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DEVELOPMENT OF PROPERTY PRICES IN POLAND

KSZTAŁTOWANIE SIĘ CEN NIERUCHOMOŚCI W POLSCE

Streszczenie

Przedstawione badanie oparte jest o prosty model podażowo-popytowy. Został on skonstruowany dla polskiego rynku nieruchomości. Podstawowym celem była analiza cen nieruchomości mieszkaniowych w Polsce w latach 2006–2013. Jako potencjalne determinanty podaży i popytu uwzględniono koszty budowy i przeciętny poziom wynagrodzeń. Dodatkowo rozważono zmodyfikowany model, uwzględniający stopę bezrobocia. Oszacowane funkcje podaży i popytu wykorzystano do wyjaśnienia dynamiki kształtowania się podaży i popytu. Skonstruowany model okazał się nie być statystycznie istotny. Jednak oszacowanie samego równania dla cen nieruchomości okazało się być statystycznie istotne. W artykule przedyskutowano możliwe przyczyny braku statystycznej istotności modelu jako całości.

Słowa kluczowe: ceny nieruchomości, podaż, Polska, popyt, rynek nieruchomości
Numer klasyfikacji JEL: R31, C32

Introduction

The property prices in Poland have increased very rapidly during last years. For example, from the end of 2006 till 2013 the average property price on primary market (evaluated for 7 greatest cities in Poland) has increased by 26%. But if 10 cities are considered, this average is even as high as 65%. The highest dynamics was observed in 2007. The prices increased even by 50% then. However since 2008 a slight decline in prices is observed[1].

Such a sudden increase is usually explained as a result of social factors and evolution of the whole economic system. Most econometric models conclude that various macroeconomic factors are statistically not important as property prices

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[1] NBP, *House Prices Database*, *www.nbp.pl/publikacje/rynek_nieruchomosci/ceny_mieszkan.xls, 2013.*

determinants. Therefore as probably the most influential factors changes in living standards, needs to have greater housing space, increase in GDP *per capita*, etc.[2] are seen. Some researchers also indicate that there may be some signs of a speculative bubble[3].

The relationship of housing supply and property prices has been studied and has been found statistically significant for developed markets[4]. One of the possible attempts towards modelling property market is considering linear or log-linear supply and demand functions. Then assuming that the partial equilibrium is fulfilled, which gives an algebraic formula for price and quantity on the market. If the particular functions are properly constructed, the well fitted model is obtained usually. The factors that are usually implemented into supply and demand functions are unemployment rate, mortgage rate, salaries, number of citizens, etc[5].

For example, a successful model has been constructed for China's urban areas, even if only construction costs and gross salary have been taken into account as determinants of housing supply and property prices[6].

If the adjustment of property prices can be explained by such a simple supply and demand model, then it may be concluded that there is no house price bubble and the increase in prices is solely the result of supply and demand forces. It seems therefore interesting to do a similar research for Polish market.

Literature review

Supply-demand models are important in economic theory, because they provide a useful tool for measuring elasticities. By knowing the elasticity one can predict the impact of change in the base variable on the demand for the considered good. Moreover, assuming the market is a competitive one, the price and quantity

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[2] K. Żelazowski, *Determinanty zmian cen nieruchomości na przykładzie rynku łódzkiego*, Zeszyty Naukowe – Uniwersytet Ekonomiczny w Poznaniu 192, 2011, s. 179–189; K. Żelazowski, *Regionalne zróżnicowanie cen i ich determinant na rynku mieszkaniowym w Polsce*, Studia i Materiały Towarzystwa Naukowego Nieruchomości 19, 2011, s. 98–106; R. Trojanek, *Determinanty wahań cen na rynku mieszkaniowym*, Studia i Materiały Towarzystwa Naukowego Nieruchomości 16, 2008, s. 85–97.

[3] K. Żelazowski, *Zjawisko bańki cenowej w kontekście zmian a polskim rynku mieszkaniowym*, Studia i Materiały Towarzystwa Naukowego Nieruchomości 15, 2007, s. 139–150.

[4] T. Conefrey, K. Whelan, Supply, *Demand and Prices in the US Housing Market*, Central Bank of Ireland Research Paper 08/RT/12, 2012, p. 1–49.

[5] J. Ashworth , S.C. Parker, *Modelling Regional House Prices in the UK*, Scottish Journal of Political Economy 44, 1997, p. 225–246; G. Meen, *The Time-Series Behavior of House Prices: A Transatlantic Divide*, Journal of Housing Economics 11, 2001, p. 1–23; Z. Qingyu, *Regional unemployment and house price determination*, MPRA Papers 41785, 2010, p. 1–22.

[6] G.C. Chow, L. Niu, *Demand and Supply for Residential Housing in Urban China*, [in:] (ed.) J. Man, *China's Housing Reform and Outcomes*, Lincoln Institute Press, Cambridge MA, 2010.

becomes the result of the interplay between forces of the supply and the demand. As a result, curves of the supply and the demand can be used in modelling the market cycle[7].

For example, Balckley[8] found that the new housing supply in U.S. is price elastic. However, elasticities can differ widely between different regions of the country[9]. It is also known that the increase in wages results in higher housing demand. It has been observed that a homeowner with high income usually prefers to move than to improve the current unit[10].

On the other hand, Augustyniak et al. stated that the real property market is always in disequilibrium[11]. The arguments are based on supply-demand model, indeed. Demand shock can be the result of speculation or changes in fundamentals. Negative demand shock can result in decrease in investments, etc. Cycles are almost the core part of any real estate market. This is due to its particular characteristic features.

Supply-demand models in more sophisticated forms are also useful. For example, DiPasquale and Wheaton analysed the market for real estate space and the market of real estate assets[12]. They have found that these markets are affected by macroeconomic determinants, financial markets, etc.

The detailed description of the advantages of using supply-demand models for the analysis of the property market is presented, for example, in the book of Lai and Yu[13]. Further, particular examples are given, for example, by Tse, Ho and Ganesan[14] and by Barot[15].

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[7] J.M. Quigley, *Real Estate Prices and Economic Cycles,* International Real Estate Review 1, 1999, pp. 1–20.

[8] D.M. Balckley, *The Long-Run Elasticity of New Housing Supply in the United States*, Journal of Real Estate Finance and Economics 18, 1999, p. 25–42.

[9] R.K. Green, S. Malpezzi, S.K. Mayo, *Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources*, The American Economic Review 95, 2005, p. 334–339.

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[11] H. Augustyniak, J. Łaszek, K. Olszewski, J. Waszczuk, *Cycles on the housing and commercial real estate market, risks and the need for appropriate and prudent valuation*, MPRA Paper No. 41070, 2012.

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[14] R.Y.C. Tse, C.W. Ho, S. Ganesan, *Matching housing supply and demand: an empirical study of Hong Kong's market*, Construction Management and Economics 17, 1999, pp. 625–633.

[15] B. Barot, *Empirical Studies in Consumption, House Prices and the Accuracy of European Growth and Inflation Forecasts*, Working Paper of The National Institute of Economic Research in Stockholm 98, 2006.

Data and methodology

Unlike many developed markets there is no commonly used house price index in Poland. Not so long ago even house prices databases were not easy to obtain. Therefore it was hard not only to collect data, but also to compare different databases and researches based on them. In this research a commonly available database from Polish central bank is used[16]. The property prices are considered to be quarterly data from primary market between the last quarter of 2006 and the second quarter of 2013. Prices for 7 cities and for 10 cities were considered. The 7 cities considered in the sample are: Gdańsk, Gdynia, Kraków, Łódź, Poznań, Warszawa and Wrocław. The 10 cities are: Białystok, Bydgoszcz, Katowice, Kielce, Lublin, Olsztyn, Opole, Rzeszów, Szczecin and Zielona Góra.

Average monthly gross salary, total new housing space available on the market, number of residents in urban areas, working population and costs of construction were taken from Central Statistical Office[17].

It is assumed that supply is a linear function of costs of construction, c, and property prices, p, i.e. (1) $q_t = a_0 + a_1 \cdot c_t + a_2 \cdot p_t + \varepsilon_t$. The demand is a linear function of income *per capita*, w, and property prices, i.e. (2) $q_t = b_0 + b_1 \cdot w_t + b_2 \cdot p_t + \varepsilon_t$. The time is indexed by t. a_0, a_1, a_2, b_0, b_1, b_2 are unknown coefficients that should be estimated.

First of all, notice that it is reasonable to consider only new housing space (just built) because property prices are taken from primary market. Secondly, the quantity, q, can be measured as new housing space per resident of urban area or per working population. The first case is reasonable because property prices are taken only for urban areas. The second possibility is reasonable, because working population may be the most significant demand force. Therefore income *per capita* may be assumed to be the average monthly gross salary per residents of urban areas or per working population. All stated possibilities were implemented into the analysis.

If the supply equals the demand, then equations (1) and (2) give as the outcome the equations for the quantity (3) $q_t = d_0 + d_1 \cdot w_t + d_2 \cdot c_t + \varepsilon_t$ and for the price (4) $p_t = e_0 + e_1 \cdot w_t + e_2 \cdot c_t + \varepsilon_t$. As previously, d_0, d_1, d_2, e_0, e_1, e_2 are unknown coefficients, which have to be estimated. Because p and q are response variables and w and c are explanatory variables in the first step equations (3) and (4) should be estimated by linear regression. Afterword, p, determined from equation (4) can be substituted into (1) and (2).

Calculations were done in GRETL package.

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[16] NBP, *op. cit*.

[17] GUS, http://www.stat.gov.pl/gus/index_ENG_HTML.htm, 2013.

First results

The first estimations were done when prices were taken from 7 cities.

Estimation of equation (3) was unsuccessful. Both mentioned ways of denominating total house space (by urban residents quantity and working population quantity) lead to statistically insignificant models. High, 10%, p-value was assumed. Moreover, R-squared was no more than 6%.

Slightly better R-squared, equal to 10%, was obtained if logarithms of variables were considered. However the model was still statistically insignificant. Therefore the quantity on Polish property market cannot be modelled solely by consumers' incomes and costs of construction.

Similar results were obtained for equation (4). None of the considered models was found statistically significant. However, at 10% p-value, explanatory variable of costs of constructions is statistically significant – both when incomes are considered per residents and per working population. Moreover R-squared is enormously higher, 53%, than in the case of previously analysed function of quantity. Nevertheless, such results are still unsatisfactory and lead to the conclusion that also price changes cannot be explained solely by changes in costs of construction and incomes.

Log-linear version of (4) is also statistically not significant. However, R-squared is slightly better. It is 55%.

The analysis was repeated for prices taken from 10 cities. It is important to notice that regression models were better then. But still not significant.

Finally, it can be concluded that the proposed model is statistically not significant.

Comparison with other models and some modifications

It is interesting to notice that similar models with regional data (from whole voivodeships) for independent variables and with property prices taken only from capitals of voivodeships also occurred to be statistically not significant. In other words no successful model was constructed when property prices were taken as dependent variable and unemployment rate, wages and working population aged 25–44 as independent variables[18].

On the other hand, if a model was constructed only for capitals of voivodeships, then very well fitted models were obtained. For example, fixed effect model with new housing space, unemployment rate, costs of construction and wages was

[18] K. Drachal, *Analiza determinant cen nieruchomości w Polsce*, Świat Nieruchomości 75, 2011, s. 30–33.

characterised by almost 92% R-squared coefficient. OLS models for particular cities were characterised by R-squared coefficient between 30% and 83%[19].

Therefore it is reasonable to add unemployment rate (for particular voivodeships) to equations (3) and (4) and estimate such a modified models. The data for unemployment rate were taken from Central Statistical Office[20]. The population size was not included explicitly in the modified model, because wages are considered as gross salary divided by working population or total population in urban areas.

Unfortunately, for 7 cities, the models for property prices are still statistically not significant. Even if robust standard errors are assumed (HAC). Surprisingly, if 10 cities are considered models are significant (with no need of robust errors). Each variable is significant for t-Student test at 5% p-value.

Table 1: OLS estimates, dependent variable: property prices for 10 cities

	Model 1	**Model 2**	**Model 3**
const	4289** (402.6)	4267** (404.0)	4078** (393.8)
costs of construction	0.2171** (0.1026)	0.2251** (0.1010)	0.2097** (0.09454)
unemployment rate	–226.7** (24.05)	–224.8** (23.90)	–227.9** (22.68)
wages	0.7614** (0.1693)		
wages / residents of urban areas		1.756e+07** (3.900e+06)	
wages / working population			1.442e+07** (2.857e+06)
R2	0.8998	0.8999	0.9104

*Standard errors in parentheses, * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level*

Source: own elaboration.

It is worth to notice that all estimated coefficients are consistent with a theory. Increase in costs of construction and in wages result in the increase of property prices. The increase in the costs of construction decreases profits of developer, therefore price should increase. Increase in wages allow consumers to afford more

[19] K. Drachal, *Property prices and regional labor markets in Poland*, Singidunum Journal of Applied Sciences, in press.

[20] GUS, *op. cit*.

expensive properties. On the other hand, increase in unemployment should result in smaller chances in obtaining housing loan, decrease a will of an average consumer to apply for long term credit, etc.

It is also interesting that including in equation (3) unemployment rate as independent variable and estimating OLS model with robust standard errors (HAC estimation) gives statistically significant models. Unfortunately, R-squared is very small for these models. Please notice, that original models with equation (3) unchanged were statistically not significant even with robust standard errors – in both cases: with original data and after logarithmic transformations.

Table 2: OLS estimates, dependent variable: new housing space available

	Model 1	**Model 2**	**Model 3**
const	4.143e+06** (1.220e+06)	4.091e+06** (1.211e+06)	3.981e+06** (1.243e+06)
costs of construction	–443.5** (183.6)	–442.3** (179.5)	–383.5* (192.2)
unemployment rate	–2.023e+05** (8.412e+04)	–2.005e+05** (8.391e+04)	–1.971e+05** (8.485e+04)
wages	1153** (308.4)		
wages / residents of urban areas		2.712e+010** (6.969e+09)	
wages / working population			1.914e+010** (5.894e+09)
R2	0.2243	0.2287	0.2099

*Standard errors in parentheses, * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level*

Source: own elaboration.

In all models (presented in Table 2) estimated coefficients are consistent with a theory.

Estimation of supply and demand

Coefficients presented in Table 1 and Table 2 are estimations of modified equations (3) and (4). The property price may be computed (by models from Table 1) and the obtained values can be treated as independent variables in modified (i.e. including unemployment rate) equations (1) and (2). Such a two stage estimation allows to approximate the supply and demand curves.

Please notice also, that modified equation (1) does not have to contain unemployment rate as independent variable in order to produce together with modified equation (2) modified equations (3) and (4) both containing unemployment rate. However, such models occur to be statistically not significant.

Therefore unemployment rate was added to equations (1) and (2). Unfortunately, models of the supply curve, given by modified equation (1) occurred to be statistically not significant. On the other hand, estimation of the demand curve was acceptable (all coefficients statistically significant). But robust standard errors had to be used and the obtained R-squared were very small.

Table 3: OLS estimates, dependent variable: demand of new housing space available

	Model 1	Model 2	Model 3
const	1.290e+07** (4.208e+06)	1.248e+07** (4.016e+06)	1.144e+07** (4.260e+06)
unemployment rate	–6.653e+05** (2.426e+05)	–6.424e+05** (2.313e+05)	–6.138e+05** (2.589e+05)
wages	2708** (904.8)		
prices estimated by Model 1 from Table 1	–2043** (845.5)		
wages / residents of urban areas		6.164e+010** (1.986e+010)	
prices estimated by Model 2 from Table 1		–1965** (797.4)	
wages / working population			4.551e+010** (1.823e+010)
prices estimated by Model 3 from Table 1			–1828* (916.6)
R2	0.2243	0.2287	0.2099

*Standard errors in parentheses, * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level*

Source: own elaboration.

All estimated coefficients have signs consistent with a theory.

Summary and conclusions

The main conclusion is that the development of property prices for the analysed period cannot be explained by market equilibrium of supply and demand, if the supply is assumed to depend on costs of construction and property price

(and optionally: unemployment rate) and the demand – on wages, property price and unemployment rate. It may be concluded that market is not in a classical partial equilibrium, other variable have to be considered (for example housing loans rates, etc.), equilibrium is obtained in partial adjustment process or there was a price bubble. Further researches with more variables are reasonable to clarify the situation.

Estimating the supply curve was unsuccessful. Although, estimating new housing space available in the first stage was successful, the very small R-squared is a sign that there are other important determinants of the housing space. It may also be the fact that building process takes relatively long time, etc.

Despite the fact that the prices in the first stage were estimated with quite high R-squared, in the second stage the obtained R-squared is very small. It confirms that development of property prices cannot be modelled by simple partial equilibrium model in the analysed case. However, the research confirmed that wages, unemployment rate and costs of construction significantly affect property prices on primary market.

Nevertheless, if there is no partial equilibrium on the market, then the proposed model is not applicable, even after further modifications. On the other hand, it may also be true that there is a great demand for properties, because of social factors, but developers are not able to satisfy the market needs. The social and economic changes may be faster than the production cycle.

The second important conclusion is that a simple linear model can predict average property price in primary market (for 10 cities), if independent variables are: costs of construction, unemployment rate and wages. In the context of previously mentioned researches[21] and their results there is an evidence that the indicators measuring the development of the whole country are consistent with the ones for big cities. In other words, the country develops as big cities and vice versa. Whereas rural areas are not consistent with these models. It is a sing of great differences between rural and urban areas. Big cities become drastically different "islands" throughout the whole country. Therefore it might be expected that the development of property prices in big cities is affected mainly by opportunities that they give their citizens: small possibility of being unemployed and relatively high wages in comparison to the surrounding area.

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Abstract

This research is based on a simple supply-demand model constructed for Polish property market. The first aim is to analyse the average property price in Poland between 2006 and 2013. Costs of construction and average gross salary are taken as potential determinants of supply and demand. The modified version with an unemployment rate is also considered. Simple supply and demand functions are constructed in order to explain property prices dynamics by the forces of supply and

demand solely. The model fails to be statistically significant. Nevertheless, the equation for property prices obtained in the first stage is statistically significant and well fitted. The probable sources of failure of the model as a whole are discussed.

Keywords: demand, supply, Poland, property market, property prices
JEL Classification: R31, C32