case of Norway.

5 Results and forecasts

In consistence with the literature cited above at the beginning of the paper we found the following endogenous variables to be important for forecasting

[11] real GDP, GDP deflator, commodity prices, federal funds rate, M2, real consumption, real residential investment, real house prices, and long-term interest spread.

[12] They tested house prices forecast on autoregressive (AR), Factor, error correction, VAR and basic BVAR model as well

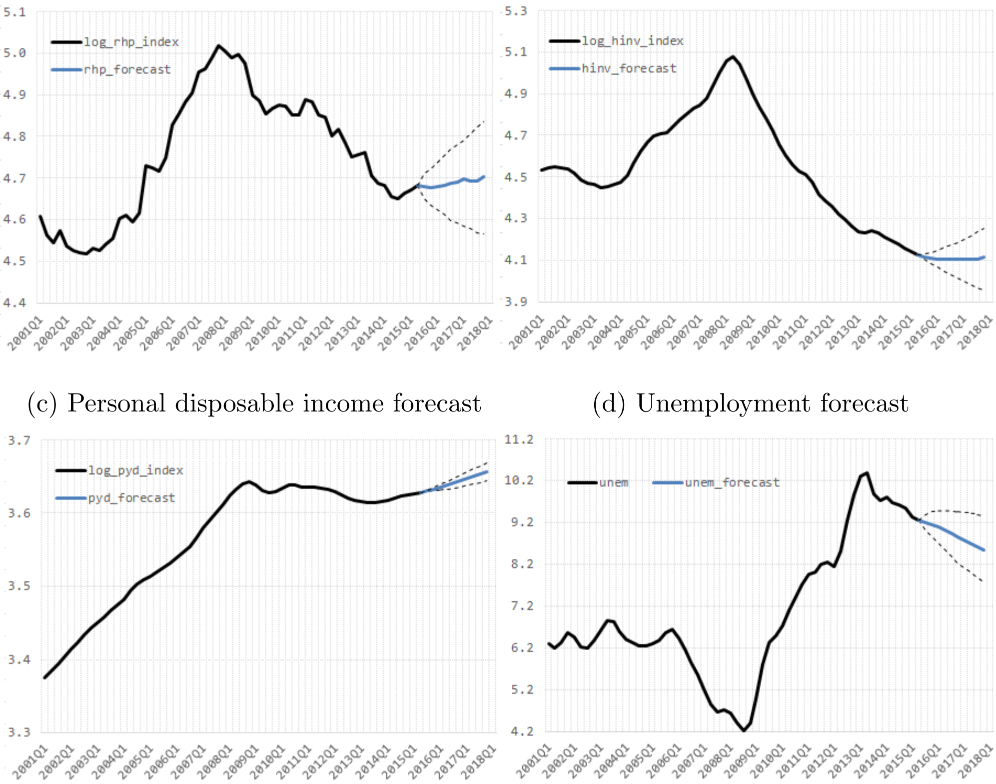
Slovenian house prices: house prices, housing investments, personal disposable income and unemployment rate. On the other hand, the variables that enter the model exogenously are the constant, GDP, construction costs and the housing interest rate. The reason of treating the construction costs, the housing interest rate and the GDP exogenously is the following. The construction costs depend on the price of construction material making them undependable from house price development[13]. As a member of the monetary union the housing interest rate is co-moving with the loans interest rates in the banking sector in Slovenia, which were following the general fall in interest rates across euro area, despite the spreads on the risk free rate which are driven by specifics of the Slovenian economy. Since the personal disposable income is treated endogenously the GDP represents as the main trending exogenous variable driving the shape of the economy.

The BVAR model consists of 4 lags and follows the Cholesky factorisation[14]. For the forecasting purposes we select univariate AR Minnesota priors with 2000 total iterations. The reason behind it is that the choice of the Minnesota prior lessens the possibility of over-fitting the model. At the same time, since we use the log-levels data, in this case the Minnesota prior uses a prior mean which expresses a belief that the individual variables entering the model exhibit a random walk behaviour. Another advantage of the Minnesota prior is its simplicity and success in forecast applications (Koop and Korobilis, 2010), even in large panels of data (Banbura, Giannone and Reichlin, 2010). The model fit and residuals of the BVAR model are presented in Appendix B in Figures 3 and 4. Future movements of the real house price index in Slovenia is presented in Figure 2. The BVAR model quite robustly predicts future movements of the real house price index. Despite the decreasing unemployment, the real house prices seem to stagnate in the near future, which is mostly attributable to stagnating dynamics of housing investment and relatively slow rebound of the personal disposable income. A similar conclusion of stagnating house prices in Slovenia is made in Lenarčič and Damjanović (2015). At the moment the recovery of the Slovene economy does not yet provide suitable conditions to stimulate growth in house prices.

[13] We have to have in mind that labour costs are part of construction costs as well and since we employ the unemployment rate as an endogenous variable, this would imply that construction costs could be treated as an endogenous variable too. In this respect we tested a model where construction costs enter the model as an endogenous variable, however it did not improve the forecasting power of the model in comparison to the model with exogenous construction cost variable. For the sake of simplicity we use the model with exogenous construction cost variable.

[14] The variable order is as follows: real house prices, housing investment, personal disposable income, and unemployment rate.

Figure 2: Forecasts



(a) Real house prices forecast

(b) Housing investment forecast

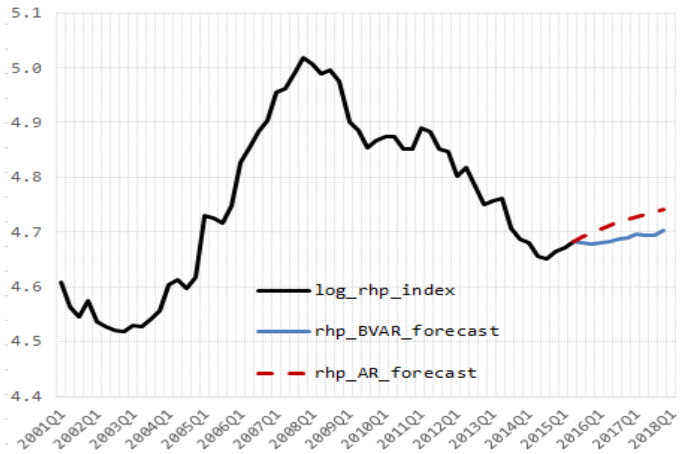
(c) Personal disposable income forecast

(d) Unemployment forecast

Source: own calculations, and Statistical Office of the Republic of Slovenia (SORS).

The forecasting power of the BVAR model was exposed to robustness checks as well. We ran an autoregressive (AR) model with 4 lags (see Figure 3). It is clear that both models indicate a slow but stagnating rise in house prices, however the AR model in comparison to the BVAR is slightly more optimistic. This is due to the low housing investment levels and slow rise in personal disposable income that prevent housing prices to respond faster, as in the AR model.

Figure 3: BVAR and AR forecast comparison



Source: own calculations, and Statistical Office of the Republic of Slovenia (SORS).

Despite being primary a forecasting exercise, we are able to perform reduced impulse responses to trace down effects of shocks to those variables to economic activity in order to check the significance and response of the main endogenous variables between each other. Looking at the reduced impulse responses (see Figures 5-8 in Appendix C), real house prices respond significantly but in line with expectations to housing investment and personal disposable income shocks. On the other hand, shock in the unemployment rate does not reflect in the real house prices. Going forward, housing investment is quite responsive in no matter what kind of shock occurs in the modelled economy. Similar conclusions, but to a lesser extent, could be drawn for the impulse responses of personal disposable income. The unemployment rate responds negatively to positive shocks in real house prices, housing investment and personal disposable income, which is in line with the economic theory as well.

The latest financial crisis has revealed a great importance of the housing sector in building-up the macroeconomic imbalances in economies. In Slovenia, housing prices were rising far above the macroeconomic fundamentals before the financial crisis and critically exposed the balance sheets of banks and other non-financial companies (especially the construction sector) during the financial crisis. The vulnerabilities in the housing market nowadays represent one of the largest challenges to address from the policy-maker's perspective, particularly from the view of the rising economic field of macro-prudential policy. Forecasting housing prices can therefore become a necessary tool for prudent implementation of new macro-prudential measures.

6 Conclusions

Forecasting house prices at the macro level in Slovenia is somewhat more challenging comparing to other countries, mainly due to the short house-price time series data and, the related of unobservable, but important, variables, which we successfully overcome by utilizing a Bayesian model. This is particularly true for taking into account one-off effects, such as the selling strategies of unsold dwellings by more important economic agents or the future taxation policies, whether on a national or a regional level. Additional diversity of house prices dynamics across the country can be driven by different levels of development of the local infrastructure and specific natural/environmental characteristics.

Despite of all difficulties with the data and individual housing sector characteristics, this paper presents a primer on Slovene house-price forecast based on a BVAR methodology. Using this framework we were able to show that the house price index is driven by housing investments, personal disposable income, unemployment, construction costs, real GDP and real housing interest rate. Based on these variables house prices in Slovenia seem to stagnate in the near future, since the Slovene does not yet provide sufficient conditions for growth.

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A Description statistics

Table 1: Variable description statistics

Variable:	House prices	Housing investment	P. dispos. income	Unemployment	GDP	Construction costs	Housing rate
Mean	4.745722	4.562961	3.548411	7.040214	9.043957	4.690784	8.515986
Median	4.739933	4.544590	3.606300	6.568682	9.084822	4.711973	6.547253
Maximum	5.019101	5.079164	3.643435	10.39529	9.197246	4.783947	22.87987
Minimum	4.520035	4.129779	3.312373	4.233395	8.837649	4.576206	2.918410
I(1)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.∗∗
None ∗	0.867171939	299.6458915	139.2752564	1.63E-15
At most 1 ∗	0.620095073	180.5426054	107.3465667	6.59E-09
At most 2 ∗	0.579886765	123.4403846	79.34144707	1.02E-06
At most 3 ∗	0.442736053	72.27375588	55.24578423	0.000804167
At most 4 ∗	0.247944611	37.77549541	35.01089942	0.024646954
At most 5 ∗	0.204841106	20.9637226	18.39771485	0.021430982
At most 6 ∗	0.118476849	7.440136829	3.841465501	0.006375758

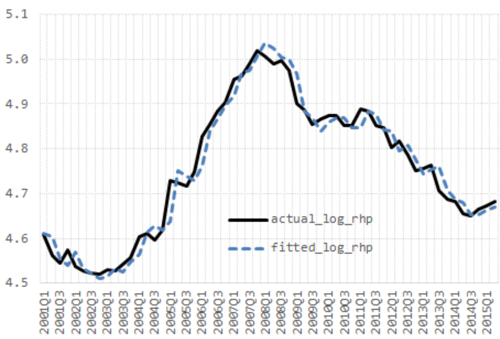
Test assumptions:
- sample (adjusted): 2000Q4 2015Q2
- 59 observations after adjustments
- quadratic deterministic trend

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level

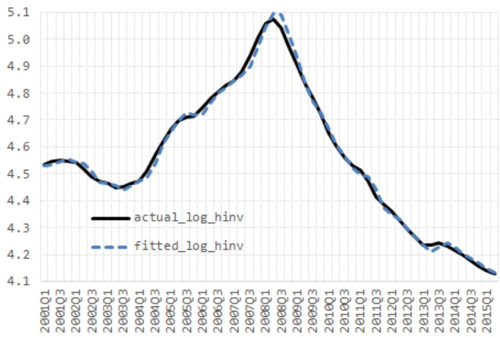
B Model fit and residuals

Figure 4: Model fit

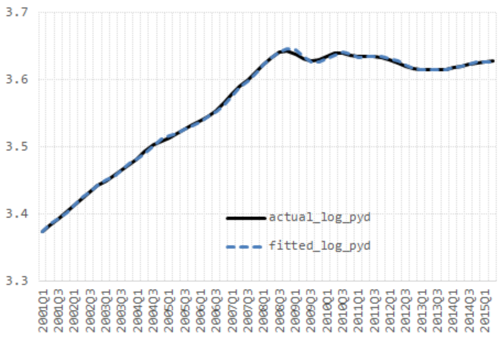
(a) Real house prices fit



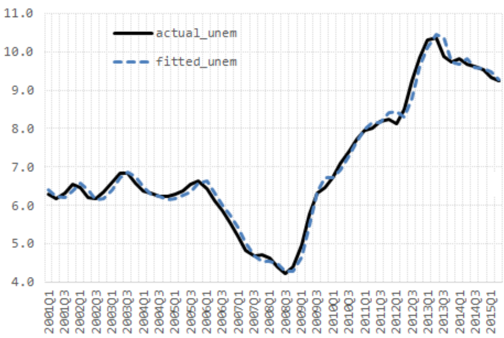
(b) Housing investment fit



(c) Personal disposable income fit



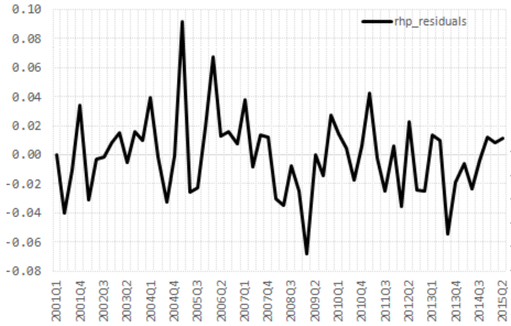
(d) Unemployment fit



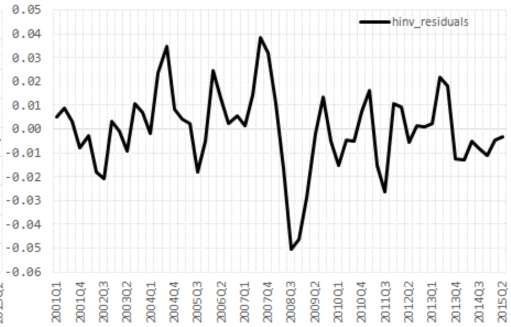
Source: own calculations.

Figure 5: Residuals

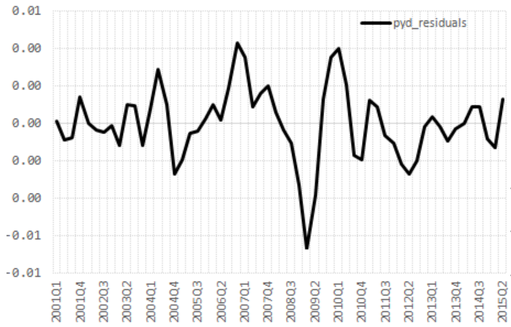
(a) Real house prices residuals



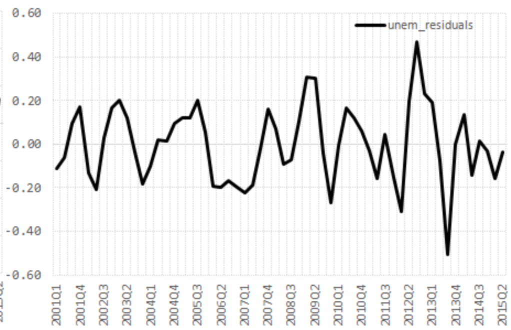
(b) Housing investment residuals



(c) Personal disposable income residuals



(d) Unemployment residuals

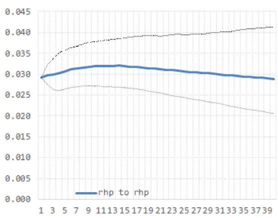


Source: own calculations.

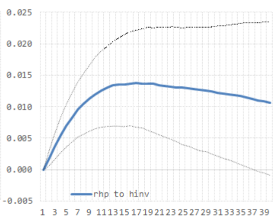
C Model impulse responses

Figure 6: Impulse responses - house prices

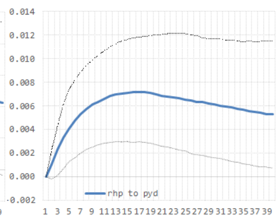
(a) Real house prices shock



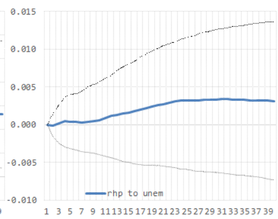
(b) Housing investment shock



(c) Personal disposable income shock



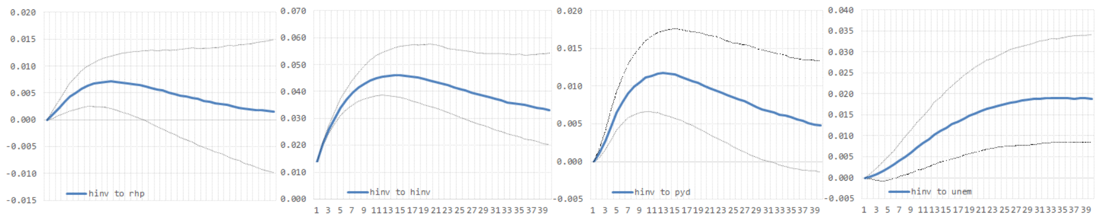
(d) Unemployment shock



Source: own calculations.

Figure 7: Impulse responses - housing investment

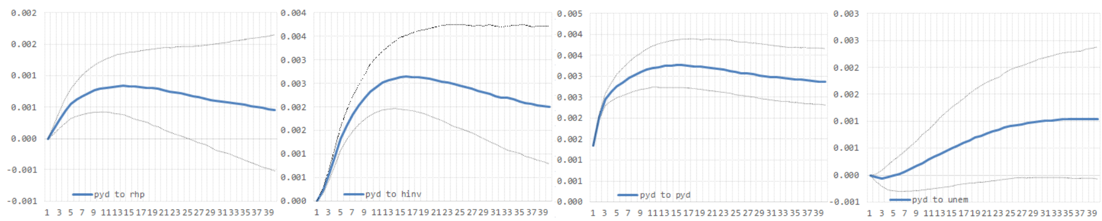
(a) Real house prices shock (b) Housing investment shock (c) Personal disposable income shock (d) Unemployment shock



Source: own calculations.

Figure 8: Impulse responses - personal disposable income

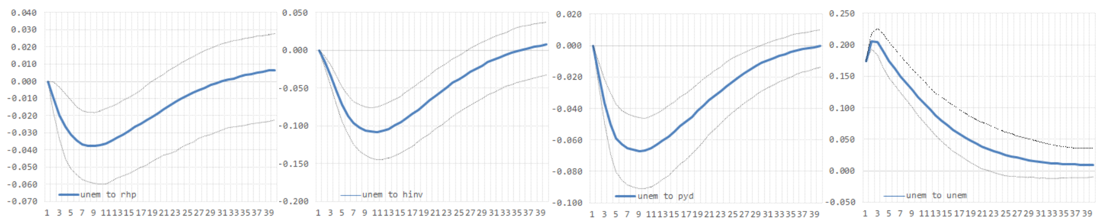
(a) Real house prices shock (b) Housing investment shock (c) Personal disposable income shock (d) Unemployment shock



Source: own calculations.

Figure 9: Impulse responses - unemployment

(a) Real house prices shock (b) Housing investment shock (c) Personal disposable income shock (d) Unemployment shock



Source: own calculations.