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Management Theory and Studies for Rural Business and Infrastructure Development
eISSN 2345-0355. 2025. Vol. 47. No. 2: 270-283
Article DOI: https://doi.org/10.15544/mts.2025.21

APARTMENT PRICES ON THE REAL ESTATE MARKET IN POLAND

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Received 30 04 2025; Accepted 10 05 2025

Abstract
The purpose of the research was to analyse the primary and secondary real estate markets in Poland during the period from 2006 to the second quarter of 2024. The real estate market is currently influenced by many previously unpredictable factors, particularly those related to the war in Ukraine. Using statistical tools, the study focused on transaction prices of properties in both the secondary markets. Projections of price changes were prepared, along with an analysis of price convergence between cities and the rate of return on real estate rental.
The forecasts indicate that transaction prices in both the secondary markets will continue to rise in future periods. Statistical data provided by the National Bank of Poland were used, and the parameters of the linear function were estimated using the classical least squares method. Calculations were performed using the Gretl software. The unconditional convergence model was applied to assess convergence.
The study was conducted in 17 cities in Poland, covering the period from the third quarter of 2006 to the second quarter of 2024. It was demonstrated that, from quarter to quarter, property prices in the primary market increase on average by 40 PLN per square meter, and in the secondary market by 30 PLN per square meter. Forecast parameters indicate that, as a result of time progression, the transaction price of flats in the primary market increases on average by 4.35 PLN per square meter each quarter.

Keywords: *forecast of price changes, real estate market, transaction price of properties, rate of return from rental properties, convergence.*

JEL Codes: *A11, C5, O18.*

Introduction

The residential real estate market in Poland is not yet considered a mature market. The market is identified with the overall exchange relations, which include revealing the intent of buying, selling, renting, or leasing by entities (Uhruska, 2012). The real estate market is characterized in various ways, including: as actions and interactions of people involved in purchasing (selling, trading, using, and developing) real estate and as an economic activity including nationwide real estate transactions (Kucharska-Stasiak, 2020). Real estate possesses several distinctive features which can be distinguished as: physical, economic, institutional-legal (Kacała, 2013 s.87), (Mach, 2014), (Trojanek, 2009).

These features determine the uniqueness of real estate, as they often coincide with each other. Physical attributes include: physical complexity, immobility, durability – characterized by the indestructibility of the ground and the long lifespan of buildings (Kucharska-Stasiak, 2020), (Kałakowski, 2003, s.13), (Ludwiczak, 2017). The set of concepts and theories of real estate market research were considered by Nobel laureate Stiglitz in his work, 'Information and the Change in the Paradigm in Economics' (Stiglitz, 2002). The beliefs he expressed highlighted the important role of classical supply and demand forces, but emphasized that academic research in this area needs to include an analysis of problems arising from information asymmetry and the role of the state in dealing with these problems (Bełej, 2016). The real estate market performs three important economic-social functions, namely exchange, information, and correcting spatial utilization (Kuryj-Wysocka & Osiecka, 2014), (Wisniewski,

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2007), (Kucharska-Stasiak, 2020), (Bzieźnicka & Wiśniewski, 2014), (Polczyk i Konowalczuk, 2018).

For investors, owners or lenders, the informational function allows entities to determine the value of real estate based on the knowledge of prices of other properties. Often, a forced appraisal by a valuer is necessary to accurately determine the value of a given property.

The real estate market is imperfect, because the equilibrium price formation mechanism does not work as it should. This is due to the fixed location, limited supply and long, capital-consuming investment cycle. In this situation, the supply changes abruptly. Moreover, the acts of buying and selling can be characterized as irrational, meaning the criterion for decision-making is not just the price. This is due to the lack of two identical properties and the fact that the decision to acquire property is in most cases a decision with long-term effects. This makes the valuation of real estate difficult. Residential properties are evaluated very subjectively, so their value is not proportional to the price. This article fills the research gap and provides a new approach to the analysis and assessment of the residential real estate market.

Econometric models are increasingly used in estimating transaction prices on the secondary markets, which help explain the mechanism of changes occurring in the area under study. Known in the literature are models describing the supply and demand for apartments eg. the Denis DiPasquale and William Wheaton model, which was described in 1992 (DiPasquale & Wheaton, 1996). A model with more variables was proposed by Kosuke Aoki, James Proudman and Gertjan Vlieghe in 2004 (Proudman, Vlieghe, & Aoki, 2004), also by Patrick Bajari, Phoebe Chan, Dirk Krueger and Daniel Miller in 2013 (Bajari, Chan, Krueger, & Miller, 2013). Michał Rubaszek and Dobromił Serwa in 2014 published the first models of demand and supply for apartments in Poland (Rubaszek & Serwa, 2014), (Czerniak i Rubaszek, 2016), (Łaszek, Augustyniak, Olszewski, & Wasz, 2014). In the described research area convergence analysis is employed. This tool is mainly used in the study of income equalization in countries and regions and levels of economic development as a result of long-term growth rates of economies (Lis, 2013). Development convergence is defined as convergence of development and can be applied to evaluate transaction price equalization (Batóg, 2010).

Residential properties are most often chosen from among properties purchased for investment purposes. Some of them are purchased for their rent, while the other part consists of properties which are used by the owner after acquisition. There is still a high demand for properties in the market, additionally, prices are consistently rising. In some cities in Poland there is also a noticeable lack of a sufficient number of apartments for rent, hence the need for statistical research of the real estate market.

The purpose of this work is to diagnose the primary and secondary real estate markets in Poland during the period from 2006 to the second quarter of 2024. The focus was on four areas of research shaping the transactional prices of real estate in the primary and secondary market, forecasting changes in these prices, the expected return from renting properties, and the convergence of transactional prices of real estate.

The study considers 17 cities, namely: Białystok, Bydgoszcz, Gdańsk, Gdynia, Katowice, Kielce, Kraków, Lublin, Łódź, Olsztyn, Opole, Poznań, Rzeszów, Szczecin, Warszawa, Wrocław, and Zielona Góra. The research covers the period from the third quarter of 2006 to the second quarter of 2024.

In studies on the formation of transactional prices in the primary and secondary real estate markets in Poland, four research hypotheses were formulated:

- (H1) There is a differentiation in prices within the housing real estate market.
- (H2) No signs of a slowdown in transactional price growth have been observed in either the primary or secondary market.
- (H3) A long-term alignment of transactional prices between the primary and secondary market has been observed.
- (H4) No long-term alignment has been observed in the expected yield from property rental in the housing market.

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Methods of the research

The study used statistical data published by the National Bank of Poland. Available NBP data were presented in the form of time series for subsequent quarters since 2006.

In the second step, the parameters of the linear function (trend function) were estimated using the classical least squares method (CLS). The calculations were performed using Gretl software.

In the third area of research, tools primarily used in examining growth convergence of countries and regions in the real estate market were employed. The β-type convergence measurement was proposed for application. The unconditional convergence model (Strahl, 2011), (Żelazowski, 2018), (Gnat, 2014), of the form of formula (1) was utilized.

The β-type convergence is most often measured using the model of unconditional convergence of the form (Strahl, 2011), (Żelazowski, 2018), (Gnat, 2014):

$$\frac{1}{T}(\ln y_{i0+T} - \ln y_{i0}) = \alpha - \left[\frac{\left(1-e^{-\beta T}\right)}{T}\right]\ln(y_{i0}) + \varepsilon_{it}, \quad (1)$$

where:

ln y_{i0+T} and ln yi0 – the category under study of region i-th (i = 1, …, N) in the final and initial year,

T – the number of years for which the growth rate is calculated (t = 1, …, T),

β – a parameter defining the speed of convergence,

ε_{it} – the random component.

The γ convergence coefficient is employed for the analysis, determined by the formula:

$$\gamma t = \frac{var(r_{it}+r_{i0})}{var(2\times r_{i0})}, \quad (2)$$

γ_t – the convergence rate for period t,

var – variance,

$r_{i\,t}$ – the rank of the i-th object in the period t,

r_{0t} – the rank of the i-th object in period 0,

i = 1, …, n,

n – the number of objects studied.

Results

The first hypothesis posits that transaction prices of apartments in the primary market in cities in Poland are more heavily differentiated than in the secondary market (Figure 1). This presupposition stems from the assumption that new apartments are being constructed in regions and cities where economic development is stronger.

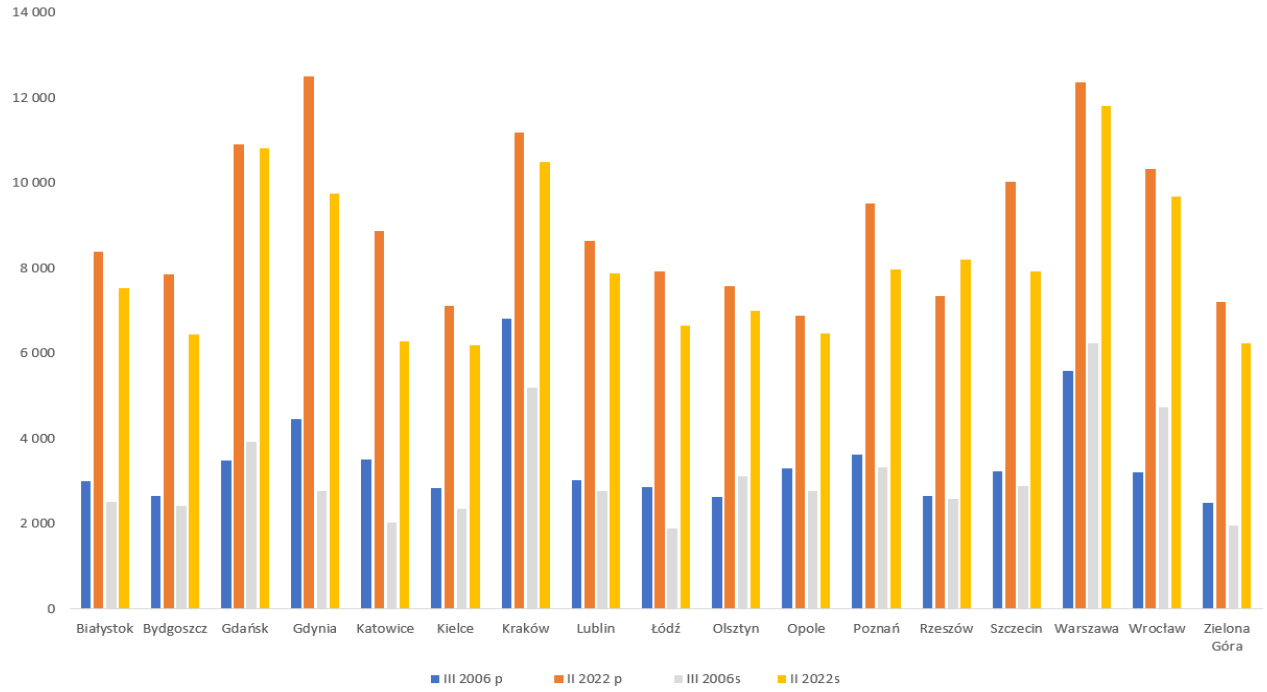

Figure 1. Transactional Prices in the Primary and Secondary Markets in the periods III 2006 and II 2024

**Source: own elaboration based on the Real Estate Market-Quarterly information of the National Bank of Poland https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

Correspondingly, a variance equality test was run for prices in the cities on both markets. The hypotheses assumed are:

H_0: - Differentiation of apartment prices on the primary market is insignificantly different from prices on the secondary market,

H_1: - Differentiation of apartment prices on the primary market is significantly higher than prices on the secondary market.

The verifying statistic presents as follows: F = 3375661,8/3224903,2 = 1,047. At the significance level of 0.05, there is no basis for rejecting the null hypotheses, the differentiation of apartment prices on the primary market is insignificantly different from prices on the secondary market.

Subsequently, the estimated econometric models of shape of transactional property prices in the primary and secondary market were verified using the least squares method – the most commonly used method of fitting a linear model to data, e.g. in correlation or regression analysis.

The first model, which presents the shape of prices in the primary market was estimated. In the first step, t-tests were used to evaluate the significance of the impact of each independent variable *Xj* on the dependent variable *Z*. The usefulness of the models was evaluated using F-Snedecor's test. The degree of model fitting was assessed using the adjusted coefficient of determination R^2.

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Table 1. Evaluations of the Structural Parameters of the Model of Shaping Transaction Prices in the Primary and Secondary Market (p-value <0,0001)

Variable*	Primary Market			Secondary Market		
	Coefficient	Standard Error	t-value	Coefficient	Standard Error	t-value
const	2704,28	85,1788	31,75	2464,61	68,4635	36,00
t	39,5961	1,05768	37,44	30,4776	1,04347	29,21
Białystok	948,087	107,914	8,786	954,144	98,9216	9,645
Bydgoszcz	1103,23	101,256	10,90	569,231	91,8542	6,197
Gdańsk	2722,27	157,199	17,32	2745,63	154,107	17,82
Gdynia	2849,02	136,152	20,93	2402,60	140,004	17,16
Katowice	1461,72	120,142	12,17	382,122	89,5177	4,269
Kielce	840,985	103,374	8,135	568,887	93,2209	6,103
Kraków	3179,51	152,531	20,84	3134,66	116,423	26,92
Lublin	1168,54	98,1111	11,91	1494,04	97,8850	15,26
Łódź	1159,59	111,263	10,42	515,090	100,105	5,145
Olsztyn	953,575	95,0328	10,03	1120,83	94,8031	11,82
Opole	609,177	105,874	5,754	726,217	77,2019	9,407
Poznań	2559,18	117,087	21,86	2161,77	100,614	21,49
Rzeszów	791,288	88,8978	8,901	1340,58	91,5719	14,64
Szczecin	1388,61	124,916	11,12	1038,91	104,400	9,951
Warszawa	4088,93	136,242	30,01	4897,63	145,414	33,68
Wrocław	2292,45	115,967	19,77	2557,77	119,177	21,46

* - the evaluation for Zielona Góra is identical to const., for the rest we apply the sum of const. and the individual assessment.
**Source: Own elaboration in the Gretl program based on the Real Estate Market - Quarterly Information from NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

The assessment of the partial regression coefficient standing at variable t is equal to 39,5961 and the error of this assessment is 1,05768. The assessment of a partial regression coefficient standing at variable t is equal to 39.59, and the error of this assessment is 1,057. Quarter by quarter, primary market property prices rise by an average of 39.59 PLN (per m2). The spatial impact resulting from the locational placement of real estate in Warsaw predestinates it to determine the price at a level that is 4088.93 PLN higher than the initial one for the entire group of cities (determined by the constans = 2704.28).

Table 2. Indicators of evaluating the formation model of transaction prices on the primary market

Residual sum of squares	1041,716	Standard error of residuals	1,008613
Determination coef. R-square	0,765919	Adjusted R-square	0,762033
F (16, 975)	197,0913	P-value for F test	<0,001
Logarithm of likelihood	−1478,392	Akaike Information Criterion	2992,784
Bayesian Information Criterion (Schwarz's Criterion)	3081,864	Hannan-Quinn Information Criterion	3026,573

**Source: Own elaboration in the Gretl program based on the Real Estate Market - Quarterly Information from NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.*

In the estimated model, the determination coefficient takes a value of 0.76, meaning that 76% of the variability of the explained variable has been accounted for by the equation. The model's fit to the data is very good and statistically significant ($F(16,975) = 197.09$; $p < 0.001$). The standard error of residuals, which is the square root of residual variance, describes the behavior of the explained variable. In the case of Model 1, it is 1,0086, indicating that the estimated values of prices on the primary market differ on average by ± 1,0086 units from the actual ones.

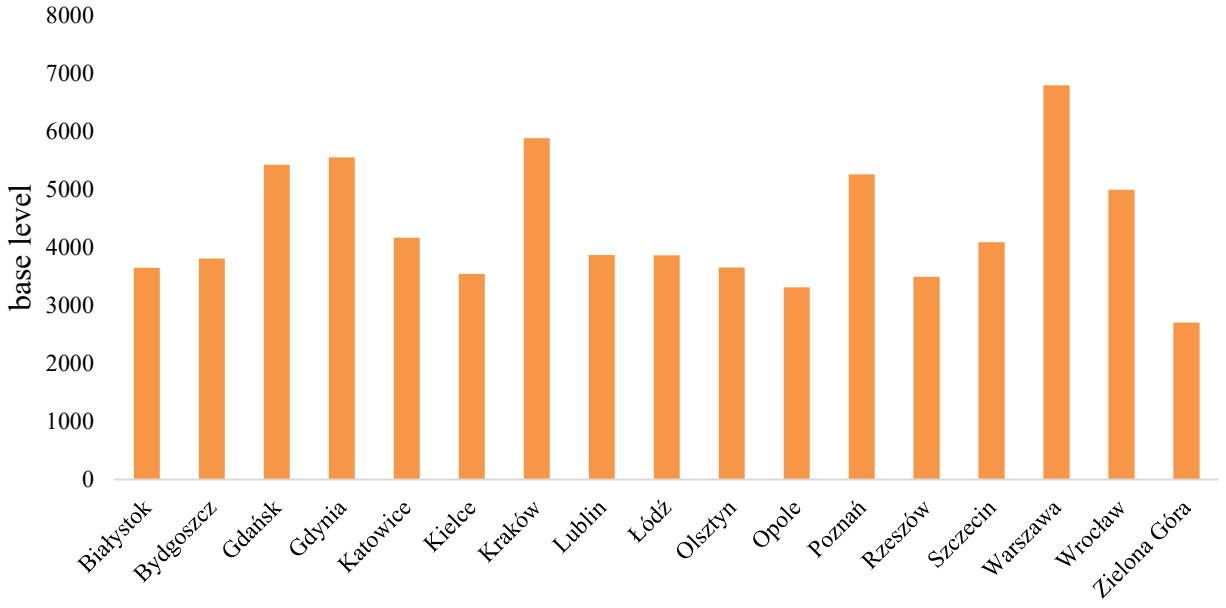

Figure 2. Values of decomposed free terms for the transaction prices model in the primary real estate market

**Source: Own elaboration in the Gretl program based on the Real Estate Market - Quarterly Information from NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

Subsequently, the second model was estimated (table 3), illustrating the formation of prices on the secondary market.

The evaluation of the partial regression coefficient standing at variable t is equal to 30.4776, and the error of this evaluation is 1.04347. Quarter by quarter, secondary market property prices increase by an average of 30 PLN (per m^2). The spatial impact here is decidedly stronger. For example, the location of a property in Warsaw predisposes it to set a price at a level that is 4897.63 PLN higher than the starting point for the entire group of cities (determined by constans = 2464.61).

Table 3. Indices of the transaction prices formation model evaluation on the secondary market

Residual sum of squares	1053,010	Standard error of residuals	1,008176
Determination coef. R-square	0,767826	Corrected R- square Adjusted R-squared	0,764016
F (17, 1036)	201,5395	p-value for F test	<0,001
Logarithm of likelihood	−1495,066	Akaike's Information Criterion	3026,132
Bayesian Information Criterion (Schwarz's Criterion)	3115,419	Hannan-Quinn Information Criterion	3059,981

**Source: Own elaboration in the Gretl program based on the Real Estate Market - Quarterly Information from the NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

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In the estimated model (Table 3), the determination coefficient assumes a value of 0.77, indicating that 77% of the variability of the dependent variable has been explained using the equation. The model's fit to the data is very good and statistically significant ($F(17,1036) = 201.54$; $p < 0.001$). The standard error of residuals, or the square root of residual variance, describes the behavior of the dependent variable. In the case of Model 1, it equals 1,0082, indicating that the estimated values of prices in the secondary market differ on average by ± 1,0082 units from the actual ones.

Between the values illustrating a certain base price level in both markets, we observe a statistically significant positive correlation ($r_{xy} = 0.932$).

In attempt to evaluate the results of a short-term real estate price forecast on the housing market, a second research hypothesis was set.

Considering the strong influence of the time trend, an attempt was made to create a trend model enriched with an autoregression factor. Due to having quarterly data, delays of up to 4 periods were proposed in the next steps. The use of autoregressive factors weakened the influence of spatial impacts in the model.

The model with the adjustment $R^2 = 0.962$ was obtained.

Table 4. Evaluation of structural parameters of the transaction prices forecast model on the primary market

Variable*	Coefficient	Standard Error	t-value	p-value
const	−55,2330	38,0598	−1,451	0,1470
t	4,35352	0,560847	7,762	<0,0001
p_1	0,883834	0,0281862	31,36	<0,0001
p_2	0,0754635	0,0334611	2,255	0,0243
p_3	0,0926534	0,0322328	2,875	0,0041
p_4	−0,0564146	0,0244734	−2,305	0,0214

**Source: Own elaboration in the Gretl program based on the Real Estate Market - Quarterly Information from the NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

Interpreting the obtained parameters (Table 4), we can state that as a result of the time factor's impact, the transaction price of flats per square meter in the primary market increases on average by PLN 4.35 per quarter. The largest share - 88.3% - in shaping this price is the price from the previous period, 7.5% from the earlier one, 9.3% from the third quarter backwards, and 5.6% is the price from the corresponding quarter of the previous year as a correction in minus.

Table 5 presents the indicators for evaluating the model of shaping the forecast of transaction prices on the primary market.

Table 5. Indicators of the model evaluation for shaping the forecast of transaction prices on the primary market

Arithmetic mean of dependent variable	5708,011	Standard deviation of dependent variable	1379,497
Residual sum of squares	70784963	Standard error of residuals	268,7556
Determination coef. R-square	0,962237	Adjusted R-squared	0,962045
F (5, 980)	4994,306	p-value for F test	0,000000

Logarithm of likelihood	−6911,553	Akaike's Information Criterion	13835,11
Logarithm of likelihood	13864,47	Hannan-Quinn Information Criterion	13846,27
Residual autocorrelation - rho1	−0,102137	Durbin-Watson Statistic	1,984640

**Source: Own elaboration based on the Real Estate Market - Quarterly Information from the NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

In the estimated model (Table 6), the determination coefficient takes the value of 0.96, which shows that the equation was able to explain 96% of the variability of the dependent variable. Despite some underestimations observed in the analyzed model, the clear fit to empirical data encourages to attempt using it for at least short-term forecasting.

The advantage of the used model is the consideration of seasonality somewhat hidden in delayed variables corresponding to particular quarters. Unfortunately, the economic situation - largely unpredictable - led to more dynamic changes (increases) in real estate market prices. The forecasting attempts made in the first period - ex-post - are somewhat underestimated, but each subsequent one already takes into account - through delayed variables - the change in the market situation.

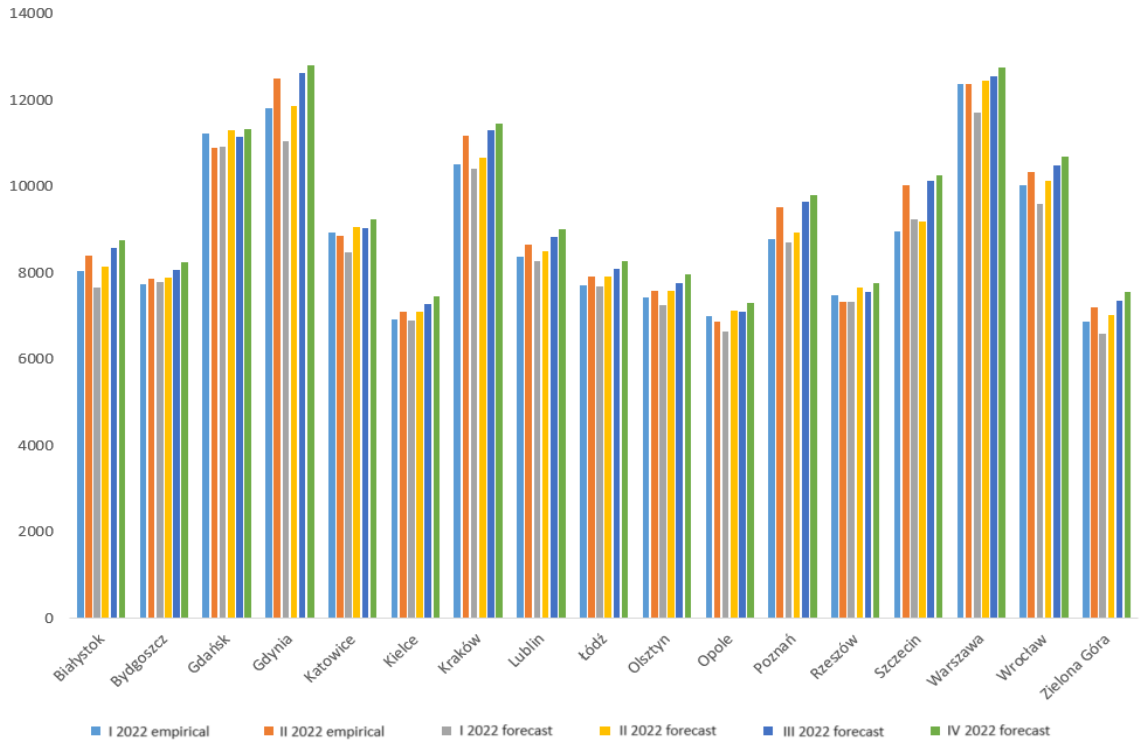

Figure 3. Forecasted and empirical values of transaction prices on the primary market for the year 2024 in a quarterly perspective

**Source: Own elaboration based on the Real Estate Market - Quarterly Information from the NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

The forecasted values differ on average from -6.5% to +3.0% in the first quarter of 2022 and from 8.4% to 4.2% in the second quarter of 2024. These differences seem to be small. The conducted forecasts indicate that transaction prices on the primary market will increase in subsequent periods, most strongly in Zielona Góra (by 17.5%) and slowest in Gdańsk – by 5.0% annually. The forecasted average price change in the studied cities is 11.6%.

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eISSN 2345-0355. 2025. Vol. 47. No. 2: 270-283
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Table 6. Indicators for the evaluation of the transaction prices forecast model formation on the secondary market

Arithmetic mean of dependent variable	5064,845	Standard deviation of dependent variable	1493,849
Residual sum of squares	31085662	Standard error of residuals	178,0105
Determination coef. R-square	0,985858	Adjusted R-square	0,985800
F (5, 980)	17096,72	P-value for F test	0,000000
Logarithm of likelihood	−6505,864	Akaike Information Criterion	13021,73
Logarithm of likelihood	13046,20	Hannan-Quinn Criterion	13031,03
Residual autocorrelation - rho1	−0,145310	Durbin-Watson Statistic	2,164876

**Source: Own elaboration based on the Real Estate Market - Quarterly Information from the NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

In the estimated model (Table 6), the determination coefficient assumes a value of 0.985, indicating that the equation was able to explain 99% of the variability of the dependent variable.

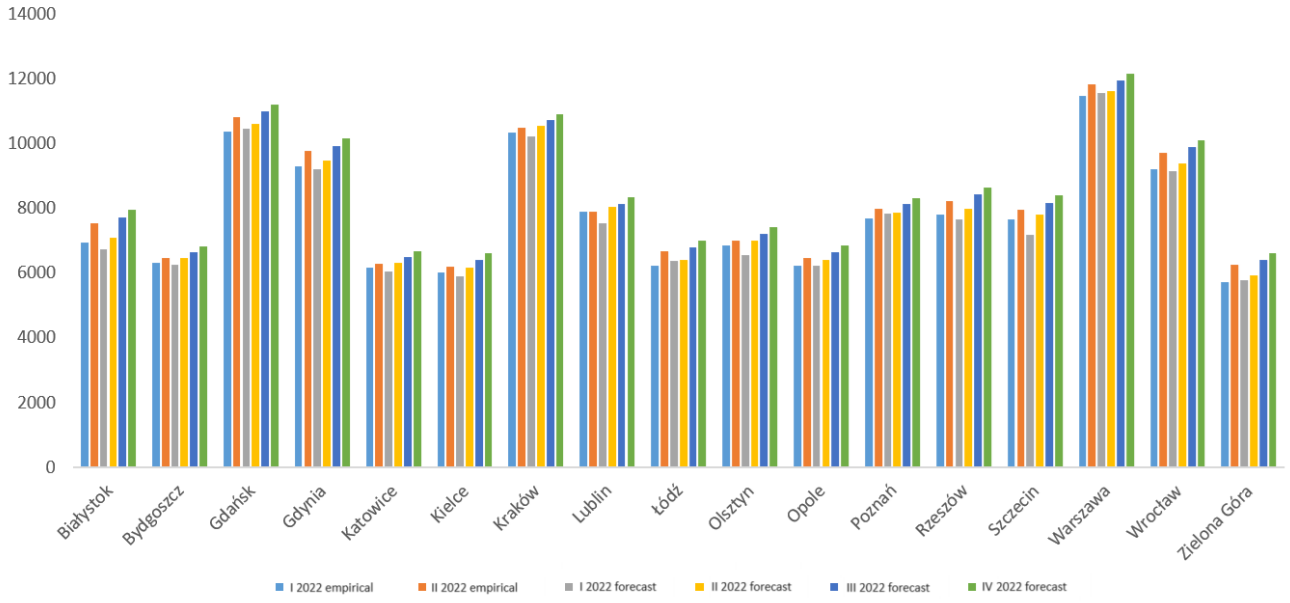

Figure 4. Forecasted and empirical transaction prices in the secondary market for 2025 in a quarterly approach

**Source: Own elaboration based on Real Estate Market - Quarterly Information NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

The forecasts conducted (Figure 4) indicate that the transaction prices in the secondary market will increase in subsequent periods, most strongly in Bialystok by 21.3%, and slowest in Warsaw - by 7.5% per annum. The forecasted average price change in the studied cities is 13.6%.

In the next step, the third research hypothesis was put forward.

For the verification of the third hypothesis, an unconditional convergence model (Strahl, 2011), (Żelazowski, 2018), (Gnat, 2014) was used in the further stage of research, with the usage of formula (1).

Based on formula (1), a study of the convergence process in the primary housing market was conducted in Microsoft Excel in view of economic, demographic, and political changes caused by the war in Ukraine. The table showed the stages of calculating the convergence rate in the primary housing market.

It was verified that the coefficient θ is statistically significant taking a negative value -3.79. However, the rate of convergence is determined by the β parameter value. The obtained results clearly indicate the occurrence of convergence - statistically significant for the primary market (β = 0.0089).

The parameter (β = 0.0089) indicates that at a slow pace, the prices of apartments on the primary market are approaching a state of long-term equilibrium, and it defines the percent of the distance from the established price level overcome within one period.

In the next step, the rate of price convergence in the secondary housing market was calculated for the investigated period from the third quarter of 2006 to the second quarter of 2024.

The coefficient θ for the secondary market was calculated. The value of this coefficient is -5.60. The obtained results clearly indicate the occurrence of convergence - statistically significant for the secondary market. The calculated value of β = 0.0096 indicates that the price differentiation in the secondary market is decreasing between the cities examined.

It was proposed to use convergence measurement to verify the hypothesis about the unification of unit prices in primary and secondary residential markets. The research method of β-convergence rate applied allowed us to accept the hypothesis that, despite its diversity, the housing market in cities in Poland is becoming similar in the researched period in terms of transaction price level.

In an attempt to assess the aligning of the housing market in Poland's cities, concerning the expected return on rental property, the fourth research hypothesis was put forward.

It is assumed, despite high demand for rental apartments due to the influx of refugees from Ukraine, that there will be no long-term equalization of the return on rental property in the housing market. This means that despite the increase in house prices in the primary and secondary market, there will be no equalization of the return on rental property in the housing market.

For the verification of the fourth hypothesis, a convergence model (Strahl, 2011), (Żelazowski, 2018), (Gnat, 2014) was used in the further stage of the study, using formula (2).

A study of gamma convergence analysis was conducted in Microsoft Excel. The chance for higher profit, gaining an investment advantage, is the analysis of the convergence of property rental income - estimation of convergence.

The study covered the period from the IV quarter of 2014 to the first quarter of 2024. The cities under consideration in the study were Białystok, Bydgoszcz, Gdańsk, Gdynia, Katowice, Kraków, Lublin, Łódź, Olsztyn, Poznań, Rzeszów, Szczecin, Warsaw, Wrocław.

Figure 5 presents the expected return on rental as a percentage of property acquisition by cash in selected cities (%).

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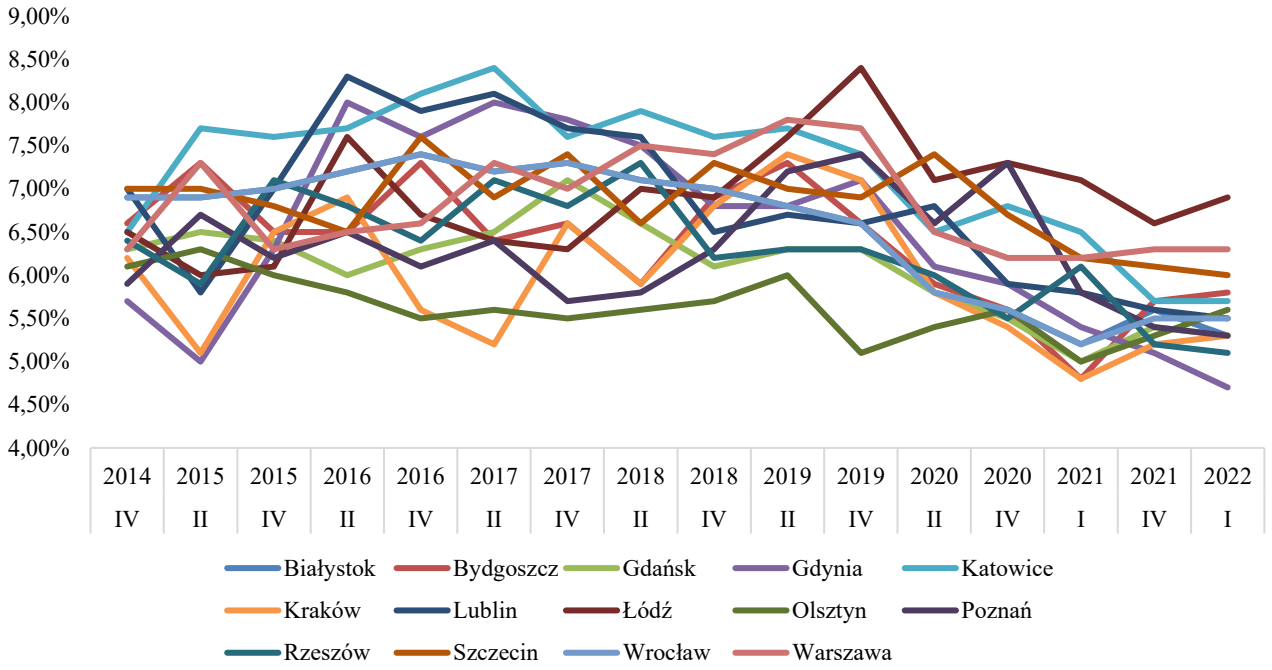

Figure 5. Estimated capitalization rate (the expected return on rent expressed as a percentage of the property purchase fully in cash in selected cities (%))

**Source: Own elaboration based on Real Estate Market - Quarterly Information NBP https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

Analyzing Figure 5, it was observed that there was a weakening of the capitalization level. There was a drop in the capitalization level, which is calculated as the ratio of annual rental income to the price per square meter of the apartment A study of the process of capitalization rate convergence on the housing market in 2014-2024 was conducted in Microsoft Excel. The data presented in percentages were first converted to ranks (Dittmann, 2014), and then an attempt was made to estimate the level of convergence.

Table 7. Calculation values for the pace of capitalization rate convergence on the housing market in selected cities

City	IV 2014 (%)	I 2024 (%)	Place IV 2014	Place I 2024	(LN (IV 2014) -LN (I 2024)) /64	LN IV 2014	LN I 2024
Białystok	6,90	5,30	3	9	0,069	1,099	2,197
Bydgoszcz	6,60	5,80	5	4	- 0,014	1,609	1,386
Gdańsk	6,30	5,30	9	9	0,000	2,197	2,197
Gdynia	5,70	4,70	14	14	0,000	2,639	2,639
Katowice	6,50	5,70	6	5	- 0,011	1,792	1,609
Kraków	6,20	5,30	11	9	- 0,013	2,398	2,197
Lublin	7,00	5,50	1	7	0,122	0,000	1,946
Łódź	6,50	6,90	6	1	- 0,112	1,792	0,000
Olsztyn	6,10	5,60	12	6	- 0,043	2,485	1,792
Opole	5,90	5,30	13	9	- 0,023	2,565	2,197

Poznań	6,40	5,10	8	13	0,030	2,079	2,565
Rzeszów	7,00	6,00	1	3	0,069	0,000	1,099
Szczecin	6,90	5,50	3	7	0,053	1,099	1,946
Wrocław	6,30	6,30	9	2	- 0,094	2,197	0,693
Warszawa	6,90	5,30	3	9	0,069	1,099	2,197

**Source: A report based on 'Real Estate Market – Quarterly Information NBP' https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html.*

To verify the hypothesis (H4), cities were organized based on the capitalization rate in the real estate market in selected cities, and ranks were assigned in Table 7.

At the significance level of $\alpha = 0.05$ of convergence coefficient γ and statistics $\chi 2 = 22{,}362$, it was not found that gamma convergence (γ) occurred during the observed period.

Summarising

The work involved an analysis and assessment of the real estate market intended for residential purposes. In discussing the real estate turnover and primarily the level of transaction prices, it was observed that during the surveyed period, prices were increasing in the primary and secondary market. The average price per 1m2 in the primary market from 2018 to the second quarter of 2024 was higher than the average price per 1m2 in the secondary market. The exception was Warsaw, where the average transaction price per 1m2 in the secondary market was higher than the average transaction price per 1m2 in the primary market. The specifics of the investment, profitability, and risk were discussed in the second chapter.

Discussing the real estate turnover and primarily the level of transaction prices, it was noticed that during the observed period, prices were increasing in the primary and the secondary market. In this study, an econometric model was estimated for the formation of transaction prices of properties in the primary and secondary market using the method of least squares. It was shown that quarter after quarter, property prices in the primary market increased by an average of 39.59 PLN (per 1 m2). The spatial impact resulting from locating a property in Warsaw predisposes it to determine a price at a level of 4088.93 PLN higher than the base for the entire group of cities (determined by constant = 2704.28). Quarter after quarter, property prices in the secondary market increase by an average of 30 PLN (per 1m2). The spatial influence here is significantly stronger. For example, locating a property in Warsaw predisposes it to determine a price at a level of 4897.63 PLN higher than the base for the entire group of cities (determined by constant = 2464.61).

Hypothesis one (H1): There is a differentiation in prices in the residential real estate market – this was confirmed.

Interpreting the obtained forecast parameters, it can be said that, as a result of the influence of the time factor from quarter to quarter, the transactional price of flats per square meter on the primary market increases on average by 4,35 PLN (per 1 m2). The greatest share - 88.3% - is made up of the price from the previous period, 7.5% from an even earlier period, 9.3% from the third quarter back and 5.6% of the price from the analogous quarter one year earlier constitutes a correction in minus. The forecasts performed indicate that the transaction prices on the primary market in subsequent periods will be increasing, most strongly in Zielona Góra (by 17.5%) and the slowest in Gdańsk - by 5.0% per annum. The projected average price change in the cities studied is 11.6%.

The projected sizes differentially average from -6.5% to +3.0% in the first quarter of 2024 and from 8.4% to 4.2% in the second quarter of 2024.

Figure 6 shows a visualization of empirical and theoretical transactional prices on the secondary market (from the model) for consecutive cities in the years 2006 - 2025.

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Management Theory and Studies for Rural Business and Infrastructure Development
eISSN 2345-0355. 2025. Vol. 47. No. 2: 270-283
Article DOI: https://doi.org/10.15544/mts.2025.21

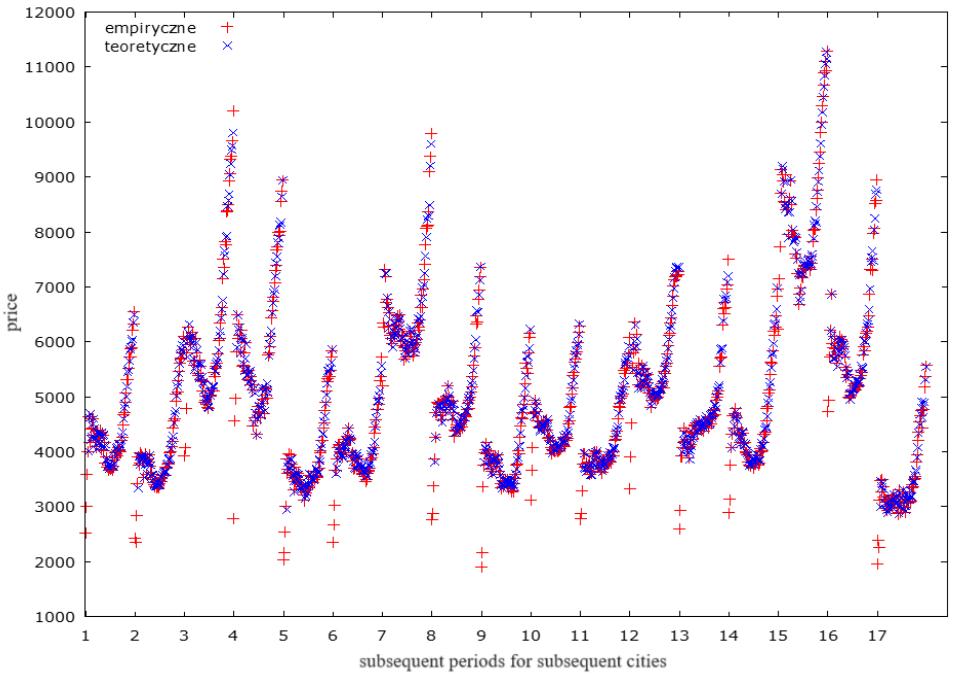

Figure 6. Empirical and theoretical transaction prices on the secondary market (from the model) for consecutive cities in the years 2006 - 2025

**Source: own elaboration based on the Real Estate Market - Quarterly Information of NBP. https://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/index2.html*

Conclusions

1) The conducted forecasts indicate that the transaction prices on the secondary market in subsequent periods will be rising, most strongly in Białystok (by 21.3%) and the slowest in Warsaw – by 7.5% per annum. The projected average price change in the studied cities is 13.6%. Since the data until the end of 2021 was introduced to estimate the forecast, we can check the differences in projected sizes. Differences were observed in the first quarter of 2022, which ranged from - 6.3% to +2.5%.

2) Whereas differences in the second quarter of 2014 were from 6.1% to 1.7% in the second quarter of 2024. These differences seem to be small, smaller than in the primary market, given the fact that we are dealing with a finished product turnover less susceptible to the influence, for example, of changes in building materials prices.

The forecasts indicate that transaction prices on both the primary and secondary market will increase in subsequent periods.

3) The third aspect is the analysis and assessment of the level of convergence - checking if transaction prices in cities in Poland are becoming similar despite their economic, demographic differences. The obtained results indicate that the coefficient θ for the primary and secondary market is -3.79 and -5.60, respectively, there is convergence - statistically significant in both cases for the primary market ($\beta = 0.0089$) and for the secondary ($\beta = 0.0096$).

4) The fourth aspect is the analysis and assessment of the process of capitalization rate convergence on the housing market in 2014-2024 and forecasting to 2025. The obtained results indicate, at the assumed level of significance $\alpha = 0.05$ of the convergence coefficients γ and the statistics $\chi 2 = 22.362$, that no gamma convergence (γ) was found in the examined period.

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