

DETERMINANTS OF THE REAL ESTATE MANAGEMENT MARKET IN EUROPE: PANEL REGRESSION MODEL (2015-2025)

ДЕТЕРМІНАНТИ РИНКУ УПРАВЛІННЯ НЕРУХОМІСТЮ В ЄВРОПІ: ПАНЕЛЬНА РЕГРЕСІЙНА МОДЕЛЬ (2015-2025)

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Abstract. *The purpose of the study is to identify the determinants of the property management market in Europe using Germany, France, Italy and Poland as case studies and to construct a panel regression model covering the period 2015-2025. To this end, the works of domestic and foreign researchers were reviewed and examples of the practical use of real estate market determinants when building the DOLS panel model were analyzed. The method of applying regression analysis and its limitations are described, among which the assumption of linearity of the relationship between independent and dependent variables is highlighted, which is not always relevant for the real estate market. Using Microsoft Excel, a panel regression model was built and its results were interpreted. During the work, it was proven that the created model is adequate and reproduces the data well. It was found that the model has high explanatory power, but requires larger amounts of data to reduce the forecast error. The ANOVA results once again confirmed the adequacy of the model and the existence of a relationship between variables. The interpretation of the variables made it possible to find that the interest rate factor does not have a confirmed impact on the real estate price index within the framework of this model. The results of the study can be used by economists, analysts and independent experts in the field of real estate management to calculate the effect of urbanization and changes in GDP per capita in the context of their impact on the EU real estate price index. The prospects for further research are to expand the model by integrating technological factors into it, such as the EU real estate management market digitalization index. In addition, the constructed model can be modernized or modified to compare the degree of influence of real estate market determinants of individual EU states on the real estate price index for citizens of these states.*

Key words: *real estate, European real estate market, real estate market determinants, management services, real estate price index econometric methods, panel regression model.*

Анотація. *Метою дослідження є визначення детермінант ринку управління нерухомістю в Європі на прикладі Німеччини, Франції, Італії та Польщі та побудова панельної регресійної моделі за період 2015-2025 рр. З цієї метою було розглянуто праці*

вітчизняних та іноземних дослідників й проаналізовано приклади практичного використання детермінант ринку нерухомості під час побудови панельної моделі DOLS. Описано спосіб застосування регресійного аналізу та його обмеження, серед яких виділено припущення про лінійність зв'язку між незалежними та залежними змінними, що не завжди актуально для ринку нерухомості. За допомогою додатку Excel було побудовано модель панельної регресії та інтерпретовано її результати. В ході роботи було доведено, що створена модель є адекватною та добре відтворює дані. Виявлено що модель має високу пояснювальну здатність, але вимагає більших обсягів даних для зменшення похибки прогнозування. Результати дисперсійного аналізу ANOVA ще раз підтвердили адекватність моделі та існування зв'язку між змінними. Інтерпретація змінних дозволила виявити, що фактор відсоткової ставки не має підтвердженого впливу на індекс цін на нерухомість в рамках цієї моделі.

Результати дослідження можуть використовуватися економістами, аналітиками та незалежними експертами у сфері управління нерухомістю для підрахунку ефекту урбанізації та зміни показників ВВП на душу населення в контексті їх впливу на індекс цін на нерухомість ЄС. Перспективи наступних досліджень полягають в розширенні моделі шляхом інтеграції до неї технологічних факторів, таких як індекс диджиталізації ринку управління нерухомістю ЄС. Крім того, побудована модель може бути модернізована або видозмінена для порівняння міри впливу детермінант ринку нерухомості окремих держав ЄС на індекс цін на нерухомість для громадян цих держав.

Ключові слова: Нерухомість, європейський ринок нерухомості, детермінанти ринку нерухомості, управлінські послуги, індекс цін на нерухомість, економетричні методи, панельна регресійна модель.

Introduction. The property management market plays a key role in the global economy, driving innovation and improving efficiency whilst maximising resources across various sectors of the economy. Statistics show that the size of the property management market has grown over the last two years from USD 16.79 billion in 2025 to USD 18.14 billion in 2026, at a compound annual growth rate (CAGR) of 8.1% (*The Business Research Company, 2026*). During this period, growth can be attributed to an increase in urban property development, the early adoption of digital property management tools, a surge in demand for outsourced property services, and the expansion of the rental housing market.

The global trend of growth in the property market is also continuing in Europe. Around 1.6 million businesses were active in the EU property sector in 2022, which is 4.1% more than in 2021. In addition, the EU real estate sector generated added value of EUR 275.1 billion in 2022, which is 3.3% more than in 2021 (*Eurostat, 2025*). Investment activity in the property sector remains concentrated in major European cities such as London, Paris and Munich (*PwC and the Urban Land Institute, 2025*). Property in smaller cities is also attracting investor interest, highlighting a growing trend towards the implementation of specialised investment strategies in some of the EU's most dynamic property markets.

It should be noted that in order to forecast the future of the EU property management market, it is necessary not only to be aware of the key trends influencing its current state, but also to identify the factors affecting it. The significance of these determinants of the EU property management market is considered as data for the application of econometric methods, one of which is the panel regression model. The relevance of constructing such a model for the period 2015-2025 is determined by the fact that during this period there have been many changes in other sectors of the economy, which have radically altered the principles and rules by which the property market operates. The choice of this decade for constructing the panel regression model is based on the fact that most of the determinants that influenced the property market in 2015-2025 will continue to influence it in the coming years. In this study, the property management market is analysed using Germany, France, Italy and Poland as case studies. These countries were selected because Germany, France and Italy are among the largest economies in the European Union, whilst Poland is experiencing rapid growth in both its property market and economy. These countries are characterised by varying levels of

urbanisation and GDP per capita, which allows for the heterogeneity of development among EU member states to be accounted for in the construction of the panel regression model.

The purpose of the study is to identify the determinants of the property management market in Europe, using Germany, France, Italy and Poland as case studies, and to construct a panel regression model covering the period 2015-2025.

Literature review. The issue of identifying the determinants of the property management market in Europe and assessing its current state has been examined by both Ukrainian and international researchers. The most relevant academic articles on the subject of property management in Europe, selected from the period 2020-2026, will be analysed below. These works were identified using the Google and Google Scholar search engines.

In Zakrevskyy's (2024) article, the EU taxonomy is described as one of the key expert determinants of property management. Zhyruk (2025) identified the overall investment attractiveness of the EU property management sector as a determinant dependent on key macroeconomic indicators of eurozone countries. I. Hanchenko (2023), in her study of trends in the development of the European property market, also highlighted the investment attractiveness of the EU property management sector as one of the determinants of its prosperity. Furthermore, in her view, the EU property market is increasingly influenced by environmental, social and governance (ESG) principles, the spread of which has resulted from the adoption of sustainable development policies in property management practice. Vysochyn (2025) examined compliance with ESG principles as a determinant of the development of the retail property market. In the academic work by Suray et al. (2025), digitalisation is described as one of the determinants of the development of the property market and its management.

Kramer, Nagl, Stang and Schafers (2023) investigated the determinants of residential property values based on data from 81,166 residential properties in Germany's seven largest cities. Cunha and Lobao (2021) analysed the determinants of property prices across the EU as a whole, the 28 EU countries, Portugal and its 25 regions. The results of their paper showed that gross domestic product (GDP) and interest rates are statistically significant determinants of property prices in the EU. Morri et al. (2021) investigated the determinants influencing the performance of European real estate funds during the period 2001-2014. They demonstrated that there is a negative relationship between the returns of real estate funds and redemption fees, performance fees and management fees (PwC, & Urban Land Institute, 2025).

The analysis of the articles reviewed has made it clear that the topic of identifying the determinants of the property management market in Europe is of great interest to researchers. It should be noted, however, that these researchers identify and analyse the determinants of the property management market through the prism of different perspectives on property and within various management contexts. This prompted the author of this article to conduct an independent analysis of the state of the property management market in Europe and to identify the determinants of its development.

Main results of the research. Shiller, winner of the 2013 Nobel Prize, identified the cost of housing construction, population growth trends and interest rates as key economic determinants of the functioning of the property market. He noted that changes in these factors are unable to halt the rise in house prices (*Shiller, 2015*). In contrast, other researchers and property market experts have identified a positive correlation between inflation and housing prices (*Marinkovic et al., 2024*). This highlights the potential of property as an effective hedge against inflation. Considering the European property management market in terms of its efficiency, the determinants influencing it should be recognised as management experience, managerial factors and human capital indicators (*Ricciotti et al., 2022*).

In addition to the statements of leading economists and the views of other researchers on the issue of identifying the determinants of the European property market, it is necessary to consider which determinants were previously identified for the construction of real econometric models. The determinants influencing EU property prices during the construction of the panel model were identified as GDP growth, unemployment, interest rates, construction volume and credit limits (*Aliman & Popa, 2025*). Another example of selecting determinants for use in the application of

econometric methods is the use of the DOLS panel model, where GDP per capita, interest rates, lending and institutional development were chosen as factors influencing housing prices in the real estate market in Central and Eastern Europe (Egert & Mihaljek 2007). Thus, following an analysis of examples of the selection of determinants for the application of econometric methods, the author proposed the use of variables reflecting the economic (GDP per capita) and financial (interest rate) aspects of the EU property market and demand for it (urbanisation).

Regression analysis is used to investigate the relationship between independent and dependent variables and to assess the direction of this relationship. However, it has several limitations. In assessing the impact of individual determinants on the property market, it allows only for the identification of correlations between variables and does not enable the determination of causal relationships. It should account for all factors that may influence the dependent variable, as their omission may lead to biased estimates (Zhao & Liu, 2023). This method is typically based on the assumption of a linear relationship between independent and dependent variables. However, property markets are characterised by non-linear relationships, which may not be adequately captured by regression analysis.

The panel regression model can be described by equation (1):

$$Y_{it} = \alpha_i + \beta X_{it} + \delta_t + u_i + e_{it}, \quad (1)$$

where Y_{it} is the outcome variable (for entity i at time t), α_i is the unknown intercept for each entity, X_{it} is the predictor vector (for entity i at time t), δ_t is the uncertainty coefficient for the time regressors (t), β represents the common effect for all entities, taking into account individual and temporal heterogeneity, u_i is the error term within the entity, and e_{it} is the overall error term (Torres-Reyna, 2007).

Modifying equation (1) for a panel regression model covering the period 2015-2025, the following equation (2) is obtained:

$$HPI_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 I_{it} + \beta_3 U_{it} + e_{it}, \quad (2)$$

where HPI_{it} is the house price index (for country i in year t), β_0 is the baseline level of the HPI , GDP_{it} is per capita income, β_1 is the effect for GDP_{it} , I_{it} is the cost of loans/mortgages, β_2 is the effect on I_{it} , U_{it} is the proportion of the urban population, β_3 is the effect on U_{it} , a e_{it} is the model error.

The equation (2) will be used below to calculate the property price index for the period 2015-2025 for EU Member States for which independent variables (GDP per capita, interest rate, % urbanisation) were available. It should be noted that the base value of the HPI for all EU countries in 2015 was 100 (European Union Statistics, n.d.). The choice of data for Germany, France, Italy and Poland is explained by the fact that the first three are the EU's largest economies, whilst Poland is demonstrating positive growth trends in its property market. These countries have different rates of urbanisation and GDP per capita, which allows for the unevenness of development among EU member states to be taken into account when interpreting the results of the regression analysis. The sample selected satisfies the requirement of representing different EU regions, from Western and Southern Europe to Central and Eastern Europe. The values of the dependent and independent variables for Germany, France, Italy and Poland are presented in Table 1.

Table 1

Input data for panel regression

EU member states	Year	Property Price Index	GDP per capita (in US dollars)	Cost of loans (interest rate)	Urbanisation (%)
Germany	2015	100	41911	0	77.2
	2020	171.87	47379	0	77.45
	2021	189.34	52265	0	77.54
	2022	217.43	49686	0.5	77.65
	2023	212.15	54343	2.5	77.77
France	2015	100	36702	0	79.66
	2020	113.87	39169	0	80.98
	2021	120.15	43725	0	81.24

	2022	128.6	41082	0.5	81.51
	2023	132.32	44690	2.5	81.78
Italy	2015	100	30387	0	69.57
	2018	98.6	34746	0	70.44
	2020	99.4	32091	0	71.04
	2021	101.1	36852	0	71.35
	2022	105.7	35635	0.5	71.66
	2023	106.8	39003	2.5	71.97
Poland	2015	100	12673	1.5	60.28
	2016	100	12464	1.5	60.18
	2018	109.48	15658	1.5	60.06
	2019	118.34	15874	1.5	60.04
	2020	131.66	15987	1.5	60.04
	2021	141.16	18635	0.1	60.08
	2022	160.3	18891	2.25	60.13
	2023	169.52	22056	6.75	60.22

Source: compiled based on (Macrotrends, 2026a; Trading Economics, 2026a; Macrotrends, 2026b; Trading Economics, 2026b)

After collecting the data, the author used Excel to construct a panel regression model. For this purpose, an add-in containing a package of analytical models was installed. Subsequently, using Excel's data analysis tool, the overall quality of the model was assessed (Table 2).

Table 2

Overall regression quality

Name of indicator	Value of the indicator
Multiple R	0.74732
R Square	0.558488
Adjusted R Square	0.492261
Standard Error	26.40334
Observations	24

Source: the author's own work

An analysis of Table 2 suggests that the model fits the data well (0.74 – a strong correlation). The model explains 55.8% of the variation in the HPI and is adequate, though not perfect. The latter is due to the fact that the model has several independent variables, and the adjusted R^2 takes their number into account.

The model error amounts to approximately 26 HPI units, which may be critical for low property price index values and insignificant for the highest ones. As a result, the model has high explanatory power but requires larger data sets to reduce forecasting error. Since the difference between R^2 and *Adjusted R^2* is not particularly significant, it can be concluded that the model is not overfitted. After assessing the overall quality of the regression, the key step was taken to verify whether the regression functioned correctly. ANOVA was performed to obtain the relevant data. The results are shown in Table 3.

Table 3

Results of the analysis of variance (ANOVA)

Variations	df	SS	MS	F	Significance F
Regression	3	17636,76	5878,919	8,432955	0,000805
Residual	20	13942,72	697,1362	-	-
Total	23	31579,48	-	-	-

Source: the author's own work

An analysis of Table 3 has helped to demonstrate the high level of statistical significance of the model. This is because the F-statistic value is 8.43, with a significance level (Significance F) of 0.000805, which is less than 0.01. The sum of squares (SS) reveals a balance between explained and unexplained variations, with the explained variations predominating, which further confirms the quality of the model. Thus, the ANOVA results demonstrate the adequacy of the model and the existence of a relationship between the variables. The final step in the model interpretation process was the interpretation of the variables, the extent of whose influence on the HPI is shown in Table 4.

Table 4

Multiple regression coefficients

Variables	Coefficients	Standard Error	t Stat	p-value	Lower 95%	Upper 95%
Intercept	339.3097	93.71047	3.62083	0.001704	143.8331	534.7863
GDP_{it}	0.004397	0.001059	4.152754	0.000492	0.002188	0.006606
I_{it}	6.526571	4.017429	1.624564	0.119911	-1.85364	14.90678
U_{it}	-5.0975	1.730382	-2.94588	0.007991	-8.70701	-1.48798

Source: the author's own work

In accordance with the general form of the model (Equation 2), the regression will take the following form:

$$HPI_{it} = 339,31 + 0,0044GDP_{it} + 6,53I_{it} - 5,1U_{it} \quad (3)$$

Equation 3 shows that a one-unit increase in GDP_{it} will cause an increase of 0.0044 in HPI_{it} whereas an increase in U_{it} results in a decrease of 5.1. In addition, the effect of the I_{it} variable on the model was not statistically significant, since its p-value exceeded 0.05 and the confidence interval [-1,85; 14,91] crossed zero. Therefore, the interest rate factor did not have a statistically significant effect on the housing price index within this model.

An economic interpretation of the results of the proposed model suggests that a one-dollar increase in the GDP per capita of Germany, France, Italy and Poland will lead to a 0.0044 rise in these countries' property price index, whilst a 1% increase in urbanisation would, conversely, reduce the index by 5.1. Germany, as the country with the highest GDP per capita over the period under review, demonstrated the greatest growth in the property price index. Poland ranked second among the countries examined in terms of the property price index, as it has the lowest rate of urbanisation and the highest GDP per capita growth rate, having increased the latter by almost 1.75 times since 2015. France's property price index showed a gradual increase between 2015 and 2023, accompanied by a steady rise in GDP per capita (except in 2022) and a statistically significant level of urbanisation growth (by 2.12%). Italy's property price index grew unevenly between 2015 and 2023, due to periods of falling GDP per capita and a record rate of urbanisation growth, which increased by 2.4%. The most profitable investments over the 2015–2023 period were in German residential property, as it demonstrated better growth dynamics than French, Polish and Italian residential property over the same period.

Conclusions. The property management market is set to continue growing in 2025-2026. The importance of its development stems from the fact that it plays a key role in the global economy and helps to drive technical and managerial innovation. It has been established that numerous researchers examine various factors influencing the state of the property market and substantiate their views on their importance through the application of econometric methods. There are examples of selecting determinants of the property market for constructing a panel model and a DOLS model, which made it possible to identify variables that influence the property price index. A range of economic, financial and social indicators for Germany, France, Italy and Poland for the period 2015-2025 has been compiled.

A panel regression model has been constructed and all key stages of its validation have been completed. It has been demonstrated that the proposed model reproduces the data well, is appropriate, has high explanatory power and allows for the maintenance of relationships between variables.

Among the model's shortcomings, a small data set was identified, which negatively affects the forecasting error, as well as the lack of confirmed influence of the interest rate factor on the property price index. Prospects for future research lie in expanding the model by integrating technological factors, such as the EU property management market digitalisation index.

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