On the dynamics of the primary housing market and the forecasting of house prices

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Abstract

This article discusses and explains the dynamics of the primary housing market, focusing on housing supply, demand, price and construction costs dynamics. We focus our attention on the primary housing market, because it can create an excessive supply, which can cause distress to the economy.

Due to multiplier effects, even small changes in fundamental factors, such as a minor changes in the interest rate, result in demand shocks. Positive demand shifts cannot be easily satisfied, as supply is rigid in the short run. This usually makes house prices grow and developers increase their production, which will be delivered to the market with a lag. Housing developers have the marketing tools to heat up the market for a prolonged period of time. Rising prices can lead to further demand increases, because housing is a consumer and an investment good. When demand moves back to its long run level, the economy is left with excessive supply, falling prices and bad mortgages.

We create a simple four-equation model, which is able to replicate the dynamics of the Warsaw primary housing market. Our model replicates historical data in an appropriate way and we apply it to forecast house prices in the next two years on quarterly basis.

Keywords: Housing market cycles; disequilibrium demand and supply forecast

1. Introduction

A dwelling plays an enormous role in the life of every household as a capital good, that generates consumer services and an investment good, which is a source of income for the future (see DiPasquale, 1992, Henderson and Ioannides, 1983 and Łaszek, 2013). The decisions of households that buy housing on the primary market depend on incomes, interest rates and prices, while those of developers who produce it depend on prices and costs.

The housing market is very important because of its social function but also because it can negatively the affect financial stability. The cyclical character is a permanent feature of the housing market and can be explained by the low elasticity of supply. The financial system and consumer behaviour have a pro-cyclical effect on demand. Ciarlone (2012) claims that housing booms in Eastern Europe were mainly caused by regulations and the lack of housing in comparison to basic needs of the households, not just by speculations.

Moreover the market is imperfect, there is a long construction time and market players behave irrational. Another problem is the information asymmetry, which means that during transactions one party is better informed than the other. Problems with reliable and complete information are in many cases a result of brokers' and developers' marketing activities in mass media, so the buyer can see a distorted picture of the market. However, developers face positive and negative consequences of the market intransparency. They can obtain higher returns, selling dwellings to uninformed clients at high prices. However, it is difficult for them to plan future production when signals from the market are misleading.

While demand is analysed in various articles, the supply side is less often studied and models of the market that could be used to make forecasts are not well developed. We can find complex economic models in the literature, where the housing market is taken into account, but it usually plays a minor role. DSGE models need to simplify the housing market and the supply side is usually not explained or it is ad-hoc, included just to close the model. If one wants to model price dynamics, it is necessary to understand the connections between the demand and supply side. We believe that our models describes the reality of the primary housing market better than complex models do and it is useful in the analysis of the impact of changes in income or mortgage rates. Additionally, we explain the influence of regulations on the real estate market.

It is important to stress that we analyze the amount of housing launched on the market and not the whole housing stock. Our rationale is as follows: We believe that in short and medium term changes in production can influence on the adjustment movements. Basing on empirical observation we reckon that in long term housing stock can have partly an impact on housing equilibrium but in a shorter period of time it has a negligible effect. Moreover very important for customers are transaction costs. The decision of selling and buying a flat is carefully considered and is usually made once or twice during a lifetime as every transaction generates additional costs.

The aim of our article is to forecast house prices in a most accurate way. We set up a simple model that bases on our work Augustyniak et al. (2014a). The economy has a direct impact on the housing market, while the effects of the housing market come through the labour market and the banking sector with a certain delay to the economy and might be non-linear. Therefore, we decided to model the housing market only and take the whole economy as given and apply the official NBP NECMOD forecast for the whole economy (see NBP 2014b). Papers that try to incorporate housing in the DSGE model fail to account for accelerator effects and frictions in the housing market, speculative behaviours and finally the time to build. This is understandable, as their aim is to model the whole economy and the inflation. If the models would include a fully developed housing market, they would be too complicated to be solved with state-of-the-art mathematical tools. In this article we discuss and explain the dynamics of the primary housing market with a simple four-equation model of housing supply, demand, price and construction costs. Our model replicates historical data well and we apply it to predict future value of the house prices, demand, supply and costs in the next two years on quarterly basis.

2. Estimation of the housing demand and supply dynamics

We present a micro-founded model of the housing market which bases on the work of Mayer and Sommervolle (2010), Steiner (2010) and Augustyniak et al (2014b)[1]. As in Mayer and Sommerville (2000), we create log-linear models of supply and demand, that describe the number of housing placed and sold on the market. The model is used to forcast the housing market over the next two years.

For the empirical analysis we use quarterly data for the Warsaw primary housing market and we use the moving average over four quarters. The house prices (P_t) origin from the NBP database BaRN. The number of housing units sold and placed on the market (HD_t, HS_t) comes from REAS data. Sekocenbud is the source of the construction costs (PC_t). We use the Central Statistical Office (GUS) data on income in the private sector ($Income_t$) and the mortgage rate ($Intrate_t$) is calculated on NBP

[1] See Mayer and Sommerville (2000) or Steiner (2010).

data. The supply, demand, price, income and construction costs time series are in logarithms. Because the REAS data start only in 2007Q1, we extended the data on housing sold and put on the market with the dynamics of CSO data on completed housing, lagged by 8 quarters. It takes around two years of time between the date at which the pre-sale contract is sold and the moment that the housing unit is completed. The demand, supply and construction costs equations were estimated separately on quarterly data for 2005Q1-2014Q3. Due to limitations in available data, the price equation was estimated for 2007Q1-2014Q3. We did not want to extend the time series for demand and supply with the same dynamics, thus we used only the original data for the price equation. We estimated each equation using the OLS regression, correcting for heteroskedasticity and autocorrelation. The recursive regression test for each regressions showed that the regression coefficients are robust.

The first equation describes the aggregated housing demand (HD_t):

$$HD_t = \alpha 1 + \alpha 2 * P_t + \alpha 3 * D(P_t) + \alpha 4 * Intrate_t + \alpha 5 * Income_t + \epsilon_t \qquad (1)$$

Here *Pt* is the log house price, $D(P_t)$ is the rate of house price growth. The interest rate $(Intrate_t)$ and income in log terms $(Income_t)$ are account for the changing economic situation. The empiric results (see table 1) show that there is a positive relation between aggregated demand and income and negative one in the case of prices and interest rates. As expected, the appreciation has a positive effect on housing demand.

The next step is the estimation of the supply in the primary housing market. Wheaton et al. (2001) and Hendershott et al. (2002) state that housing producers base their decisions on past and information. The housing supply is the number of dwellings put on the market in a given quarter and is estimated with the following equation

$$HS_t = \beta 1 + \beta 2 * D(P_{t-4}) + \beta 3 * D(PC_{t-4}) + \beta 4 * Intrate_{t-4} + \epsilon_t \qquad (2)$$

Here $\beta 1$ is the autonomous production, a particular number of housing units that will be produced regardless of current prices or costs (see Augustyniak et al., 2012). Basing on empirical observation, we include price increases lagged by one year $(D(P_{t-4}))$. Producers of dwellings react directly to price increases and start new constructions, but those dwellings will be delivered to the market in the form of pre-sale contracts one year later. Higher construction costs lagged by one year $D(PC_{t-4})$ and lagged interest rates $D(Intrate_{t-4})$, lower the developers' willingness to begin new projects. The interest rates inform developers about consumers' financial affordability, which determines their ability to buy housing. Higher interest rates cause also higher alternative costs of investments in real estate.

The price adjustment mechanism is estimated in equation 3. The house price dynamics depend mainly on their lagged levels, so $D(P_t)$ depends on its past realizations $D(P_{t-1})$. Moreover, as in Tse, Ho and Ganesan, 1999 prices react with a one quarter lag to the supply and demand mismatch[2] $(HS_{t-1} - HD_{t-1})$. Excessive demand makes prices rise, while they start to fall under excessive supply.

$$D(P_t) = \vartheta 1 + \vartheta 2 * D(P_{t-1}) + \vartheta 3 * (HS_{t-1} - HD_{t-1}) + \epsilon_t \qquad (3)$$

We tested the price adjustment for asymmetric reactions and found that the price increase in response to excessive demand is as strong as the price decrease in response to excessive supply. We would expect prices to decline faster than they rise, which would help developers to decrease the stock of unsold housing and the market move back to its equilibrium. However, developers lower their price expectations slowly, looking forward to find a buyer, that will be willing to purchase the dwelling for the high price. When dwellings are financed with credit, the loan agreement would refrain housing producers from decreasing prices below a certain level. Purchasers could negotiate the price, but they have very little negotiation power and not enough information about the number of unsold housing in a given location. Housing producers are not interested in lowering the price and amidst oversupply they still place new dwellings on the market. To some extent this is the result of projects which are under way and cannot be stopped. We observe this phenomenon, not just in the Polish housing market, but in other housing markets, too.

The construction cost dynamics $D(PC_t)$, which affect the start of new construction are estimated in equation 4. We find that construction costs depend strongly on their past realization $(D(PC_{t-1}))$.

[2] Indeed this is the same as the adjustment of the stock of unsold housing, which evolves as $Stock_t = Stock_{t-1} + HS_t - HD_t$, thus its change $\Delta Stock_t$ equals $HS_t - HD_t$.

Moreover, they grow with house supply increases ($D(HS_{t-1})$), as more input goods are needed and their costs increase.

$$D(\mathrm{PC_t}) = \rho 1 + \rho 2 * \mathrm{D}(\mathrm{PC_{t-1}}) + \rho 3 * \mathrm{D}(\mathrm{HS_{t-1}}) + \epsilon_t \quad (4)$$

Using the four equations described above, we describe the dynamics on the housing market. We observe that constantly low interest rates or increasing incomes lead to a demand boom, which in turn causes price increases and a supply boom. When incomes and nominal housing prices rise at the same pace, relative house prices remain stable, and the housing boom can last for a long time. It can be stopped only by a huge shock (for example the sub-prime crisis in the USA, which made banks to constrain the disbursement of mortgages).

Table 1. Regression results of the determinants of aggregate supply, demand, prices and production costs.

	LHD_t	**LHS_t**	**$D(LP_t)$**	**$D(LPC_t)$**
LP_t	**-0.894** ***			
	(0.189)			
$D(LP_t)$	**7.714** ***			
	(1.465)			
$D(LP_{t-1})$			**0.835****	
			0.089	
$D(LP_{t-4})$		**9.922** ***		
		(1.966)		
$Intrate_t$	**-13.301** **			
	(6.065)			
$Intrate_{t-4}$		**-12.770** *		
		(6.670)		
$LIncome_t$	**1.164** ***			
	(0.339)			
$D(LPC_{t-1})$				**0.977** ***
				(0.103)
$D(LPC_{t-4})$		**-14.377** ***		
		(2.033)		
$D(LHS_{t-1})$				**0.022** ***
				(0.007)
$LHS_{t-1} - LHD_{t-1}$			**-0.022** *	
			(0.012)	
C	**6.925** ***	**8.857** ***	0.001	0.0003
	(2.365)	(0.382)	(0.003)	(0.001)
Adj. R^2	0.82	0.71	0.69	0.89

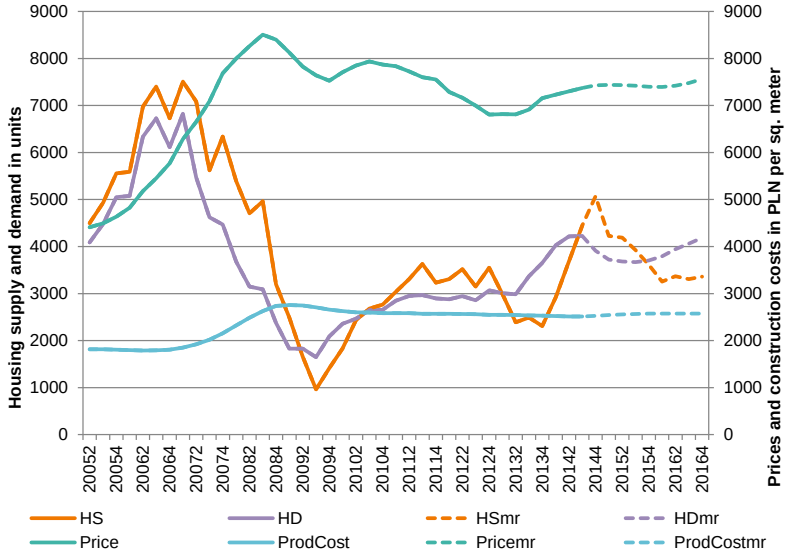
*Newey-West standard errors (HAC) in brackets, ***, **, * significant at the: 1%, 5% or 10%.*

3. Forecasting of house prices

To forecast house prices we use our housing cycle model, which uses four endogenous variables (demand, supply, costs and prices) and two exogenous variables (mortgage rates and income). The historical data used in the analysis comes from the NBP database BaRN, REAS, GUS, Sekocenbud as described in part 3. The equations are recursive, which allows us to calculate the values for the next period and again for the next period, etc. For the forecast of the two exogenous variables we use the

interest rate and economic growth projection stemming from the NECMOD model (see Budnik et al., 2009), published in the Inflation Report of the NBP (2014b). The income is assumed to grow at the same pace as GDP growth. Interest rates are always set constant over the forecast period, thus also the mortgage rate is constant. Our housing forecast covers the next 2 years on quarterly basis until the end of 2016. We would like to make our forecast as long as possible, but our intuition and also common knowledge on forecasting tells us that it is not reasonable to forecast for longer periods than two years. The forecast results were transformed from logs to normal numbers and are presented in Figure 9. The demand and supply measured in housing units is on the left axis, while prices and construction costs per sq. meter in PLN are presented on the right axis.

Figure 9. Forecast of housing demand, supply, house prices and construction costs



The observed values are presented as solid lines and the dotted lines show us the predictions. We see that prices should first decline and then increase slightly, while costs should be relatively stable in the future. Supply should rise for a short period and then decrease sharply. Demand should fall in the next quarters and increase gradually since the middle of 2015. We should point out that housing policy has a significant effect on demand and supply. Also potential changes in interest rates will change the demand and supply of housing, but this is beyond the scope of this paper. Our forecast should be understood only as an academic analysis and an indicator that tells in which direction the housing market will evolve.

4. Conclusions

Our analysis allows us to determine the main drivers of housing demand and supply in the primary housing market in Warsaw. We first study the dynamics of the housing market and find that demand is mainly driven by rises in income and interest rate declines, und unlike expected, the appreciation of housing boosts its demand. The supply rises if increases in prices are higher than increases of construction costs.

We build a four equation model, which replicates the real dynamics of the housing market well. This model allows us to forecast the behavior of the housing market for the next two years on quarterly basis. As it can be easily replicated, we believe that our model is useful for policy makers, central banks and regulators to test how changes in mortgage rates or income affect prices, demand and supply in the primary housing market.

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